Project report

Understory plants on reforested pastures at Finca Alexis, Puntarenas, Costa Rica

PP Tropenbotanik und Pflanzen-Tier-Interaktionen in Costa Rica

by
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WS 19/20

Supervisor: Mag. Dr. Anton Weissenhofer

Introduction

Costa Rica, as one of the most biodiverse countries worldwide, accommodates about 9,361 plant species, including ferns and fern allies, Gymnosperms and Angiosperms (Hammel et al., 2004). There are several studies about plant biodiversity in the tropics, but since there is such an immense species richness, there is still a significant gap in the knowledge of several plant groups, e.g. understorey plants. Understory plants make up about half of the Costa Rican flora, consisting of herbs (27%), treelets (16%), and part of vines (16%) (Hammel et al., 2004). Nevertheless, most of the conducted studies are concerned with tree biodiversity (Gentry & Dodson, 1987a; Huber, 1996; Huber et al., 2008; Mayfield & Daily, 2005). This is why this survey pursues the study of understory plants in the Golfo Dulce region where the La Gamba Field Station is situated. A first survey on the herbaceous flora around La Gamba has been conducted by Holzer et al. (2016) during a field course of the University of Vienna in 2016.

This study focuses on the understory flora of Finca Alexis. Finca Alexis is a former pasture with a farmhouse (Casa Alexis) of the Tropical station at the Fila Consteña mountain range (Fila Cal) that was converted into a simple field station. It is part of the COBIGA project (Corredor Biológico La Gamba) with the goal to form a rainforest corridor between the tropical mountain rainforest of Fila Cal and the lowland rainforest of the Golfo Dulce (https://www.regenwald.at/en/project-information/biological-corridor-cobiga-forest-and-climate-protection). In the present study herbaceous and other understory plants were sampled.

This study aims to create an initial photographic reference list of understory plants of the Finca Alexis, in order to facilitate future research in the region. The reference list features detailed photographs of habit and main characteristics, and includes a short description of the plants. Moreover, a checklist of my observations as well as data of understory plants from a study performed at the same time (Eberle & Lutz, 2020) was put together. Eberle & Lutz study was carried out on Finca Alexis and concerned the differences of the spontaneous flora on reforestation sites of different age.

Material and Methods

Study site

Finca Alexis (137,02 ha) is located in south-west Costa Rica on the Fila Costeña range (Fila Cal), near the village of San Miguel. The Finca consists of three parts, Finca Alexis 1, 2 and 3 (Map 1), which range from 215 to 515 m.a.s.l. and covers lowland to premontane rainforest vegetation. Due to the lack of a climate graph of the Finca Alexis, a climate graph of La Gamba is shown (Figure 1). Precipitation is most likely higher than in La Gamba but the general outline is due to the proximity presumably the same. High precipitation occurs especially from May to December (rainy season) while there is a drier season with notably less rain from January to March (Weissenhofer & Huber, 2008).

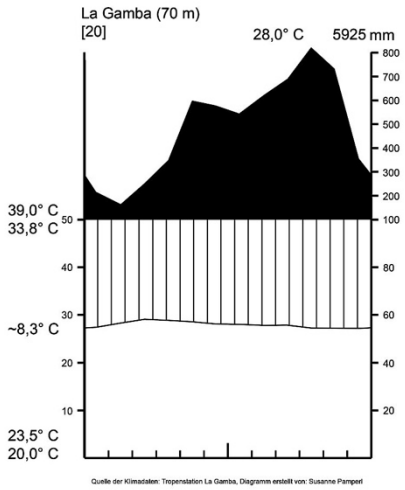
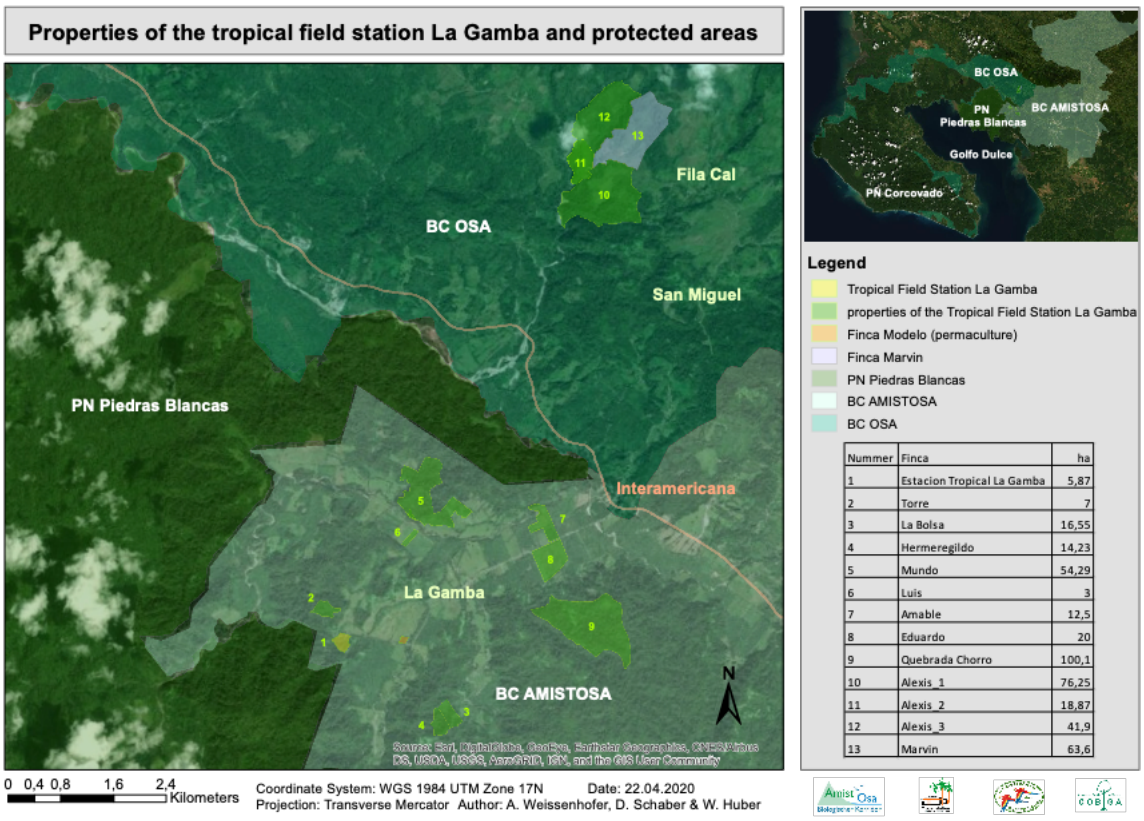


Figure 1. Climate graph of La Gamba, Puntarenas, Costa Rica.



Nummer	Finca	ha
1	Estacion Tropical La Gamba	5,87
2	Torre	7
3	La Bolsa	16,55
4	Hermeregildo	14,23
5	Mundo	54,29
6	Luis	3
7	Amable	12,5
8	Eduardo	20
9	Quebrada Chorro	100,1
10	Alexis_1	76,25
11	Alexis_2	18,87
12	Alexis_3	41,9
13	Marvin	63,6

Map 1. Properties of the tropical Field Station La Gamba in south-western Costa Rica. Nr. 10–12= Finca Alexis 1–3.

The study was carried out on Finca Alexis 1 which covers 76 ha consisting of 22 ha reforested pastures, 49 ha primary and secondary forests and 5 ha teak plantation. The soil of Finca Alexis is acidic with a mean pH of 5. Soil humidity varies (from dry to moist) depending on the exposition. The Finca was formerly used as pasture for cattle breeding and reforested from May 2017 to July 2019 with a total of 6,971 trees being planted.

Data collection

Herbs, vines, small understory shrubs and treelets were collected. Only flowering or fruiting plants were sampled to make sure a determination is possible. From all collected plants pictures were taken in their natural habitat, characteristic features briefly noted (growth form, flower colour, etc.). Plant samples were taken, herbarized and identified. The corresponding species list of all collected plants including pictures and a short description is added in the appendix. Due to time limitations plants were only collected alongside the pathway leading from Casa Alexis through the reforested areas to the

Figure 2. Aerial photograph of the study area at Finca Alexis 1. White line: pathway from Casa Alexis through reforested pastures to the edge of the primary forest, about 650 m long. Blue cross: Location of the study plot from Eberle & Lutz (2020), sector 1. Circle: Casa Alexis. Foto: Anton Weissenhofer.

primary forest (Figure 2).

The checklist as well as the photographic reference list includes also data from my colleagues Paul Eberle and Leonie Lutz. They were participants of the same practical course and investigated a 20×20m plot (zero point at N 8°45,838; W 83°09,950) on Finca Alexis 1. The plot was used as pasture for cattle breeding and reforested during 2016-2017. Their study focuses on spontaneous growth on reforested areas. Woody plants were recorded by Leonie Lutz in the aforementioned 20×20 plot. Non-woody plants were sampled by Paul Eberle in a 3×3 subplot. Pictures from their identified plants were made by my colleague Marissa Hahn.

Plant identification

Plants were collected and identified at the Tropical Station La Gamba (TLG) with the help of specialists, the herbarium at TLG, Tropicos website (https://www.tropicos.org/home, 12.5.20) and the use of determination literature (e.g. Weber et. al., 2001; Hammel et al., 2004).

One Fabaceae species, *Desmodium* sp., could not be identified to species level since while collecting it was mistaken for another *Desmodium, Desmodium adscendens.* Therefore, not enough flower and fruit material was collected to determine the species.

Results

In total 32 understory species out of 15 families and 26 genera were sampled on the Finca Alexis 1 including data from Eberle & Lutz (2020). The most represented families were Melastomataceae and Asteraceae with seven and six species, Rubiaceae with four species, Fabaceae with three species and Poaceae with two species. The ten other families were represented by only a single species (Table 1). The photographic list features 26 of the sampled species (see appendix).

Table 1. Checklist of understory plants on Finca Alexis 1, south-western Costa Rica.

Nr.	Family	Genus	Species	Author	Data Source	Habit
1	Apocynaceae	*Mesechites*	*trifidus*	(Jacq.) Müll. Arg.	own observations	vine
2	Asteraceae	*Ageratum*	cf. *conyzoides*	L.	own observations	herb
3	Asteraceae	*Eirmocephala*	*brachiata*	H. Rob.	Eberle (2020), Lutz (2020)	giant herb
4	Asteraceae	*Heterocondylus*	*vitalbae*	(DC.) R.M. King & H. Rob.	own observations	shrub
5	Asteraceae	*Vernonanthura*	*phosphorica*	(Vell.) H. Rob.	Eberle (2020), Lutz (2020)	treelet
6	Asteraceae	*Vernonia*	*patens*	Less.	Eberle (2020), Lutz (2020)	treelet
7	Asteraceae	cf. *Vernonia*	sp.		Eberle (2020), Lutz (2020)	giant herb
8	Begoniaceae	*Begonia*	*multinervia*	Liebm.	own observations	herb
9	Cyperaceae	*Scleria*	cf. *melaleuca*	Rchb. ex Schltdl. & Cham.	own observations	grass
10	Fabaceae	*Calopogonium*	*mucunoides*	Desv.	own observations	herb
11	Fabaceae	*Desmodium*	*adscendens*	(Sw.) DC.	own observations	herb
12	Fabaceae	*Desmodium*	sp.		own observations	herb
13	Gleicheniaceae	*Gleichenella*	*pectinata*	(Willd.) Ching	own observations	fern
14	Lamiaceae	*Hyptis*	*obtusifolia*	R. Br.	own observations	herb
15	Melastomataceae	*Clidemia*	*capitellata*	(Bonpl.) D. Don	own observations	treelet
16	Melastomataceae	*Clidemia*	*sericea*	D. Don	own observations	treelet
17	Melastomataceae	*Conostegia*	*subcrustulata*	(Beurl.) Triana	Eberle (2020), Lutz (2020)	treelet
18	Melastomataceae	*Leandra*	*granatensis*	Gleason	Eberle (2020), Lutz (2020)	treelet
19	Melastomataceae	cf. *Leandra*	*mexicana*	(Naudin) Cogn.	Eberle (2020), Lutz (2020)	treelet
20	Melastomataceae	*Miconia*	*gracilis*	Triana	Eberle (2020), Lutz (2020)	treelet
21	Melastomataceae	cf. *Tibouchina*	*longifolia*	(Vahl) Baill.	own observations	treelet
22	Nephrolepidaceae	*Nephrolepis*	*brownii*	(Desv.) Hovenkamp & Miyam.	own observations	fern
23	Onagraceae	*Ludwigia*	*octovalvis*	(Jacq.) P.H. Raven	own observations	herb
24	Piperaceae	*Piper*	*hispidum*	Sw.	Eberle (2020), Lutz (2020)	treelet
25	Poaceae	*Brachiaria*	*brizantha*	(A.Rich.) Stapf	Eberle (2020), Lutz (2020)	grass
26	Poaceae	*Ischaemum*	*timorense*	Kunth	own observations	grass
27	Rubiaceae	*Sabicea*	*panamensis*	Wernham	own observations	vine
28	Rubiaceae	*Sabicea*	*villosa*	Schult.	own observations	vine
29	Rubiaceae	*Spermacoce*	cf. *alata*	Aubl.	own observations	herb
30	Rubiaceae	*Spermacoce*	*remota*	Lam.	own observations	herb
31	Selaginellaceae	*Selaginella*	sp.		own observations	fern ally
32	Verbenaceae	*Lantana*	*camara*	L.	own observations	shrub

Discussion

This is the first study on understory plants at Finca Alexis. The checklist records 32 understory plants from 15 families and 26 genera (Table 1). The photographic reference list features 26 collected plants as well as the names and location of the 6 plants without a picture (see appendix). Not all sampled plants were photographed since Eberle (2020) and Lutz (2020) studies did not focus on creating a photographic reference list.

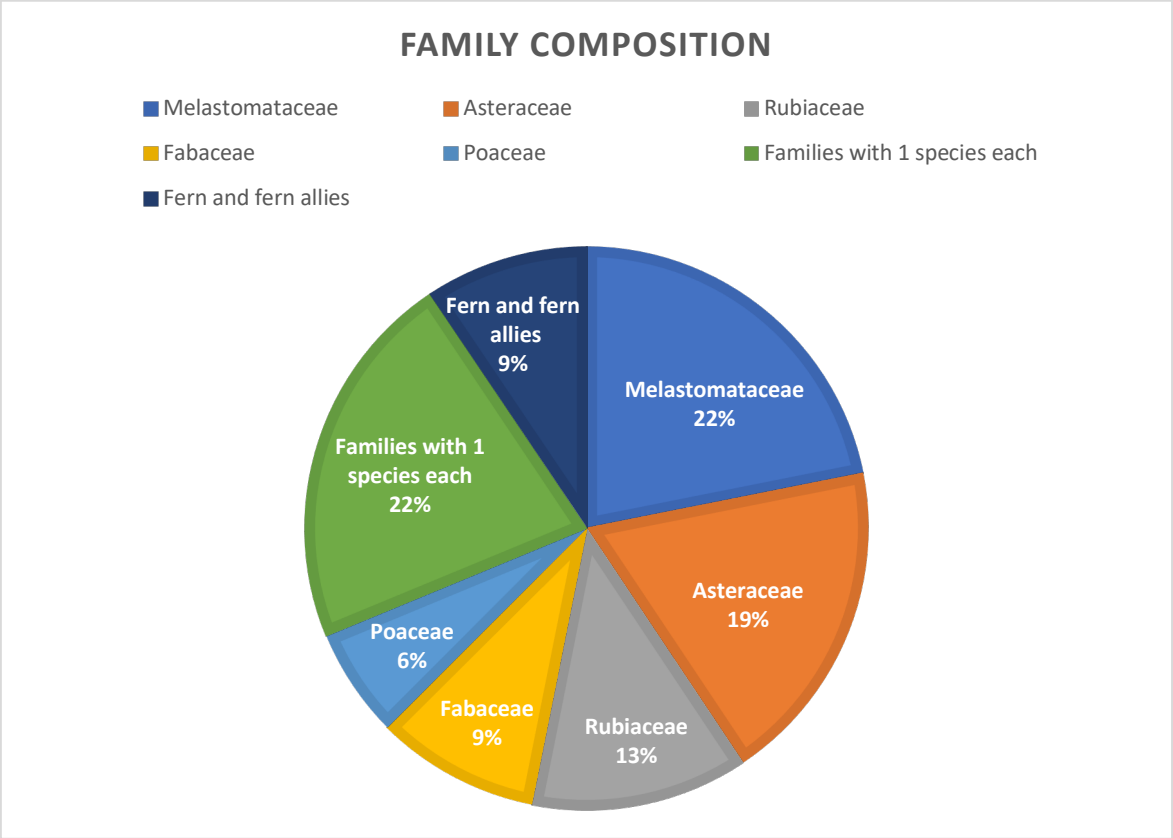


Figure 3. Family composition on Finca Alexis 1, Puntarenas, Costa Rica.

Together the four families, Melastomataceae, Asteraceae, Rubiaceae and Fabaceae, make up more than half of all species (see Fig. 3). Melastomataceae and Asteraceae were the most abundant with seven and six species. Both pose as big and important families in the Costa Rican flora (Hammel et al., 2004). Holzer et al. (2016) found the Asteraceae to be the most abundant family in areas around La Gamba. However, only few Melastomataceae were found in Holzer et al.´s study. This is due to the fact that Melastomataceae are mostly woody shrubs and treelets, and therefore, were not collected in the aforementioned study.

Rubiaceae were represented by four species, two herbs from the genus *Spermacoce* and two vines from the genus *Sabicea*. Rubiaceae in general are distributed worldwide, with an emphasis on the tropics. Counting about 13, 000 species, the family poses as the fourth biggest angiosperm family in the world (Davis et al., 2009). Species of the genus *Spermacoce* are often found in ruderal vegetations, such as shown here on the Finca Alexis. The two collected *Spermacoce* species, *Spermacoce* cf*. alata* and *Spermacoce remota,* are neophytes in tropics and sub-tropics of the Old World (Taylor, 2014).

The Fabaceae were represented by three species, two *Desmodium* species and *Calopogonium mucunoides,* all of them are herbs. Fabaceae, with an estimation of 19,500 species from about 750 genera worldwide (Maarten & Byng, 2016), also count as one of the biggest angiosperm families (Davis et al., 2009). Gentry (1993) describes the Fabaceae (or Leguminosae) as the most important tree family in the neotropics. They are also one of the most important herb families in the world. Besides that, the family is extremely important for human use, especially crucial for the human nutrition, ranking only second to Graminae (Graham & Vance, 2003).

Monocotyledones, especially *Poaceae*, are very common and abundant in the study area, with a high coverage, as would be expected in disturbed habitats, such as a former pasture. Contrary to the coverage, monocotyledons were only represented by a few species, *Ischaemum timorense* and *Brachiaria brizantha (Poaceae)* and *Scleria* cf. *melaleuca* (Cyperaceae). According to Hammel et al. (2004) Poaceae and Cyperaceae are two of the five biggest herb families in Costa Rica. Since it is a tall (up to 1,80m), fast growing and very competitive grass, *Brachiaria brizantha* dominates the vegetation (Figure 4). Due to the lack of nutrients and space it is difficult for other seedlings to survive in the thicket of *Brachiaria brizantha*. When the planted trees grow and produce shadow, the grass loses its dominance since it is not competitive enough anymore. It will be gradually replaced by species adapted to the forest understory and the next step in the succession can start. This again throws light on the utter importance of the COBIGA reforestation project. Without reforestation with shadow building tree species like (e.g. *Inga spectabilis*) on the former pastures, succession is delayed. Presumably the

renaturation of the desired climax vegetation, in this case the former tropical lowland rainforest, would not be reached at all. Understory plants that can grow in the thick *Brachiaria brizantha* vegetation are mostly shrubs and treelets (many Asteraceae and Melastomataceae) and lianas (e.g. *Sabicea villosa,* Rubiaceae). This is also the case on fields overgrown with the invasive plant *Gleichenella pectinata* (syn. *Dicranopteris pectinata*) that grows on open areas around La Gamba (Weissenhofer et al., 2008). *Gleichenella pectinata* emits allelopathic substances that prevents angiosperms seedlings to germinate (Voltarelli et al., 2012).

Figure 4. Owner Elias standing on Finca Alexis. *Brachiaria brizantha* dominates the vegetation. The fern *Nephrolepis brownii* can be seen on the left-hand side. Finca Alexis, Puntarenas, Costa Rica. Imagery date: 5.2.20

Ferns are an important part of the Costa Rican Flora, especially in higher altitudes (Hammel et al., 2004; Gentry & Dodson, 1987a). At the study site they were represented by two ferns and a fern ally. *Gleichenella pectinata*, *Nephrolepis brownii and Selaginella sp.,* the fern ally. *Gleichenella pectinata* was found at Finca Alexis 1 but only sporadic and not dominating. The other collected fern, *Nephrolepis brownii*, was found near the

regularly mowed path on the edge of the reforested areas from Finca Alexis 1. It originates from Southeast Asia and is an invasive plant. It grows fast and reaches heights of 1,80 m, which makes it a strong competitor. Since it is widely used as an ornamental plant and its spores are dispersed by wind, *Nephrolepis brownii* was able to spread widely easily. (www.cabi.org/isc, 28.04.20).

The photographic reference list features 26 collected plants as well as the names and location of the 6 plants without a foto (see appendix). Not all sampled plants were photographed since Eberle (2020) and Lutz (2020) studies did not focus on creating a photographic reference list.

Since the Finca Alexis was only studied for two days due to time limitations, a complete checklist of the understory flora could not be generated. To create a full checklist for the area it would be necessary to study the flora at different times of the year to be able to sample all plants while flowering and/or fruiting to ensure a correct determination. Furthermore, it would be advisable to take photos of the important features of the determined plants to further simplify study on understory plants in this region and eventually generate a complete Field Guide.

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Appendix

Understory plants on reforested pastures at Finca Alexis, Puntarenas, Costa Rica

-Photographic reference list-

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Inhaltsverzeichnis

Fern and fern allies

Gleicheniaceae

Gleichenella pectinata

Fern, climbing on other vegetation, fronds dichotomous branched, pinnate, invasive, found next to pathway


Nephrolepidaceae

Nephrolepis brownii

Fern, up to 1,80 m, leaflet margin minutely crenate, sporangia in groups (sori), indusium kidney-shaped, neophyte, origin southeast Asia, found on the edge of the study site on Finca Alexis 1


Selaginellaceae

***Selaginella* sp.**

Fern ally, creeping shoot, microphylls with one unbranched vein, found on pathway

Monokotyledones

Cyperaceae

Scleria* cf. *melaleuca

Sedge, leaves tristichous, inflorescence paniculate, fruit (achene) dark purple, found on pathway

Poaceae

Brachiaria brizantha

Grass, 1–2m high, leaf sheaths and inflorescence hirsute with simple hair, inflorescence raceme, dominant grass on Finca Alexis 1

Foto by Marissa Hahn

Ischaemum timorense

Grass, inflorescence two divergent spikes, sporadic in the *Brachiaria brizantha* thicket

Dicotyledones

Apocynaceae

Mesechites trifidus

Vine, leaves opposite and about 4,5cm–12 cm long, white petals, greenish-white tube, climbing on other vegetation on the edge of the pathway


Asteraceae

Ageratum* cf. *conyzoides

Herb, up to 1.5 m, leaves opposite, margin crenate, lavender flowers, found next to pathway


Eirmocephala brachiata

Herbaceous shrub to shrub, stems ascending, minutely hirsute to glabrous, leaves simple, margin crenate, abaxial leave veins hirsute, easy recognizable inflorescence, lavender flowers, found on study site on Finca Alexis 1

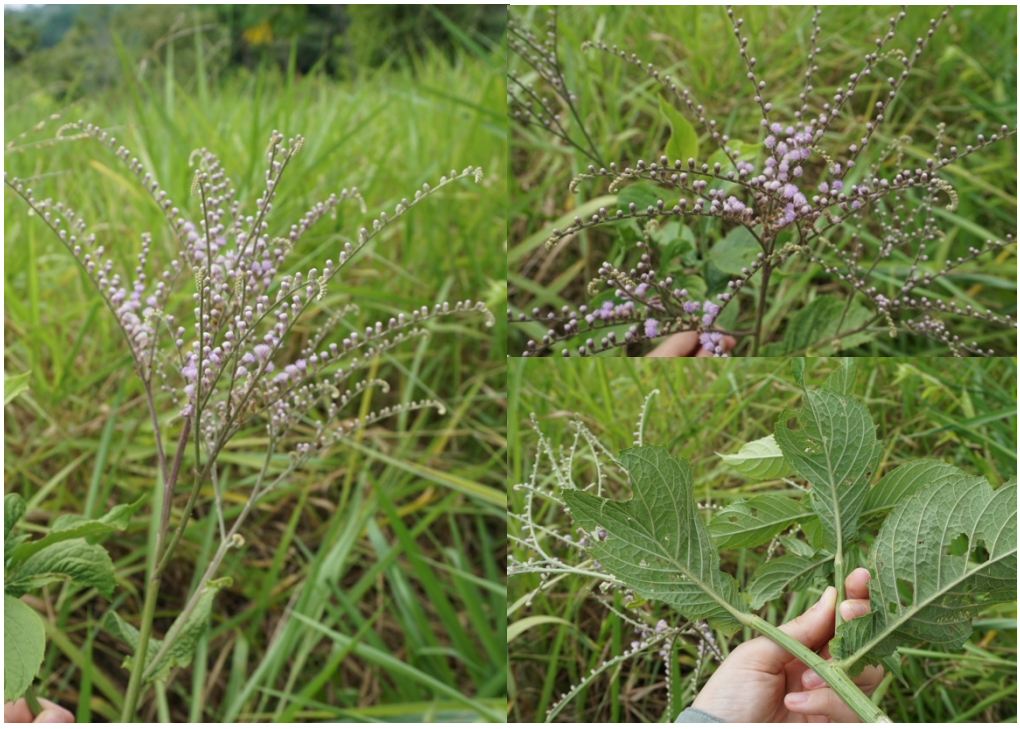


Foto by Marissa Hahn

Heterocondylus vitalbae

Scandent herb, base lignified, leaves serrate, closer to inflorescence entire margin, white flowers, greenish to pale pink involucrum, climbing on vegetation next to pathway

Vernonanthura phosphorica
Shrub to treelet, found on study site Finca Alexis 1
no picture

Vernonia patens
Shrub to treelet, found on study site Finca Alexis 1
no picture

cf. *Vernonia* sp.
Giant herb, found on study site Finca Alexis 1
no picture

Begoniaceae

Begonia multinervia
Succulent herb, up to 1,60 m high, stem red, leaves alternate, simple and asymmetric cordate, lower surface red, flowers pale pink, found on shaded pathway bordering primary forest

Fabaceae

Calopogonium mucunoides

Herbaceous vine, stem, calyx, fruits pilose with golden hair, leaves alternate and trifoliate, flowers pale purple, fruit (legume) about 3 cm long, found next to pathway

Desmodium adscendens

Herb, leaves alternate and trifoliate, leaflet apex obtuse, flowers pinkish to pale purple, jointed fruit (loment) consisting of 1-5 parts (articles), adhesive fruit, epizoochor distribution, found on the pathway

***Desmodium* sp.**
Herb, leaves alternate and trifoliate, leaflets bigger than leaflets of *Desmodium adscendens*, leaflet apex more acute, found on pathway close to primary forest, location moist and shady

Lamiaceae

Hyptis obtusifolia
Herb, leaves opposite, elliptic, margin serrate, flowers verticillastrate (in clusters looking like a whorle of flowers), found on study site on Finca Alexis 1

Melastomataceae

Clidemia capitellata

Shrub to treelet, pilose with simple hair, leaves opposite, margin minutely serrate, inflorescence pendant spike, up to 15 cm, flowers white, calyx pilose, with simple hair, found on study site on Finca Alexis

Clidemia sericea

Treelet, plant pilose, leaves opposite, margin entire, flowers white, tetramerous, stamen bright pink, fruit berry purple to dark purple, found near pathway in the shade of a group of trees

Conostegia subcrustulata

Shrub to treelet, leave opposite, ovate, serrate and ciliate, inflorescence panicle, flowers pale pink, stamen yellow, fruits pink going dark blue, found on study site on Finca Alexis 1

Foto by Marissa Hahn

Leandra granatensis

Shrub to treelet, plant hirsute, leaves opposite, ciliate, margin minutely serrate, inflorescence hirsute with thick, red hair, berries red going dark blue, also hirsute with thick red hair, found on study site on Finca Alexis 1

Foto by Marissa Hahn

cf. *Leandra mexicana*

Shrub to treelet, found on study site Finca Alexis 1

no picture

Miconia gracilis

Treelet, leaves opposite, occurring on study site Finca Alexis 1

no picture

cf. *Tibouchina longifolia*

Herbacous shrub, leaves opposite, pilose with simple hairs, margin entire,
flowers white, found on pathway near primary forest, location moist and shady

Onagraceae

Ludwigia octovalis

Herb, leaves alternate, margin entire, flowers tetramerous bright yellow, fruit capsule, found next to the pathway in light shade

Piperaceae

Piper hispidum

Shrub to treelet, leaves alternate, elliptic or elliptic-ovate, 4-11 cm long, found on study site on Finca Alexis 1

Rubiaceae

Sabicea panamensis

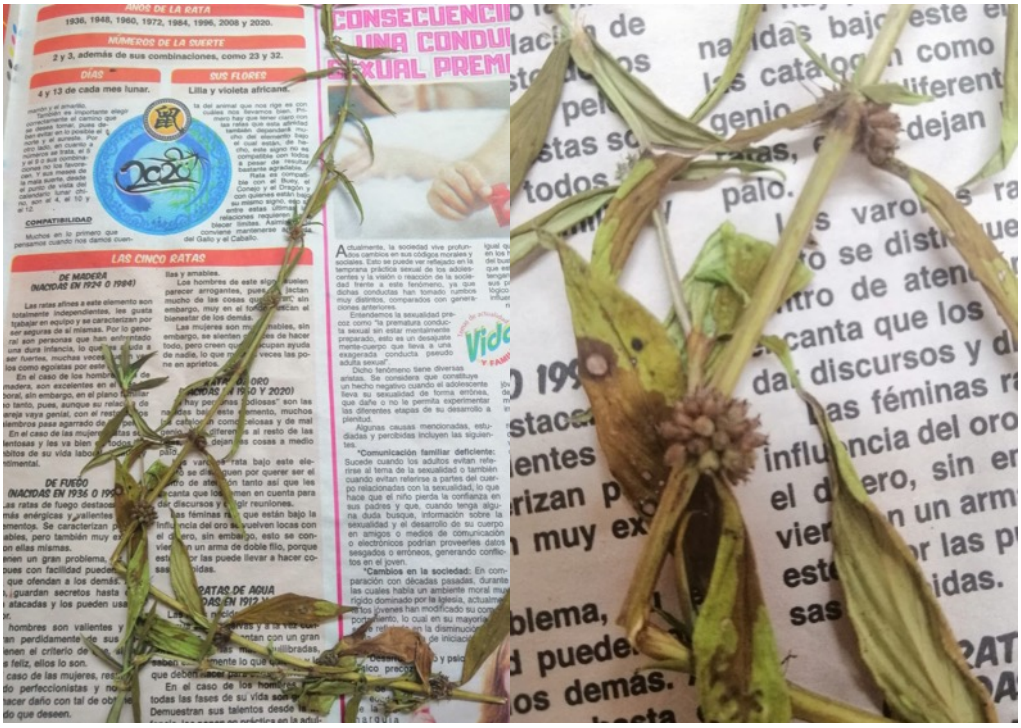
Vine, stem reddish, minutely pilose, leaves opposite, glabrous, flowers white about 1 cm, bigger than flowers of *Sabicea villosa*, found next to pathway climbing on other vegetation


Sabicea villosa

Vine, stem green and pilose, leaves opposite and pilose, stipules, flowers tubular, about 5 mm, white, found next to pathway an on the study site on Finca Alexis 1


Spermacoce* cf. *alata

Herb, up to 1 m, leaves opposite, inflorescence verticillastrate, many flowers in inflorescence, flowers small, white, found on study site on Finca Alexis 1



Spermacoce remota

Herb, up to 40 cm, leaves opposite, lanceolate, inflorescences with few flowers, flowers small, white, found on pathway near primary forest, location moist and shady

Verbenaceae

Lantana camara

Shrub, leaves opposite, inflorescence head, flowers tubular, flowers change in colour from yellow to red, found in a meadow next to pathway in direct sunlight