Colegio de Postgraduados

Design of an interpretive trail and conservation of native orchids (Orchidaceae) in an anthropized landscape

Baltazar-Bernal, Obdulia[1*]

[1] Coordinadora Paisaje y turismo rural. Programa de Investigación en Ornamentales Colegio de Postgraduados - Campus Córdoba. Km. 348 Carr. Fed. Córdoba-Veracruz.
* Correspondence: obduliabb@colpos.mx

ABSTRACT

Objective: to design an interpretive trail of native orchids in the gardens of Campus Cordoba, Colegio de Postgraduados.

Design/Methodology/Approach: this study is descriptive and field based. First, the feasibility of the trail was validated through an online survey. Afterwards, several field trips were conducted; the script was created, and finally the interpretive script of the trail was validated.

Results: of the respondents, 95% considered the orchid interpretive trail as feasible. The inventory of the trail area allowed to verify that the orchids are accessible at all stations along the route. The design of the interpretive trail has nine thematic stations: 0. Introduction, 1. The *Catasetum* trail, 2. *In vitro* germination, 3. Acclimatization of orchids, 4. Miniature orchids, 5. Establishing orchids in phorophytes, 6. The *Laelias* trail, 7. The "May Flowers" trail, and 8. The "Donkey ears" (*Thricocentrum luridum*). The interpretive trail allows anyone to know and appreciate the diversity of wild orchids, 28 species and their phorophytes, along 700 m of walking trails for a 2.5-hours route.

Limitations of the study/Implications: it is a guided interpretive trail.

Findings/Conclusions: The interpretive trail allows us to appreciate the importance of the Orchidaceae family; which is one of the largest families in Mexico and the world through environmental and ornamental importance.

Keywords: pollinators food, conservation, environmental education, phophytes, visitors.

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INTRODUCTION

Environmental education deals with people's relationship with nature in order to become aware of the accelerated growth of the human population, environmental degradation, the overexploitation of natural resources and the extinction of animal and plant species, in order to achieve informed citizens who know and solve the various environmental situations (Pellegrini, 2009). There are different mechanisms for providing environmental education. The interpretive trail is among them, which aims to communicate about the importance of the conservation of the cultural and natural heritage of a site. For this reason, information is prepared beforehand so that tourists can strengthen their social, historical or environmental culture. As any case as it

may be, through recreation, thus facilitating sensations, emotions and awareness in visitors (SECTUR, 2004; Phillips *et al.*, 2014).

Public parks and green areas of educational institutions can be a good setting for the implementation of interpretive trails, for the awareness of students and the general public. For example, at the Simón Bolívar University, in Venezuela, an environmental education program was designed with several interpretive trails, called Guided Didactic trails, among them, one trail is "The parts of the plant: similarities and differences" (Pellegrini Blanco, Reyes Gil, & Pulido, 2007). At the University of Quintana Roo, Campus Cozumel, Mexico, plant species were classified according to ethnobotanical use, as the interpretation factor for interpretive trails (Chan-Quijano and López-Mejía, 2012). At the Luis A. Martínez Institute, in Riobamba, Ecuador, it was proposed to create an interpretive trail as a pedagogical strategy to promote the use of existing agricultural and natural resources (Calero *et al.*, 2019). For these reasons, public and private gardens with orchids have a good educational potential, through interpretive trails.

Based on the aforementioned, this proposal is intended as a guide for the design of an interpretive trail, where the knowledge of the landscape of anthropized and peri-urban areas is integrated. So that it can be applied in all sites that have biodiversity and culture such as educational centers, cities, municipalities, parks, walking trails, gallery landscapes with *Taxodium* trees, public and private gardens. In a way that, through interpretive trails, the interpretation and learning of what is to be preserved is achieved, composed of elements in the landscape (flora, fauna, bodies of water and culture).

The Orchidaceae family is one of the three most numerous globally (Cartay, 2020), with around 35 000 species (Dressler, 1993); Mexico ranks twelfth, with 1315 species (Solano-Gómez *et al.*, 2019). This family is characterized by having flowers of various sizes, shapes, and colors; they are so attractive that they attract pollinators that facilitate fertilization and seed production (Hágsater *et al.*, 2015). However, human activity has placed this plant family as the second most threatened, after cacti (Alvarado-Martínez, 2012). For example, there are 187 threatened species in Mexico, out of which 74 are endemic (NOM-059-SEMARNAT-2010).

Based on all the above, it was considered pertinent to design an interpretive trail "The Eden of Native Orchids" in the gardens of the Colegio de Postgraduados, Campus Cordoba; with a focus on conservation and interpretation of botanical concepts for the course "Conservation and Sustainable Use of Flora" of the Master's Degree Program in Landscape and Rural Tourism, which can also be used for informative courses on orchids. The objective of this study was to design an interpretive trail of native orchids with a focus on conservation and interpretation of botanical concepts in the gardens of the Colegio de Postgraduados, Campus Cordoba.

MATERIALS AND METHODS

Materials

The site of the intervention is located in Colegio de Postgraduados, Campus Córdoba; which is located at km 348 of the Mexico-Veracruz Federal Highway, in the municipality of Amatlán de los Reyes, Veracruz, Mexico, at the geographic coordinates 18° 51' 21" N,

96° 51' 35" W, at 627 m altitude. The climate is warm and humid, with abundant rainfall in summer (INEGI, 2008), an average annual temperature of 20 °C (INEGI, 2007) and 1900 mm as average total annual rainfall (INEGI, 2006).

The total extension of the Campus is 57 hectares (ha), with 1.38 ha of buildings with administrative offices, classrooms, cubicles, pilot plants, service areas, greenhouses and laboratories. Buildings are surrounded by gardens, paths and experimental and production areas for coffee, lemon and sugar cane crops, among others. In the 2 ha of gardens, some representative specimens of the native vegetation of the Tropical Lowland Forest are preserved, with secondary and introduced vegetation. The population of the Campus is around 150 people, including undergraduate students who are involved in professional stayings or social services, thus occupying the facilities for about 8 hours a day, mainly from Monday to Friday.

Methods

The design of the interpretive trail was based on the concepts proposed by Ham (1992), SECTUR (2004) and Baltazar *et al.* (2014), in four sequential phases: I. Description of the study area, II. Online survey, III. Trail design, and IV. Validation of the interpretive script for the trail, as a tourist activity. Based on the latter, a descriptive and field approach was used, with five routes, as explained below.

Stage I. *Description of the study area*. Explicitly, three exploration visits were made to the gardens of the Campus to identify the characteristics of the feasible space for the interpretive trail: extension, type of vegetation, species of orchids and their hosts, ease of access for people with disabilities, and features with interpretive opportunities of native orchids.

Stage II. *Electronic survey*. With the application of Google Drive Forms, the Campus community was surveyed to find out their interest in the feasibility of an interpretive orchid trail at the Campus.

Stage III. *Design of the interpretive trail*. Based on the concepts proposed by Ham (1992), SECTUR (2004) and Baltazar *et al.* (2014), five tours were made with the following activities:

1 Identification of the trail route. After having inventoried the presence of orchids, the route was defined.
2 Inventory of natural resources. An inventory of 28 species of epiphytic orchids and their phorophytes (hosts) was done in several routes to support the central idea of the trail and to establish the different stations.
3 Determination of interpretation stations. Once the interpretive features were identified (concepts: diversity, biology, botany and reproduction of orchids, pollinators and trail conservation), the interpretation stations on the trail were selected.
4 Map of interpretive resources. The selected area was plotted and the length between stations and the total length of the trail were measured using a GPS device.

5 Definition of the type of trail. According to the interpretive information of the study area, it was determined that this trail is guided.
6 Preparation of interpretive texts. From the compilation of bibliographic information on biology, pollinators and conservation of orchids, on the chosen interpretive features, the corresponding texts are elaborated, which will be deployed with interpretation techniques such as the invitation to participation, the dramatization and the question.

Stage IV. *Validation of the interpretive script of the trail.*

Once the interpretive script of the guided trail was finished: Interpretive Trail "The Eden of the Native Orchids" at Campus Córdoba" of the Colegio de Postgraduados. The validation of thematic content was done by the students of the master's degree in landscape and Rural Tourism to verify the content, the relevance of the texts, and the titles of each station of the trail. The observations were added to the interpretive script at each of the stations on the trail.

RESULTS AND DISCUSSION

Description of the study area

The gardens of the Campus are distributed in an area of 2 ha of native, secondary and introduced vegetation. Tree cover is around 50%, with tree species from Mesophyll Forest and Tropical Lowland Forest such as soursop (*Annona muricata*), ash (*Fraxinus* sp.), native avocado (*Persea* sp.), mamey sapote (*Pouteria sapota*), Mahogany (*Swietenia macrophylla*), Golden rain (*Tecoma stans*) and Mulatto wood (*Bursera simaruba*) and newly established species such as jicaro (*Crescentia cujete*), chicozapote (*Manilkara zapota*), cacao (*Theobroma* spp.) and exotic species such as cashew (*Anacardium occidentale*), neem (*Azadiractha indica*), mango (*Mangifera indica*) and lemon (*Citrus* × lemon) (cf. Baltazar-Bernal *et al.*, 2020). The garden area is home to a collection of 28 native orchids, actively reforested with native tree species.

Survey

Before designing the trail, an online survey was conducted within the Campus community, using Google forms and obtaining 30 responses. The results of the survey showed a general trend around the feasibility of the orchid interpretive trail (95% consider it feasible). Regarding the impact on the knowledge and care of orchids (95% were in favor); the diversity of the flora (90% considered it as a characteristic); the knowledge of orchids (60%) such as the May Flower (*Oncidium sphacelatum*) (45% know it); Donkey's ear (*Trichocentrum luridum*); laelias (*Laelia anceps*) (20% know them); and others (15%).

Interpretive Trail Design

Between 2021 and 2022, five guided tours were carried out by students and two teachers to identify the stations of the trail; to take photographs and notes for description of the orchid species with scientific name, the distance walked, and the time spent during the entire interpretive trail. The interpretive trail has a distance of 700 m and 9 stations that

can be covered in 2 hours and 30 minutes, in a semicircular route that has infrastructure for people with disabilities, and it is feasible to walk throughout the year (Figure 1).

Trail Stations

There are nine stations on the trail, the description of which is set below:

Station 0. Introduction

Welcome to the Interpretive Trail "The Eden of the Native Orchids of Campus Cordoba". During the tour, please pay close attention for you to learn a little more about orchids: a plant family known botanically as Orchidaceae, which is one of the largest in Mexico and the world. Surely, they are very attractive to you due to size and color diversity of their flowers. During the tour, we shall recognize 28 species of orchids (Table 1), some of which are threatened by extinction risk. We will make eight more stops, along 700 m in approximately 2.5 hours on foot. The interpretive trail stations and resources that we are going to use are described in Table 2.

As we move on to the next station; Do any of you want to reflect on the importance of orchids? Which ones do you know? and What do you know about them?

Station 1. Catasetum walk

At this first station, there is an abundance of orchids of the genus *Catasetum* (Figure 2) such as *Catasetum integerrimum* which, as you can see, established naturally in the Robeline palm (*Phoenix roebelenii*), 3 to 4 m height. That medium-sized epiphytic orchid is *C. integerrimum* that blooms here from May to September and lives in the Tropical Lowland Forest on the slopes to the Gulf of Mexico, up to Nicaragua. It is one of the most numerous species here on Campus, tolerating direct sun, shedding its foliage from January to March, and featuring both male and female flowers (Figures 3A and 3B).

You should know that the flower of orchids has three sepals, two petals and a labellum that serves to attract pollinator insects that, when looking for nectar, move the anther that

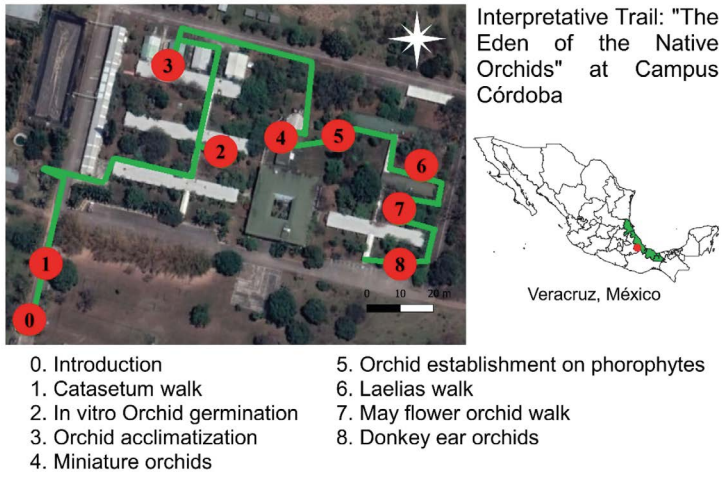

Figure 1. Interpretive trail the Eden of the native orchids at Cordoba Campus. Veracruz, México. Source: elaborated by the author, based on a Google Earth image.

Table 1. Orchids along the interpretive trail "The Eden of Native Orchids of Campus Cordoba".

No.	Species	No.	Species
1	*Brassia verrucosa* Lindl.	15	**Oncidium sphacelatum* Lindl.
2	**Catasetum integerrimum* Hook.	16	**Platystele stenostachya* (Rchb. f.) Garay.
3	*Comparettia falcata* Poepp. Y Endl.	17	*Prosthechea ochracea* (Lindl.) W.E. Higgins
4	*Encyclia parviflora* (Regel) Withner.	18	*Prosthechea radiata* (Lindl.) W.E. Higgins.
5	**Epidendrum cardiophorum* Schltr.	19	*Rhyncholaelia glauca* (Lindl.) Schltr.
6	*Epidendrum ciliare* Jacq.	20	**Specklinia digitale* (Luer) Pridgeon & M.W.Chase
7	*Epidendrum radicans* Pav. ex Lindl.	21	**Specklinia tribuloides* (Sw.) Pridgeon & M.W. Chase.
8	**Laelia anceps* Lindl.	22	*Stanhopea oculata* (G. Lodd.) Lindl.
9	*Lycaste aromatica* (Graham) Lindl.	23	*Stanhopea ruckeri*
10	**Maxillaria densa* Lindl.	24	*Stanhopea tigrina*
11	*Maxillaria elatior* Rchb. f.	25	*Stelis purpurascens* A. Rich. y Galeotti.
12	*Maxillaria variabilis* Bateman ex Lindl.	26	**Trichocentrum lindenii* (Brongn.) M.W. Chase & N.H. Williams
13	*Myrmecophila grandiflora* (Lindl.) Carnevali, Tapia-Muñoz & I. Ramírez	27	**Trichocentrum luridum* (Lindl.) M.W. Chase & N.H. Williams.
14	*Notylia barkeri* Lindl.	28	*Trichosalpinx ciliaris* (Lindl.) Luer

*Naturally pollinated orchids; Source: elaborated by the author.

Figura 2. The Catasetum walk.

covers the polliniums or pollen containers and discharge it into the stigmatic cavity. Thus, pollinating the flower that will later develop a fruit with millions of seeds to reproduce naturally.

Did you know that 80% of orchids need a pollinator to form their fruit? According to some authors such as Ackerman *et al.* (2023), 67% of the 456 orchid species they studied were pollinated by a single pollinator, 14% by two, and 17% by three or more species (Tremblay, 1992). Pollinators are bees such as *Eulaema polychroma*, wasps, flies, butterflies (diurnal and

Table 2. Stations and interpretive resources of the interpretive trail "The Eden of Native Orchids of Campus Córdoba."

Station/distance	Orchid*/Host	Resources	Message/Expected learnings
0.Introduction	2	Trail brochure Orchid flowers and fruits	Trail presentation Orchids importance
1. *Catasetum* walk	2,7 *Phoenix roebelenii*	Orchid flower Female flower Male flower Catasetum fruit	Orchid flower parts Ochid pollinators Flower manual pollination Flower and orchid fruit development
2. *In vitro* orchid germination 240 m	2	Catasetum fruit cut in half Culture medium Orchid seds	*In vitro* germination Threatened orchids
3. Orchid acclimatization 110 m	1,20,21	Vitroplants Tray with lid and substrate	Importance of orchid acclimatizing
4. Miniature orchids 130 m	20,21,27,11 *Pouteria sapota*	Seedlings on the bark on mamey tree *Specklinia digitale* and *S. tribuloides* in flowering	Naturally established miniature orchids Mamey tree as a phorophyte Threatened orchids
5. Orchid establishment on phorophytes 65 m	5,8,15	Plant with pseudobulbs Plant produced *in vitro* and acclimatized	Pseudobulbs importance Orchid plant division Establishing orchids
6. *Laelias* walk 65 m	1,5,7,8,9,10,11,12, 13,22,23,24 *Fraxinus* sp. *Persea* sp	Avocado and ash trees Established *Laelias*	*Laelia anceps*, *Lycaste aromatica*, *Maxillaria elatior*, *M. densa*, *Stanhopea oculata* and *S. trigrina*. Threatened orchids
7. May flower orchid walk 50 m	2,4,13,15,17,18,19 *Azadiractha indica* *Cedrela odorata* *Persea* sp.; *Yucca* sp.	Neem and cedar trees *Oncidium sphacelatum* *Myrmecophila gradiflora*	Largest orchid species from the trail and Mexico
8. Donkey ears orchids 50 m	14,26,27 *Thuja occidentalis*	Thuja trees *Trichocentrum lindenii* *T. luridum*	Phorophyte *Trichocentrum lindenii* *T. luridum*

Source: elaborated by the author; *Orchids references included in Table 1.

Figure 3. *Catasetum integerrimum*: (A) Female flower, (B) Male flower, and (C) Fruits.

nocturnal) and birds such as hummingbirds, according to Hills *et al.* (1972) and Rodriguez *et al.* (1992). Please notice that, according to Ackerman *et al.* (2023) and Ackerman (1996), a large majority of orchids deceive their pollinators, as they do not provide any reward. The deception is alimentary, or orchids imitate oviposition and mating sites; also, they provoke pseudo-antagonism and even sexual deception.

This is the orchid *Epidendrum radicans* that grows on stones, that is, it is lithophytic and reaches up to 80 cm in height and is distributed from Mexico to Central America and Colombia. Here on the Campus *E. radicans* blooms in full sun from February to April, and is pollinated by the butterflies *Anartia fatima* and *Danaus* spp., according to Wolfe (1987); also, this orchid has formed fruits naturally.

You can now appreciate the importance of pollination for the reproduction of these beautiful plants, some of which take up to 11 months to fruit, according to Baltazar *et al.* (2023). On the Campus, it has been identified that two orchids are self-pollinating, seven have pollinators, and 19 lack pollinators. What to do in the latter case? Well, artificial pollination can be performed. Do you want to learn how to do it? Let's go!

Station 2. *In vitro* orchid germination

We let you know that, as a result of pollination, one to four capsules can be formed per plant (Figure 3C). Then, amazingly, when the fruit ripens and opens, it releases about three million "dust-like seeds" that are dispersed by the wind. Only a few of them will give rise to a new plant in association with mycorrhizal fungi because they are so tiny that they do not have enough nutrient reserves and because they have a very tiny and undifferentiated embryo, according to Hágsater *et al.* (2015).

Please note know that the rates of symbiotic germination and survival of orchid plants in natural environments are less than 1%, according to Teixeira da Silva *et al.* (2015) and Chen *et al.* (2020), thanks to its association with a mycorrhizal fungus; but in anthropized environments they are much lower. The alternative is *in vitro* germination of those dust-like seeds, in the laboratory of plant tissue culture. Come and see how it is done.

First, the ripe fruit is washed and disinfected in that laminar flow hood. It is then manipulated with those tweezers and cut with the scalpel to extract the seeds (Figure 4A).

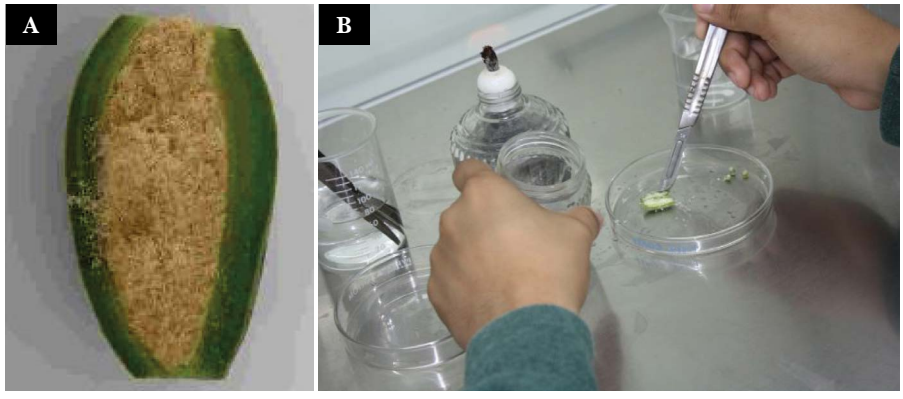

Figure 4. *In vitro* reproduction of orchids. (A) Fruit of *Catasetum integerrimum* cut in half, (B) Handling of orchid fruit in the laminar flow hood.

The seeds are then placed in the Murashige and Skoog (1962) 50% culture medium with 15 grams of sugar using a scalpel (Figure 4B). It will take 45 days for the seeds to germinate in a controlled environment. In this laboratory we have achieved 95% germination of seeds of *C. integerrimum*, *Myrmecophila grandiflora* and *Specklinia digitale*, and 80% with *Lycaste aromatica* and *Oncidium sphacelatum*.

Have you already learned the scientific and common names of the orchids we have seen? Do you remember what percentage of germination is achieved in natural environments? Do you remember Why? Does any of you want to comment something on *in vitro* germination of orchids?

Station 3. Orchid acclimatization

At three and six months after germination, subcultures are made in the laboratory. Afterwards, to acclimatize the seedlings they are moved to the greenhouse to gradually adapt them to the natural conditions of the field, for 12 months. Vigorous *in vitro* developed seedlings are selected, with four well-developed leaves and 5-10 cm tall. They are extracted from containers and placed in tap water. They are washed until the culture medium is completely removed to prevent the development of pathogens (Figure 5A).

The seedlings are then immersed in a Captan solution at 1 g L^{-1} and planted in a plastic tray with sterilized substrate of Chilean Sphagnum moss or Peat moss Premier®, in an autoclave at 120 °C, for 60 minutes and watered to field capacity (Figure 5B). Immediately, the tray is hermetically covered for the first two weeks in 70% shade and at a temperature of 24 °C. Then, trays are opened gradually. Plants are watered manually with a spray bottle and they are covered again. In the fourth week, they are completely uncovered and watered daily by sprinklers and put in 50% shade for six to 10 months (Figure 5C).

Finally, in the last three months, the plants are placed in stress with a 50% reduction in watering, and exposure to 70% sunlight to stimulate the hardening of the leaves and the development of vigorous roots, covered by the velamen, that white tissue that covers the root of epiphytic orchids. Survival rate can be between 40 and 100%.

Why do you consider the acclimatization process of seedlings produced *in vitro* to be important? If the germination rate is 95% and the acclimatization rate is 80%, what is the actual survival rate of orchids produced *in vitro*?

Figure 5. Acclimatization of orchids. (A) Seedling washing, (B) Trays with substrate and (C) Acclimatized *Lycaste aromatica* seedlings.

Station 4. Miniature orchids

This is a perennial Mamey fruit tree (*Pouteria sapota*), native to the Mexican tropics and Central America, up to 50 m tall and 80 cm in diameter at breast height (dbh), with a broad, pyramidal and irregular crown, with simple leaves of 15 to 30 cm (Figure 6A). The bark of the adult Mamey is fissured, which allows mosses and lichens to grow and creates a perfect moistured micro environment for mycorrhizal fungi.

Do you remember that mycorrhizae are essential for the symbiotic germination of orchid seeds? This makes the Mamey tree an excellent natural host (or phorophyte) for orchids.

Seedlings of *Specklinia digitale* and *S. tribuloides*, miniature orchids, have been observed here in mamey bark (Figure 6B). Both species bloom most of the year, as does *S. digitale* (Figure 6C), a threatened orchid, according to SEMARNAT's Official Mexican Standard 059 [2010/2019] (NOM-059-SEMARNAT-2010). It has been observed here at the Campus, that this Mamey fruit tree is the only phorophyte of the miniature orchids. The fruit fly *Drosophila* sp. is identified as pollinator of *S. tribuloides* (Karremans *et al.*, 2015) and possibly also of *S. digitale*, as both orchids form fruit.

Other orchids, hosted by the Mamey tree, are *Platystele stenostachya*, a miniature orchid with light yellow flowers and an orange labellum; *Maxillaria elatior*, a medium-sized orchid with solitary red-orange flowers smaller than 5 cm; and *Trichocentrum luridum*.

Do your remember why the mamey is a good phorophyte for miniature orchids? Why are mycorrhizal fungi important for orchids?

Station 5. Orchid establishment on phorophytes

Orchid plants are divided and established during the rainy season. Plants with four pseudobulbs are used, since it has been seen in *Myrmecophila grandiflora* (Figure 7A) that with a single pseudobulb the plant dies. Also, orchid plants propagated *in vitro* and already acclimatized can be used. In order to promote the anchoring of orchid plants, native

Figure 6. Miniature orchid host: (A) The Mamey fruit tree (*Pouteria sapota*), (B) *Specklinia* sp. seedlings, and (C) *Specklinia digitale* in bloom on the bark of the Mamey tree.

Figure 7. Establishing orchids: (A) Plants of *Myrmecophila grandiflora*, (B) Acclimatized plants of *Lycaste aromatica* and (C) Establishing orchids in the phorophyte.

phorophytes with cracked bark are chosen, and placed at the junctions of the branches that form a V or an L, fixed with thick cotton or henequen thread, with a minimum duration of 6 months, so that the roots of the plant are anchored to the bark of the tree.

During this period, watering should be supplied on days when it does not rain. The plants will reach a height of 15 cm from the base of the pseudobulb to the tip of the largest leaf and their roots will reach 10 cm in length on average, as in *Lycaste aromatica* (Figure 7B and 7C), as indicators of survival. Hernández-García *et al.* (2021) reported they successfully established 30 specimens of *Laelia anceps* in ash (*Fraxinus* sp.) and Creole avocado (*Persea* sp.) with this technique in November 2020 (Figure 8).

Figure 8. Establishing *Laelia anceps* on *Persea* sp.

Let's set up an orchid plant! Does anyone remember the suggestions for the most convenient orchid establishing? What characteristics must a phorophyte have to be considered ideal? What care should be taken in order to establish the plants?

Station 6. Laelias walk

This orchid is popularly known as "Lily of All Saints"; *Laelia anceps* is a medium-sized epiphytic orchid, with floral stalks reaching 80 cm and inflorescences of two to five lilac flowers, highly prized for its beauty. Did you know that *L. anceps* was one of the most widely used orchids in the first hybridization programs in the world? This is an account published by Halbinger and Soto (1997).

At Campus Cordoba, the *Laelias* trail has 40 specimens; *L. anceps* blooms from late October to early December (Figure 9) and occasionally in April. As *L. anceps* is traded in markets in the region, mass harvesting has decreased populations in their natural habitat. According to Baltazar-Bernal *et al.* (2020) *L. anceps* is found in trees and pots in backyards and is pollinated by *Bombus medius*.

This plant you see here is known in Mexico as "little spider"; it is *Brassia verrucosa*, a medium-sized orchid, with inflorescences of more than 12 fragrant flowers, with a bright white labellum and green polka dots, which blooms from June to August. These you see here are *Epidendrum cardiophorum* with small, creamy-green flowers and *Maxillaria densa* that blooms in February. *Maxillaria variabilis* is a small orchid, with yellow or burgundy flowers smaller than 1.5 cm that bloom in autumn, winter and summer. Here you can also see *Stanhopea oculata* and *Stanhopea tigrina* which are threatened orchids according to NOM-059-SEMARNAT-2010. Both species bloom in July, but there is no fruiting. *S. tigrina* is an endemic species that grows in a region of Mexico. This is *Lycaste aromatica* that blooms in April and gives off an exquisite cinnamon fragrance.

Can anyone of you explain what an endemic orchid is?

Figure 9. Specimens of *Laelia anceps* at *Laelias* walk station.

Station 7. May flower orchid walk

This majestic orchid is our "May Flower" also known in México as "Golden rain", *Oncidium sphacelatum*. It is an orchid that develops abundant floral stalks that can reach 1.5 meters in length, with more than 150 yellow flowers with brown spots, which blooms in April and May. Because it is one of the most abundant and most photographed orchids at Colegio de Postgraduados, Campus Cordoba, it has become a main attraction (Figure 10). It is a representative species in the central area of the state of Veracruz, where it is used in religious traditions and as an ornamental plant.

The vast majority of the *O. sphacelatum* specimens on Campus, reproduced after being established in 2017 following the procedure already described, based on the division of specimens. They were located on neem (*Azadiractha indica*), cedar (*Cedrela odorata*), avocado (*Persea* sp.) and Izote [Ee-zo-teh] (*Yucca* sp.) plants (Figure 11).

Figure 10. The Mexican "May Flower" – Lluvia de oro (lit. Golden rain; *Oncidium sphacelatum*).

Figure 11. May Flower walk in one of the gardens at Colegio de Postgraduados, Campus Córdoba.

Damon and Cruz (2006) reported that pollination of *O. sphacelatum* is natural by the pollinator *Centris mexicana*; but this occurs in one flower out of every 5000 on Campus. This orchid has been germinated *in vitro*. As an attractive orchid, *O. sphacelatum* is used in landscape projects, also as *Encyclia parviflora* and *Myrmecophila grandiflora*, which bloom from April to June and March and April, respectively.

Myrmecophila grandiflora is the largest orchid in Mexico and, surprisingly, once the flower is pollinated, the fruit develops and matures in as little as 30 days. So, in one floral stalk you can found flowers and fruits developing at the same time (Figure 12). Those other orchids are *Prosthechea ochracea* and *Prosthechea radiata* which bloom in May-July and July-September, respectively. Does anyone remember which is the largest orchid in Mexico?

Station 8. Donkey ear orchids (*Trichocentrum luridum*)

The thuja (*Thuja occidentalis*) is a small, introduced evergreen tree that reaches 4 m in height, with a trunk up to 40 cm in dbh, with narrow longitudinal striations on its bark, and flattened branches that form a globose crown of dense foliage (Figure 13).

The thuja retains its leaves, which is critical for hosting *Notylia barkeri*, an orchid that blooms from March to April; *Trichocentrum lindenii* which has purplish foliage and 30 cm flower stalks, that blooms in July; and *Trichocentrum luridum* (Figure 14) which has green foliage and flower stalks 1 to 1.5 m in length, that blooms in March and April. Both *Trichocentrum* species are pollinated by bees of the genus *Centris*, according to Carmona and García (2009), to form fruit and reproduce by symbiotic germination.

Can anyone share their thoughts on the characteristics of an ideal phorophyte for orchids? You may begin with those trees we observed, Mamey, Avocado and Thuja, three of the most visited native hosts on the trail.

Figure 12. *Myrmecophila grandiflora* with flowers and fruits.

Figure 13. Thuja (*T. occidentalis*) is host for *Trichocentrum lindenii* and *Trichocentrum luridum*.

Figure 14. *Trichocentrum lindenii* with purplish leaves and *T. luridum* with green leaves.

CONCLUSIONS

With nine stations involving 28 species, 700 m length and 2.5 hours to cover the routes on foot, the orchid interpretive trail is a good alternative to inform the public on the importance, problems of extinction risk, and the reproduction of orchids; since it is possible to achieve with it an active and participatory learning. It is essential to plan, manage, and regulate education tourism activities to reduce their impact on anthropized landscape as it were ecosystem.

The objective was accomplished, to show this design of the Interpretive Trail "The Eden of the Native Orchids at Campus Cordoba" as both, an environmental and ornamental theme. Something similar might be done in public parks in order to raise awareness among students and citizens; thus, going beyond the merely informative to an active social participation, for example with a permanent campaign to repopulate orchids.

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