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Surveys for Cirsium wrightii and other rare plants (*Graptopetalum bartramii*, *Pediomelum pentaphyllum*, *Pectis imberbis*, *Leucosyris blepharophylla*, and *Eryngium sparganophyllum*) in northeastern Sonora and northern Chihuahua, Mexico

Final Report

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Abstract

This report presents the results of the search and location of six rare Arizona plants that reach their southern distribution limit in Mexico. The field work was carried out during 35 days, from September 28, 2017 to April 30, 2019, covering 55 locations, 37 of them with suitable habitat, in the states of Sonora and Chihuahua traveling more than 6,900 km. Of the six rare plant species we searched for, four of them were found, two in Sonora (*Eryngium sparganophyllum* and *Graptopetalum bartramii*) and four in Chihuahua (*Cirsium wrightii*, *Eryngium sparganophyllum*, *Graptopetalum bartramii*, and *Leucosyris blepharophylla*).

The locations where the rare plants were found in Sonora were Sierra Las Avispas near Nogales; Sierra Nácori Chico (Mesa Tres Ríos Region); and northeast of Sonora (Rancho Agua Caliente); while in Chihuahua rare plants were found in Ojo Vareleño in Casas Grandes, Río Piedras Verdes near Colonia Pacheco, and Baños de San Diego south of the city of Chihuahua.

During the fieldwork, 394 herbarium specimens were collected and deposited in the USON Herbarium, and their duplicates will go to the Herbarium of the University of Arizona. In addition, 590 field observations of plant species from the explored sites were registered and whose records will be entered into the database of Observaciones Generales de Flora del Noroeste de México (RHNM). Specimens and field observations records will be available online through the website of the Red de Herbarios del Noroeste de México and SEINet.

Introduction

The main objective of this project was to conduct field studies in suitable habitats in search of new populations of rare plants, as well as inspect historical sites in northern Sonora and Chihuahua, Mexico, known for having suitable habitats for six species of rare plants (*Cirsium wrightii*, *Graptopetalum bartramii*, *Pediomelum pentaphyllum*, *Pectis imberbis*, *Leucosyris blepharophylla* and *Eryngium sparganophyllum*). Five of these species are currently under review by the United States Fish and Wildlife Service; Information on the presence, absence, threats and habitat conditions determined by this study will inform current and future reviews, decisions to list them and recovery planning for these taxa.

Wright´s marsh thistle, ***Cirsium wrightii*** A. Gray, are biennials or monocarpic perennials, 100-300 cm; Distinguished from other thistles in the southwest by being small-headed (involucres 1-2 cm), corollas white to pink-purple, bisexual florets, mid-stem leaf bases extending down stem as spiny wings, and heads borne on long peduncles (1-15 cm) in open panicles. Inhabits springs, seeps, marshes, stream banks, often in alkaline soil; of conservation concern; 1100-2600 m; Ariz., N.Mex., Tex.; Mexico (Chihuahua, Sonora). Occurs from the mountains of south-central New Mexico eastward to the cienegas of the adjacent southwestern Great Plains.

Cirsium wrightii is a wetland thistle that occurs in wet meadows associated with alkaline springs and seeps (ciénegas) in New Mexico, Arizona and northern Mexico. Its few known Mexican locations have not been studied, but some of its United States populations are known to be extirpated or declining (Sivinski, 2012).

Cirsium wrightii is currently and historically known to occur in the states of Arizona, New Mexico, Chihuahua and Sonora (USDI-Fish and Wildlife Service 2010). The single location in Arizona is an historical 1851 collection from San Bernardino Ciénega, which straddles the international border with Mexico and no longer has suitable wetland habitat on the Arizona side of the line (Baker 2011). The only known extant populations in the United States are in the New Mexican counties of Chaves, Eddy, Guadalupe, Otero and Socorro (Sivinski, 2012).

Cirsium wrightii is listed by the state of Arizona as a candidate species of concern. Not known from Arizona except for one historic specimen near San Bernadino Ranch, currently San Bernadino Wildlife Refuge in Cochise County. According Bob Sivinski (Pers. Comm., 2017), no one has recently seen *Cirsium wrightii* in Mexico. There are only two specimen collections – one in Sonora (Fronteras in 1890) and another in Chihuahua (south of Galeana decades ago). There were two large springs feeding a large marsh that were likely the habitat of the Chihuahua population. That wetland is named Ojos de Arrey (30.06009,

-107.59093). Between the 2003 and 2015, imagery on Google Earth showed that the springs and marsh have dried out, and mostly destroyed by 2015. The type locality at San Bernardino Cienega straddles the border of Arizona and Sonora, but all of that wetland on the U.S. side has long ago been dried and destroyed and recent searches of wet remnants on the Mexico side did not locate any thistles.

The discovery of new populations of *Cirsium wrightii* and the other five species will increase their knowledge of distribution and ecology and help reevaluate its *status* to be included under the Endangered Species Act and conservation needs.

Bartram stonecrop, ***Graptopetalum bartramii***, is a perennial herb; rosettes solitary or few, 7-16 cm wide, of 15-70 leaves, on stem 1-3 cm thick. Differs from *G. rusbyi* in its longer, apiculate leaves, acute sepals, paniculate inflorescence, and fall phenology. Its flowering period is from September to February. *Graptopetalum bartramii* is a sky island species growing on rocky outcrops along arroyos and canyons, often in shade and litter with Madrean evergreen woodland at 3900-6700 ft (1190-2040 m) elevation. Thick succulent leaves glaucous and gray-green in color. Old flowering stalks give population reddish-brown appearance from a distance. Flowers reported to have strong disagreeable odor resembling odor of stinkhorn fungus (Phillips 1982). Leaves of distinctive shape.

At the beginning of this project, *Graptopetalum bartramii* is known in Mexico only from northern Sonora in Sierra Las Avispas near Nogales (2002); And two localities in Chihuahua: One in Pacheco (1948), near Casas Grandes and the other one to the northwest of Las Varas in the municipio of Madera (1980).

Arizona eryngo, ***Eryngium sparganophyllum*** Hemsl., is a herbaceous perennial with a basal rosette of leaves and a scapose stem to 1.5 m tall; basal leaves linear, up to 1 m long, entire or rarely with one or two spinose teeth; cauline leaves few and reduced; inflorescence a compound umbel with compact head-like umbels terminating the branches; heads ovoid or ovoid-oblong, 12-25 mm long, 10-15 mm wide, with several ovate or lanceolate basal bracts and similar, but smaller bractlets within the head that barely exceed to the length of the fruits; corolla cream colored or bluish purple; fruit ovoid, 3-4 mm long with scales at the angles and smaller scales between.

In Mexico, the distribution of the plant appears to be highly disjunct with a known population in Chihuahua and another in Sonora and then a gap of more than 500 miles to the region where Durango, Jalisco, Nayarit and Zacatecas adjoin (New Mexico Rare Plant List 2013). Garcia-Ruiz (2013) reports that there are very few records from Michoacán and that populations are small, restricted, and made up of a few isolated individuals from two locations in la Sierra del Centro.

Beardless chinch weed, ***Pectis imberbis***, is a perennial herb, occurs in Arizona and northern Mexico (Chihuahua and Sonora) in relatively small, widely separated populations on Pine-oak-juniper woodlands, grasslands, arid shrublands; 1000-1700 m elevation.

Overgrazing may be a factor in the scarcity of these plants. They are generally more than 25 cm before they begin to flower and may be unable to reproduce under grazing pressure.

Contra yerba, ***Pediomelum pentaphyllum***, is an erect to decumbent perennial herb, found in Arizona and New Mexico on sandy or gravelly soils in mesquite or yucca grassland communities and creosote-bush scrublands, from 3,500-6,500 ft (1067-1981 m). This species is extremely rare and has been used by the Tarahumara people to reduce fever.

Leucosyris blepharophylla, is a caespitose perennial rhizomatous herbs 4–35 cm tall; stems 4–12+ from woody crown, sparingly branched in distal half, branchlets somewhat fastigiate, erect-ascending; herbage glabrous or nearly so with leaves dimorphic, basal and cauline; basal present at anthesis, in compact persistent rosette, sessile; capitula radiate, ray florets 8– 14, disk florets 12–20+; corolla 4.5–5.5 mm long. Cypselae 1.7–2.4 mm long, rays pappose (Pruski and Hartman, 2012). During the 1851 U.S./Mexico boundary survey, *Leucosyris blepharophylla* was collected once in New Mexico by Charles Wright. It has not seen in New Mexico since that time and probably has extirpated from the state. The two springs in the Playas Valley that may have been the type locality have captured for livestock water, and most riparian vegetation there been eliminated. The only known extant populations of this plant are at gypsum hot springs (Baños de San Diego) near Ciudad Chihuahua (Nesom et al. 1990) and two closely located recently discovered populations in Presidio County, Texas (Poole et al. 2007).

Materials and methods

In this project, we traveled more than 6,900 Km for fieldwork, and during 35 days we explored 55 sites in the states of Sonora and Chihuahua with habitats that could support plants such as *Cirsium wrightii*, *Pectis imberbis*, and *Graptopetalum bartramii*. Search was carried out in several municipios of northern and southeastern Sonora, mainly localities such as Cuenca Los Ojos Conservation Area (Agua Prieta), Sierra Las Avispas (Nogales), Sierra Chivato (Santa Cruz), Rancho Agua Caliente (Nacozari de García), Sierra Alta region (Huachinera, Bacerac and Bavispe), Los Bajíos (Quiriego) and La Estrella (Rosario). We also explored sites with pine-oak, juniper woodland and grasslands in the state of Chihuahua, at the vicinities of Janos, Casas Grandes, Colonia Pacheco, Galeana, Buenaventura and city of Chihuahua.

Additionally, in this survey we also searched for other rare plants such as *Eryngium sparganophyllum*, *Leucosyris blepharophylla*, and *Pediomelum pentaphyllum*. Searching

sites for *Eryngium sparganophyllum* was very important because they are also potential suitable habitats for *Cirsium wrightii*.

During field surveys, we did 590 field observations of plants and collected 394 herbarium specimens. All these records are going to the SEINet-Red de Herbarios del Noroeste de México online database (herbanwmex.net). We counted the surveyed plants found, and specimens of these were deposited into the Universidad de Sonora Herbarium (USON). Duplicates and photovouchers of cacti will be going to herbaria in the United States and Mexico (ARIZ, ASU, DES, TEX, MEXU, HCIB, and CIIDIR). Finally, all photographs are by José Jesús Sánchez-Escalante unless otherwise indicated.

Results and Discussion

In this work, we visited 55 locations in the states of Sonora and Chihuahua; as a result, 37 of them showed that they had a favorable habitat for at least one of the six rare plants sought (Table 1). Eight populations of rare plants were found in seven locations with suitable habitat, in six of them at least one of the species searched was found while in another one (Ojo Vareleño), populations of *Eryngium sparganophyllum* (historical) and *Cirsium wrightii* (new) were found. Only the populations of *Graptopetalum bartramii* found (4) could be considered as self-sustaining since the other four populations are in three privately owned properties (Ciénega Agua Caliente, Ojo Vareleño and Baños de San Diego) and their conservation depend entirely on the management of their owners.

Table 1. Results of the search for six species of rare Arizona plants in the states of Sonora and Chihuahua, Mexico.

Rare plant species	Locations w/suitable habitat searched	Locations w/negative surveys	Populations found	Self-sustaining populations	Locations w/access granted	Historic locations (visited)
Cirsium wrightii	5	4	1	0	5	1
Graptopetalum bartramii	11	7	4	4	11	2
Pediomelum pentaphyllum	5	5	0	0	4	0
Pectis imberbis	10	10	0	0	10	4
Leucosyris blepharophylla	1	0	1	0	1	1
Eryngium sparganophyllum	6	4	2	0	6	2
Total	37*	30	8	4	36	10

* There were 37 locations because Ojo Vareleño shares one location with suitable habitat for both *Cirsium wrightii* and *Eryngium sparganophyllum*.

Of the six rare plants that we were looking for in this survey, we only found populations for *Cirsium wrightii*, *Graptopetalum bartramii*, *Eryngium sparganophyllum* and *Leucosyris blepharophylla*, two in Sonora (*Eryngium sparganophyllum* and *Graptopetalum bartramii*) and four in Chihuahua (*Cirsium wrightii*, *Eryngium sparganophyllum*, *Graptopetalum bartramii*, and *Leucosyris blepharophylla*).

Cirsium wrightii

During this survey, we tried to visit all of the Mexican localities with suitable habitat for *Cirsium wrightii*, such as San Bernardino Ciénega on the Sonoran side of the border, and one 1982 collection in La Angostura, Chihuahua, S Galeana; however, we excluded for exploration the unique collection of 1890 in Fronteras because it was impossible to know the exact location.

Rancho San Bernardino. In the search for *Cirsium wrightii*, we visited Rancho San Bernardino, municipality of Agua Prieta, Sonora. This site is located on federal highway MEX 2, 24 km east from Agua Prieta, Sonora. Here, we explored the marsh along the border with the United States, very close to San Bernardino National Wildlife Refuge where the holotype of *Cirsium wrightii* was collected by Charles Wright in 1851 (A. Gray, 1852). Our search was unsuccessful here and our informant, Alberto Terán-Figueroa, who has been working in San Bernardino for eight years, told us that he has never seen any plants of *Cirsium* here. We also did not find plants of *Eryngium sparganophyllum* in this area.

Cienega San Bernardino is a highly disturbed site with the presence of several invasive exotic plants such as *Salsola tragus*, *Cynodon dactylon*, *Sorghum halepense*, *Arundo donax* and *Helianthus annuus*; as well as some opportunistic native species that like disturbed sites such as *Prosopis velutina*, *Ziziphus obtusifolia*, *Ambrosia confertiflora*, *Ambrosia monogyra*, *Solanum elaeagnifolium* and *Atriplex canescens*. Although we did not find *Cirsium wrightii* or *Eryngium sparganophyllum* in the cienega, we also recorded some interesting plants from environments with alkaline water such as *Almutaster pauciflorus*, *Typha domingensis* and *Sporobolus airoides*. Other plants found in this locality were *Populus fremontii*, *Physalis acutifolia*, *Physalis pubescens*, *Isocoma tenuisecta*, *Anisacanthus thurberi* and *Suaeda torreyana*.

Ojos de Arrey, municipality of Buenaventura, Chihuahua (October 4, 2017). 7 km south from Galeana, on Federal Highway MEX 10. We visited this site in the small town of La Angostura. It is a historical site for *Cirsium wrightii*. Until the eighties, Ojos de Arrey was a hot springs spa that harbored a great diversity of aquatic organisms. Adrián Hernández-Cárdenas, a resident from La Angostura, told us that since 15 or 18 years, the waterhole began to dry out due to the excessive pumping of the aquifer in nearby Mennonite farms, as they allocate water for agricultural use. As a result, the spring that fed the thermal

waters dried up and now the spa is in total abandonment and almost destroyed. We found no evidence here of *Cirsium wrightii*, nor of other aquatic plant species.

Ojo Caliente, municipality of Buenaventura, Chihuahua (October 4, 2017). Is a private hot spring spa, located 21 km (by road) E Buenaventura, 1.3 km south of the federal highway MEX 10. We visited Ojo Caliente as a place with potential to find *Eryngium sparganophyllum*, *Cirsium wrightii* and perhaps *Leucosyris blepharophylla*. The visit to this site was not on the itinerary so it was short and we did not find any of the species we were looking for. Although, for the limited time available, we only search around the pond and in the water discharge from the bathrooms. We suggest doing a wider exploration of this site in the future.

We also visited a couple of hot springs near Casas Grandes, Chihuahua: The first was El Ojito, located south of Nuevo Casas Grandes, between Colonia Francisco I. Madero and Hacienda San Diego. The second one corresponds to El Ojo Vareleño, located in the northwest of Casas Grandes. The purpose of visiting these places was to search for populations of *Cirsium wrightii* and *Eryngium sparganophyllum*.

El Ojito, municipality of Nuevo Casas Grandes, Chihuahua (October 10, 2018). With the hope to find *Cirsium wrightii* and/or *Eryngium sparganophyllum*, we went to Colonia Francisco I. Madero, an agricultural area where we met Héctor Ramón Carrillo (74 years old and resident of that town) who guided us to El Ojito, a hot spring spa near Colonia Madero. Don Héctor told us that when he was a boy, it was the tradition that the people of Colonia Madero went to El Ojito to bathe. Today it is a private property and the spring closed to public. The caretaker agreed to give us permission to enter and visit the spring. This place is quite very disturbed and we observed that the heavy machinery had done their job, removing the original soil and vegetal cover in the surroundings of the spring. We did not find *Cirsium* nor *Eryngium* here; however, we recorded some plants such as *Populus fremontii*, *Salix gooddingii*, *Ludwigia peploides*, *Almutaster pauciflorus*, *Anemopsis californica*, *Acalypha neomexicana*, *Bidens aurea*, *Lemna*, *Oenothera rosea*, *Datura inoxia*, *Euphorbia spp.*, *Anoda cristata, Solanum rostratum, Baccharis salicifolia*, *Baccharis sarothroides*, *Conyza Canadensis*, and *Chenopodium ambrosioides*. We also recorded several non-native plants here, such as *Persicaria*, *Nasturtium officinale*, *Cynodon dactylon*, *Plantago major*, *Xanthium strumarium*, and *Taraxacum officinale*.

El Ojo Vareleño, municipality of Casas Grandes, Chihuahua (October 10, 2018). 4.5 km (by air) NW Casas Grandes. Fortunately, in this survey, we found a new population of *Cirsium wrightii* at El Ojo Vareleño, a hot springs spa in the town of Casas Grandes. Their owners are the Varela family, hence the name Vareleño. With the allowance of Antonio Varela Flores and Mauricio Varela Álvarez we explored the surroundings of the hot spring and we were very pleased to find *Cirsium wrightii* and *Eryngium sparganophyllum* here, just where the water comes out of the spring; however, the invasive plant, carrizo (*Arundo donax*), is a great danger for the conservation of these species. It will be necessary to

establish a very careful plan to control *Arundo* in the place. It is very important to note that we explored only a 5 hectares area, where we obtained a plant list with almost 80 species. In addition to *Cirsium* and *Eryngium*, there are in the site another native species preferring alkaline water environments such as *Andropogon glomeratus*, *Ageratum corymbosum*, *Typha domingensis*, *Almutaster pauciflorus* and *Anemopsis californica*. We recorded some other interesting plants here such as *Populus fremontii*, *Salix gooddingii*, *Celtis reticulata*, *Fraxinus velutina*, *Morus microphylla*, *Senna wislizeni*, *Acleisanthes dealbata*, *Lactuca*, and *Sphaeralcea angustifolia*. However, we also recorded a large number of non-native species such as *Arundo donax*, *Chenopodiastrum murale*, *Salsola tragus*, *Marrubium vulgare*, *Echinochloa colona*, *Cynodon dactylon*, and *Eragrostis cilianensis*.

Antonio Varela Flores (left) and Mauricio Varela Álvarez (right), two members of the Varela family, owners of El Ojo Vareleño.

During our visit to El Ojo Vareleño, we talked Antonio and Mauricio Varela about the importance to preserve the populations of *Cirsium wrightii* and *Eryngium sparganophyllum*. They told us that are very interested in the protection of the spring and therefore the populations of *Cirsium* and *Eryngium* as conservation objects. This would prevent the municipality of Casas Grandes from installing pipeline directly in the discharge of the spring to supply water to Universidad Tecnológica de Casas Grandes. In 2018, the owners of El Ojo Vareleño declared to the newspaper El Diario: “We disagree with the diversion of the water to the Universidad Tecnológica Paquimé. Therefore, we deny the consent of water being extracted from the spring for that University, because would cause the shortage of water that is currently irrigated, and that would result in the impact of the

ecological balance of the region" (Periódico El Diario, 2018). During our meeting, they also expressed their interest for obtain, from Fish and Wildlife Service of Arizona, a letter of interest highlighting the importance for conserving both plant species in El Ojo Vareleño.

Graptopetalum bartramii

We searched ***Graptopetalum bartramii*** in two of the three historical populations and we found both. One in Sierra Las Avispas, southwest of Nogales, Sonora, and another one on Río Piedras Verdes near Colonia Pacheco, Chihuahua.

Sierra Las Avispas, municipio of Nogales, Sonora (March 21, 2019). SON 43, 15 Km (by road) SW from MEX 15 towards Sáric; 18.7 Km (by air) SSW from Nogales. We went to this locality to relocate a *Graptopetalum bartramii* population recorded by Thomas Van Devender in 2002. A population with only three live plants was found (2 adults, 1 seedling) growing on basalt rocky walls in a roadside shady canyon. Natural grassland-oak woodland with *Quercus arizonicus*, *Q. emoryi*, *Q. toumeyi*, *Juniperus deppeana*, *Garrya wrightii*, *Dasilyrion wheeleri*, *Opuntia chlorotica*, *O.* cf. *durangensis*, *O. engelmmanii*, *Fraxinus gooddingii*, *Berberis haematocarpa*, *Populus fremontii*, *Salix gooddingii*, *Platanus wrightii*, *Juglans major* (A), *Prunus serotina*, *Agave palmeri*, *Muhlenbergia dumosa*, *Artemisia ludoviciana*, *Ageratina paupercula*, *Rhus choriophylla*, *Asclepias linaria*, *Coreocarpus arizonicus*, *Yucca madrensis*, *Fouquieria splendens*, ferns and mosses.

Cueva de la Olla/Cueva de las Golondrinas, municipality of Casas Grandes, Chihuahua (October 3, 2017). SW Casas Grandes. These are a pair of contiguous localities on the Río Piedras Verdes; here, we only performed a short exploration and found no evidence of *Graptopetalum bartramii*.

Puente Steven, Río Piedras Verdes crossing, municipio of Casas Grandes, Chihuahua (October 11, 2018). Located N from Colonia Pacheco and SW from Casas Grandes, we went down to the riverbed and walked for two kilometers by the Piedras Verdes River, climbing over the rocky slopes and looking over the canyon walls. After an unsuccessful search for six hours, and just as we were returning to the car, somewhat disappointed, we found a small population with only six plants of Graptopetalum bartramii (3 adult plants and 3 seedlings). Without daring to assure it, we could suppose that this is the historic population of *Graptopetalum bartramii* reported by R. McCabe in 1948, near Colonia Pacheco; however, it would be highly recommended to carry out a more extensive search in both directions of the river. Pine-oak forest with *Pinus engelmanni*, *Pinus cembroides*, *Pinus leiophylla*, *Juniperus flaccidus*, *Quercus arizonica*, *Rhus aromatica*, *Artemisia*, *Commellina*, *Bidens*, *Dalea*, *Muhlenbergia*, *Solanum*, Ferns and mosses.

By August 2018, we went to Mesa Tres Ríos region in Sonora, where we recorded three new localities for *Graptopetalum bartramii* in the Sierra de Nácori Chico. On road to the campsite near Mesa Tres Ríos, we did four stops where we recorded some interesting

plants. We searched for *Graptopetalum bartramii* in sites with suitable habitat and marked with an asterisk (*).

Near Cajón Cruz del Diablo, municipality of Huásabas, Sonora (August 6, 2018). 6.2 Km (by air) NE Huásabas. Our first stop on road to Mesa Tres Ríos; foothills thornscrub with *Amoreuxia palmatifida* (Pr), *Merremia palmeri*, *Encelia farinosa*, *Pennisetum ciliare*, *Prosopis*, *Condalia*, *Ipomoea arborescens*, *Abutilon*, *Portulaca suffrutescens*, *Mimosa dysocarpa*, *Ambrosia cordifolia*, *Melinis repens*, *Allionia incarnata*, and *Solanum lumholzianum*.

Near El Coyote, municipality of Bacadehuachi, Sonora (August 6, 2018). On road to Huachinera, 1.6 Km W of the crossing with road to Bacadehuachi. Another stop on road to Mesa Tres Ríos. Foothills thornscrub with *Prosopis velutina*, *Acacia occidentalis*, *Lysiloma watsonii*, *Caesalpinia pulcherrima*, *Opuntia* cf. *durangensis*, *Cylindropuntia thurberi*, *Encelia farinosa*, *Croton ciliatoglandulifer*, *Bursera stenophylla*, *Cynanchum ligulatum*, *Ruellia nudiflora*, *Melampodium cupulatum*, *Bouteloua repens*, *Pennisetum ciliare*, and *Boerhavia*.

Arroyo El Riíto, municipality of Nácori Chico, Sonora (August 6, 2018). Between Nácori Chico and Mesa Tres Ríos, 11 Km (by air) NE of Nácori Chico. Our third stop on road to Mesa Tres Ríos. Riparian canyon with *Platanus wrightii*, *Prionosciadium macrophyllum*, *Selaginella novoleonensis*, *Argyrochosma jonesii*, *Argyrochosma limitanea subsp limitanea*, *Tradescantia andrieuxii*, *Aristolochia watsonii*, *Euphorbia revoluta*, *Manihot rubricaulis*, *Mecardonia procumbens*, and *Castilleja tenuiflora*.

Arroyo La Cueva crossing, municipality of Nácori Chico, Sonora (August 6, 2018). Roadside between Nácori Chico and Mesa Tres Ríos, 2.5 Km (by air) al SW de Mesa Tres Ríos. Last stop before we reach La Cueva campsite. Pine-oak forest with *Pinus*, *Cupressus*, *Quercus*, *Ilex rubra*, *Ostrya virginiana* (Pr), *Rhus aromatica*, *Tilia americana* (P), *Ceanothus buxifolius*, *Platanus wrightii*, *Salix bonplandiana*, *Asclepias lemmonii*, *Guardiola arguta*, *Verbena pinetorum*, *Gomphrena nitida*, *Solanum rostratum*, *Iresine heterophylla*, and *Bouteloua diversispicola*.

La Cueva campsite, near Mesa Tres Ríos, municipality of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 3.5 km (by air) SSW Mesa Tres Ríos. Pine-Oak forest with *Pinus*, *Quercus*, *Salvia*, *Echeandia flavescens*, *Commelina dianthifolia*.

***On road to Pico La India**, Municipio of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 2.8 km (airline) S Mesa Tres Rios, 1.6 km (by road) SE Rio La Cueva. Crossing on primary gravel road between Mesa Tres Rios and Chuichupa, Chihuahua. George Ferguson discovered this Arroyo La Cueva subpopulation and found only one live plant in this locality, growing in soil pocket on basalt rock layer exposed from an old roadcut. Pine-Oak-Juniper Woodland on hillside. Dominant plants in immediate area are *Pinus engelmannii*, *Pinus chihuahuana*, *Quercus durifolia*, *Q. rugosa*, *Q. arizonica*, *Juniperus deppeana*, *J. arizonica*, *Arctostaphylos pungens*, *Arbutus xalapensis*, *Rhus*

aromatica, *Fraxinus velutina*, *Toxicodendron radicans*, *Muhlenbergia emersleyi*, *Vitis arizonica*, ferns and mosses.

On road to Pico La India, municipality of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 3 km (by air) S Mesa Tres Ríos. Pine-oak forest with *Pinus, Quercus*, *Tigridia pavonia*, *Sedum stelliforme*, *Houstonia wrightii*, *Cosmos pringlei*, *Tradescantia pinetorum*, *Glandularia chiricahensis*, *Euphorbia macropus*, and *Commelina erecta*.

On road to Pico La India, municipality of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 2.6 km (by air) S Mesa Tres Ríos. Pine-oak forest with *Pinus, Quercus*, *Arbutus arizonicus*, *Ipomoea madrensis*, *Habenaria clypeata*, *Lithospermum cobrense*, *Macroptilium gibbosifolium*, *Lasianthaea podocephala*, *Cologania obovata*, *Gibasis linearis* subsp. *rhodantha*, *Sisyrinchium cernuum*, and *Milla biflora*.

***On road to Pico La India**, municipality of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 2.8 km (by air) SSE of Mesa Tres Ríos. 29.81603°, -108.70449°, 1771 meters. Pine-oak forest with *Pinus, Quercus*, *Cologania angustifolia*, *Phaseolus pauciflorus*, *Calochortus venustulus*, *Oxalis alpina*, *Galium aparine*, *Rhynchosia precatoria*, *Commelina erecta*, *Euphorbia colorata*, *Passiflora suberosa*, *Silene scouleri*, *Euphorbia anychioides*, *Euphorbia bilobata*, *Pleopeltis polylepis* var. *erythrolepis*, and *Castilleja tenuiflora*.

On road to Arroyo Largo, municipality of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 3.2 km (by air) SSE of Mesa Tres Ríos. 29.812111°, -108.703194°; 2384 meters. Pine-oak forest with *Pinus, Quercus*, *Malaxis crispata*, *Malaxis novogaliciana*, *Habenaria clypeata*,

On road to Pico La India, municipality of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 6.5 km (by air) SSE of Mesa Tres Ríos. 29.782°' N, -108.70062°' W, 2208 meters. Pine-oak forest with *Pinus, Quercus*, *Cologania angustifolia*, *Penstemon wislizenii*, *Polygala obscura*, *Physalis caudella*, *Erigeron*, *Cosmos diversifolius*, and *Lupinus argenteus*.

On road to Arroyo Largo, municipality of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 7 km (by air) SSE of Mesa Tres Ríos. 29.773914°, -108.691855°, 2346 meters. Pine-oak forest with *Pinus, Quercus*, *Agastache pallida*, *Sambucus*, and *Phytolacca icosandra*.

***On road to Arroyo Largo**, municipality of Nácori Chico, Sonora (August 7, 2018). Sierra Madre Occidental, 7.2 km (by air) SSE of Mesa Tres Ríos. 29.7725°, -108.688973°; 2384 meters. Pine-oak forest with *Pinus, Quercus*, *Robinia neomexicana*, *Prunus serotina* var. *virens*, *Rubus idaeus* subsp. *strigosus*, *Cosmos diversifolius*, *Salvia arizonica*, *Trifolium wormskioldii* (A), *Calylophus toumeyi*, *Oenothera elata*, *Stevia plummerae*, *Vicia pulchella*, *Ratibida Mexicana*, *Geranium wislizeni*, *Eryngium lemmonii*, *Ceanothus buxifolius*, *Rumex*, *Vitis arizonica*, *Ipomopsis*, *Acmispon*, *Pellaea*, and *Lithospermum cobrense*.

Arroyo La Cueva on road to Mesa Tres Ríos, municipality of Nácori Chico, Sonora (August 8, 2018). Sierra Madre Occidental, 2.35 km (by air) SW of Mesa Tres Ríos. Pine-oak forest with *Pinus, Quercus*, *Opuntia phaeacantha*, *Agave shrevei*, *Viguiera longifolia*, *Euphorbia*

colorata, *Lasianthaea podocephala*, *Prionosciadium madrense*, *Bommeria hispida*, *Cuphea wrightii*, *Potentilla thurberi*, and *Acmispon*.

***Near Mesa Tres Ríos**, municipality of Nácori Chico, Sonora (August 8, 2018). Sierra Madre Occidental, 1.4 km (by air) S of Mesa Tres Ríos. Oak-pine forest with *Pinus, Quercus*, *Begonia gracilis*, *Portulaca suffrutescens*, *Sida neomexicana*, *Selaginella novoleonensis*, *Melampodium longicorne*, *Commelina dianthifolia*, and *Thalictrum fendleri*.

Near Mesa Tres Ríos, municipality of Nácori Chico, Sonora (August 8, 2018). Sierra Madre Occidental, 1.3 km (by air) S of Mesa Tres Ríos. 29.828540°, -108.710580°; 1899 meters. Oak-pine forest with *Pinus, Quercus*. Here we found a small population of *Agave parryi*, although it seems that it was established under cultivation.

***Mesa Tres Ríos**, municipality of Nácori Chico, Sonora (August 8, 2018). Sierra Madre Occidental, 1.7 km (by air) SW of Mesa Tres Ríos. 29.827120°, -108.721730°; 1769 meters. Oak-pine forest with *Pinus, Quercus*, *Hypericum formosum*, *Hypericum moranense*, *Conyza, Solanum*, *Loeselia glandulosa*, *Echeandia flavescens*, *Ipomoea plummerae*.

On road to Rancho San Antonio, municipality of Nácori Chico, Sonora (August 8, 2018). Sierra Madre Occidental, 1.6 km (by air) N of Mesa Tres Ríos. 29.85485°, -108.71235°; 1778 meters. Oak-pine forest with with *Pinus, Quercus*. We recorded here succulent species such as *Opuntia phaeacantha*, *Opuntia chlorotica*, *Agave shrevei* and *Yucca madrensis*.

***On road to Rancho San Antonio**, municipality of Nácori Chico, Sonora (August 8, 2018). Sierra Madre Occidental, on road to Rancho San Antonio, 1.8 km (by air) N from Mesa Tres Ríos. Oak-pine forest with *Quercus hypoleucoides*, *Q. arizonica*, *Juniperus deppeana*, *Ceanothus buxifolius*, *Heuchera sanguinea*, *Brickellia*, *Opuntia*, *Echinocereus rigidissimus*, *Agave shrevei*, *Dasylirion wheeleri*, grasses, ferns, mosses, and, nearby tall pines. George Ferguson and Stephen Hale discovered a small population (5 living plants) of *Graptopetalum bartramii* on a basalt rock layer exposed from an old road cut, growing in soil pockets. Population spread ca. 100 meters from flowing streambed; plants are well up on W side of drainage, growing on nearly vertical cliffs of an old roadcut with SE facing aspect. Plants are visible from the road being on the roadcut, and easy to access by passerbys. The population is fairly exposed, subject to desiccation with little shade, or shelter from freezing. No recent fires. Erosion by heavy rains possible although roadcuts are very old and stable now, covered in vegetation, mosses and ferns. Searching the immediate area did not locate any other individuals than those on the roadcut, although natural large basalt cliffs exist above and below this roadcut, which are relatively inaccessible and was not searched (Ferguson 2018).

On road to Nácori Chico, municipality of Nácori Chico, Sonora (August 9, 2018). Sierra Madre Occidental, 5.5 km (by air) SW Mesa Tres Ríos. Pine-oak forest with *Pinus*, *Quercus*, *Opuntia robusta*, *Echinocereus stolonifer subsp. tayopensis* (Pr), and *Portulaca suffrutescens*.

***Arroyo El Macho, on road to Nácori Chico**, municipality of Nácori Chico, Sonora (August 9, 2018). Sierra Madre Occidental, Sierra de Nácori Chico, 8.95 km (by air) SW from Mesa Tres Ríos. We explored this new population of *Graptopetalum bartramii* discovered by Susan Carnahan 26 June 2018 on basalt rock layer exposed from an old roadcut, growing in soil pockets and in cracks of bare rock. In this locality, we counted 60 live plants; however, George Ferguson (2018) counted 74 total live plants (37 seedlings, 23 immature, 11 mature, 3 mature-robust) and 26 dead plants. Population spread 40 meters at ca. 20 meters from flowing streambed; plants are on N side of drainage, growing on nearly vertical cliffs of an old roadcut with SSE facing aspect. Plants are visible from the road being on the roadcut, and easy to access by passerbys. The population is fairly exposed, subject to desiccation with little shade, or shelter from freezing. No recent fires have burned through here. Erosion by heavy rains possible although roadcuts are very old and stable now, covered in vegetation, mosses and ferns. The searching in the immediate area for 0.5 km along the streambed of natural boulders did not locate any other individuals than those on the roadcut. Beyond our limited search are vast areas of potential habitat for *Graptopetalum bartramii*. Pine-oak forest with *Pinus engelmannii*, *Pinus arizonica*, *Pinus strobiformis* (Pr), *Pinus chihuahuana*, *Quercus hypoleucoides*, *Q. rugosa*, *Q. arizonica*, *Q. durifolia*, *Juniperus deppeana*, *Acer grandidentatum*, *Fraxinus velutina*, *Ilex rubra*, *Arctostaphylos pungens*, *Arbutus xalapensis*, *Ceanothus buxifolius*, *Heuchera sanguinea*, *Prionosciadium madrense*, *Agave shrevei*, *Yucca madrensis*, *Vitis arizonica*, *Verbena Carolina*, *Selaginella*, *Graptopetalum bartramii*, *Sedum*, *Galium*, ferns and mosses.

***On road to Nácori Chico**, municipality of Nácori Chico, Sonora (August 9, 2018). Sierra Madre Occidental, 20 Km (by air) NE of Nácori Chico. Pine-oak forest with *Pinus*, *Quercus*, *Arbutus*, *Juniperus*, *Agave shrevei*, *Bouvardia ternifolia*, *Rhus aromatica*, *Buddleja sessiliflora*, *Dasilyrion gentry*, *Ageratina rothrockii*, *Calylophus toumeyi*, *Sedum steliforme*, and *Acmispon*.

On road to Nácori Chico, municipality of Nácori Chico, Sonora (August 9, 2018). Sierra Madre Occidental, 17.7 Km (by air) al NE de Nácori Chico. Oak forest with *Quercus oblongifolia*, *Juniperus*, *Garrya wrightii*, *Dasilyrion gentryi*, *Bouvardia ternifolia*, *Mandevilla foliosa*, *Agave shrevei*, *Allium*, *Clematis*, and *Asclepias elata*.

On road to Nácori Chico, municipality of Nácori Chico, Sonora (August 9, 2018). Sierra Madre Occidental, 15.6 Km (by air) NE of Nácori Chico. Overgrazed grassland in the transition from Pine-oak forest to foothills thornscrub with *Dodonaea viscosa var. angustifolia*, *Matelea quercetorum* and *Amoreuxia palmatifida* (Pr).

On road to Nácori Chico, municipality of Nácori Chico, Sonora (August 9, 2018). Sierra Madre Occidental, 15.3 Km (by air) NE of Nácori Chico. Overgrazed grassland in the transition from Pine-oak forest to foothills thornscrub with *Dodonaea viscosa var. angustifolia*, and *Matelea tristiflora*.

Eryngium sparganophyllum

Arizona eryngo is important for several reasons. It is an indicator for the health of ciénega habitats. Its conspicuous flowers are of high value for an impressive diversity of pollinators including hummingbirds and invertebrates (Makings et al. 2015). It is also of particular interest from a scientific standpoint and is considered by botanists to be an enigma due to its complex and unique morphology. From a sheer aesthetic perspective, it is a lovely plant with elegant angles and visually striking flowers (Curry 2018).

There may only be two populations of Arizona eryngo in Mexico as the disjunct southern populations may represent a different species than the northern populations and true *E. sparganophyllum* may only be found in Chihuahua and Sonora. The status of the population in Chihuahua is unknown. The population at Agua Caliente in the Río Bavispe basin in Sonora appears healthy (Sanchez Escalante Personal Communication 2018: in Curry 2018). Ojos de Arrey, a once-large spring complex in the Rio Santa Maria drainage south of Galeana where biologists thought Arizona eryngo could potentially occur based on habitat conditions, found that the condition of the wetland was one of total deterioration, apparently caused by over-exploitation of the aquifer (Sanchez Escalante Personal Communication 2018: in Curry 2018).

We searched three historic populations of *Eryngium sparganophyllum* and only two were relocated, one in Sonora (Rancho Agua Caliente) and another in Chihuahua (Ojo Vareleño, in the municipio of Casas Grandes).

Ciénega Agua Caliente, municipality of Nacozari de García, Sonora (March 21, 2018). The only known site for *Eryngium sparganophyllum* in Sonora is located at Rancho Agua Caliente, which is 17.5 Km (by air) east of Esqueda. We were pleased to find here an abundant population of *Eryngium sparganophyllum*, hundreds of plants distributed along the marsh where the water of the spring flows. Although the condition of the population of *Eryngium* is very good, the habitat is somewhat disturbed, so the owner of the ranch should be aware about the importance of avoiding more impact on the site to conserve this species. Some of the associated aquatic plants are *Eleocharis parishii*, *Juncus bufonius*, *Schoenoplectus americanus*, *Almutaster pauciflorus*, *Sisyrinchium demissum*, and *Pluchea salicifolia*.

Cienega Tonibabi, municipality of Moctezuma, Sonora (September 24, 2018). In the search for *Eryngium sparganophyllum* and *Cirsium wrightii*, we also visited Cienega Tonibabi near Moctezuma. We explored the hot spring surroundigs but we did not find *Eryngium* nor *Cirsium*. This marsh is in a foothills thornscrub with secondary vegetation. Some common plants here are: *Prosopis velutina, Celtis pallida, Ruellia nudiflora, Ruellia intermedia, Acacia farnesiana, Mitracarpus hirtus, Rivina humillis, Tithonia thurberi, Zinnia zinnioides, Anoda, Trianthema portulacastrum, Ipomoea spp., Xanthium strumarium*, *Phyla nodiflora*, *Anemopsis californica, Ageratum corymbosum* and *Schoenoplectus americanus*.

As we said before, **Ojo Vareleño** (October 10, 2018) is also an historic locality for *Eryngium sparganophyllum* and, in the present, shares the habitat with *Cirsium wrightii*. We are pleased to say that, in this work, we relocated a historic population of *Eryngium* but we were only able to count about 56 live adult plants because the high density of the Carrizo (*Arundo donax*), making it difficult to explore the whole place.

In our visit to **Ojos de Arrey** (October 4, 2017), as historic site for *Cirsium wrightii*, we also looked for *Eryngium* but didn't find them because, as we said before, the spring that fed the thermal waters dried up and now the habitat is abandoned and destroyed.

Rancho Ojo Caliente, municipality of Buenaventura, Chihuahua. 21 km (by road) to the E of Buenaventura, 1.3 km south of the federal highway MEX 10. A new and potential location for *Cirsium wrightii* and or *Eryngium sparganophyllum*. In a brief search, we did not find these plants here but a wider exploration of this area in the future is recommended.

Pectis imberbis

In this work, and in addition to exploring some potential locations for *Pectis imberbis*, we went to all historical locations in Sonora, and in none of the sites visited could we find traces of this plant. We assume that all these historical populations in Sonora have disappeared due to the habitat change caused by severe overgrazing.

On road to Sierra Alta, municipality of Moctezuma, Sonora (September 24, 2018). SON 14 road, 22.8 km E Moctezuma on road to Huásabas. We started here the search for *Pectis imberbis* but did not find it; however, in this site we recorded the northernmost occurrence of *Bursera stenophylla*, a characteristic tree of the low deciduous forest and the low elevations of the holm oaks (Felger, 2000). The place has grasses such as *Aristida ternipes* var. *ternipes*, *Bouteloua repens*, *Urochloa arizonica*, *Heteropogon contortus*, and the invasives *Melinis repens* subsp. *repens* and *Pennisetum ciliare*; also, shrubs and low trees such as *Baccharis sarothroides*, *Euphorbia cymosa*, *Acacia millefolia*, *Lysiloma watsonii*, *Ipomoea arborescens*, *Stenocereus thurberi*, and *Quercus chihuahuensis*.

Norte de Horconcitos, municipality of Bacerac, Sonora (September 29, 2017). The first historical site for *Pectis imberbis* is the Ciénega de Horcones, it is located in Rancho El Bajío del Oso, 10.4 km (by road) north from Huachinera, immediately after crossing the bridge. In this first trip, we could not access because the door has locked. Later, in Bacerac we were informed that the ranch belongs to the Swanson family, residents of Hermosillo who until now we have not been able to contact.

Rancho La Estancia, municipality of Bacerac, Sonora (September 24, 2018). 7.5 Km (by air) N Huachinera. We could not acces to Ciénega de Horcones but we entered a nearby ranch, La Estancia, with permission of its owner José Juan Samaniego-Villaescuza who resides in Huachinera. Here, we also did not find any traces of *Pectis imberbis*. It seems that, as in other localities in the region, the severe overgrazing reduces the possibility that

in the future we could find this species. Desert grassland with secondary vegetation. Common plants here are: *Prosopis velutina*, *Celtis pallida*, *Juniperus arizonicus*, *Gutierrezia microcephala*, *Bouteloua*, *Eriogonum*, *Chamaecrista nictitans*, *Portulaca suffrutescens*, *Phemeranthus aurantiacus*, *Guilleminea densa*, *Crusea hispida*, *Boerhavia*, *Sida*, *Gomphrena sonorae*, *Amaranthus sp.*, *Euphorbia spp.*, *Ambrosia confertiflora*, *Mollugo verticilata*, *Ruellia nudiflora*, *Machaeranthera tagetina*, *Mimosa biuncifera*, *Fraxinus gooddingii*, *Rivina humillis*, *Talinum paniculatum*, *Commicarpus scandens*, *Polygala*, *Argythamnia*, *Pectis prostrata*, and *Condalia correlli*.

We continued our search for *Pectis imberbis* in the Sierra Alta Region, exploring sites like Bajío del Oso, municipio of Bacerac and Arroyo Huevón, municipio of Bavispe.

Rancho Bajío del Oso, municipality of Huachinera, Sonora (September 25, 2018). 6 Km (by air) NNE Huachinera. Unsuccessfully, we explored this desert grassland. Common plants here are: *Juniperus arizonica*, *Parthenium incanum*, *Yucca baccata*, *Agave shrevei*, *Dasylirion wheeleri*, *Gutierrezia microcephala*, *Calliandra eriophylla*, *Fouquieria splendens*, *Mandevilla brachysiphon*, *Polygala macradenia*, *Salvia parryi*, *Coryphantha recurvata*, *Cylindropuntia spinosior*, *Cylindropuntia leptocaulis*, *Opuntia phaeacantha*, *Echinocereus fendleri*, *Mammillaria grahamii* and some species of grasses including the following genera: *Aristida*, *Bothriochloa*, *Bouteloua*, *Dasyochloa*, *Heteropogon*, *Lycurus* and *Muhlenbergia*.

Paseo campestre at Río Bavispe, municipality of Bacerac, Sonora (September 30, 2017). 2.5 km SSW from Bacerac (30.34266, -108.94801, 1,037 meters elevation). We look for *Pectis imberbis* around this place but we did not find it. Here, the vegetation is a combination of semi-desert grassland and thorn scrub with low trees and shrubs. We recorded here many species of plants such as *Prosopis velutina*, *Gutierrezia sarothrae*, *Rhus choriophylla*, *Condalia warnockii*, *Eysenhardtia orthocarpa*, *Juniperus coahuilensis*, *Mimosa biuncifera*, *Ambrosia monogyra*, *Baccharis sarothroides*, *Fouquieria splendens*, *Nissolia schotti*, *Brickellia coulteri*, *Perityle californica*, *Perityle emoryi*, *Acourtia sp.*, *Elytraria imbricata*, *Porophyllum macrocephalum*, *Tetramerium nervosum*, *Portulaca umbraticola*, *Commicarpus scandens*, *Talinum paniculatum*, *Xanthisma spinulosum*, and *Amaranthus palmeri*. Along the river, we also recorded some trees and shrubs such as *Prosopis velutina*, *Salix gooddingii* y *Populus fremontii*, *Baccharis salicifolia*, *Celtis pallida*, *Rhus microphylla*. Also several succulents such as *Agave parryi*, *Opuntia phaeacantha*, *Cylindropuntia spinosior*, *Acacia greggii*, and the non-native *Nicotiana glauca*. Ferns and related plants such as *Astrolepis* and *Selaginella rupincola*, were also recorded there.

Arroyo Huevón (Arroyo La Petaquilla), municipality of Bavispe, Sonora (September 25, 2018). 4 Km (by air) W Bavispe. The next historical site for *Pectis imberbis* is located west of Bavispe on a creek, tributary of the Bavispe River. To enter this site, we met the president municipal of Bavispe, Mr. Cornelio Vega-Vega, who did arrangements to allow us the entrance to the arroyo. He also told us that there would most likely be a mistake

with the coordinates of the historic site, since Arroyo La Petaquilla is located several kilometers east of Bavispe, in the Sierra Madre Occidental. Apparently, the true locality for the Stephen S. White specimen of *Pectis imberbis* (1940) does not correspond to the actual record in SEINet. This is a canyon riparian forest in a desert grassland with some interesting plants such as *Celtis reticulata*, *Acacia constricta*, *Acacia millefolia*, *Fouquieria splendens*, *Encelia farinosa*, *Erythrina flabelliformis*, *Ambrosia monogyra*, *Baccharis salicifolia*, *Baccharis sarothroides*, *Selaginella rupincola*, *Brickellia venosa*, *Astrolepis sinuata*, *Perityle sp*., *Cylindropuntia thurberi*, and *Echinocereus rigidissimus*. Some interesting findings here were *Salvia languidula*, *Anoda maculata*, *Sedum* cf. *alamosanus*, and *Graptopetalum rusbyi*, another rare sonoran species.

Rancho Los Ojos, municipio de Agua Prieta, Sonora (October 1, 2017). In the search for *Pectis imberbis*, we also explored this site located 48 Km East Agua Prieta, with semi-desert grassland and oak forest. We recorded some plants such as *Quercus arizonicus*, *Cupressus arizonicus*, *Garrya wrightii*, *Rhus coriophylla*, *Ericameria laricifolia*, *Arctostaphylos pungens*, *Yucca madrensis*, *Agave palmeri*, *Agave schottii*, *Fouquieria splendens*, *Opuntia chlorotica*, *Cylindropuntia spinosior*, *Echinocereus rigidissimus*, *Mammillaria grahamii*, *Nolina sp*., *Bouteloua curtipendula*, among others. Even though the grassland had a good state of conservation, we did not find *Pectis imberbis* here.

Continuing our serch for *Pectis imberbis*, we went to the southernmost localities in Sonora, Los Bajíos and La Estrella. We did not find *Pectis imberbis* in both sites and their surrondings.

Los Bajíos (Ejido Los Conejos), municipality of Quiriego, Sonora (April 10, 2018). This locality is in the northernmost region of the Guarijíos ethnic group (Makurawe). It is one of the two southernmost historic locations of *Pectis imberbis* in Sonora, and 40 km (by air) E Quiriego. According to our informant, Rafael Méndez (75 years old) ex-Governor of the Guarijíos in Los Bajíos, in the twentieth century begining the 1950s, the site began to transform from grasslands with oak (called “sabanillas”) to what is now the foothills thornscrub or as they call: “monte mojino”. This transformation of the vegetation was largely due to overgrazing of the original grasslands. Several plants of foothills thornscrub and tropical deciduous forest were recorded here: *Sebastiania pavoniana*, *Sebastiania bilocularis*, *Guazuma ulmifolia*, *Pachycereus pecten-aboriginum*, *Ipomoea arborescens*, *Lysiloma divaricatum*, *L. watsonii*, *Fouquieria macdougalii*, *Callaeum macropterum*, *Karwinskia humboldtiana*, *Randia echinocarpa*, *Heliocarpus attenuatus*, *Croton*, *Diphysa suberosa*, *Ambrosia cordifolia*, *Agave vilmoriniana*, *Bursera fagaroides*, *B. laxiflora*, *B. grandifolia*, *Haematoxylum brasiletto*, *Stenocereus thurberi*, *Ferocactus pottsii*, *Opuntia wilcoxii*, *Prosopis glandulosa* var. *torreyana*, *Wimmeria mexicana*, *Struthanthus palmeri*, *Parkinsonia praecox*, *Hintonia latiflora*, *Vachellia campechiana*, *Senna atomaria*, and *Cylindropuntia thurberi*.

La Estrella, municipality of Rosario, Sonora (April 11, 2018). It is located 12 km (by air) E of Rosario Tesopaco, it is another of the two southernmost historical localities for *Pectis imberbis*. Pedro Borbón-Valenzuela (64 years old), resident of La Estrella and owner of Rancho El Sabinito told us that the vegetation in certain areas has changed since he was a child, from the sabanillas (grasslands with oak woodland) to the current thornscrub or Monte Mojino. Plants of foothills thornscrub were recorded here: *Pachycereus pecten-aboriginum*, *Ipomoea arborescens*, *Lysiloma divaricatum*, L. watsonii, *Fouquieria macdougalii*, *Callaeum macropterum*, *Karwinskia humboldtiana*, *Randia echinocarpa*, *Croton sp*., *Senna sp*., *Desmanthus sp*., *Ambrosia cordifolia*, *Parthenium tomentosum* var. *stramonium*, *Bursera fagaroides*, *B. laxiflora*, *B. grandifolia*, *Malphigia emarginata*, *Haematoxylum brasiletto*, *Zanthoxylum fagara*, *Lantana hispida*, *Stenocereus thurberi*, *Mimosa palmeri*, *Opuntia wilcoxii*, *Prosopis glandulosa* var. *torreyana*, *Wimmeria mexicana*, *Struthanthus palmeri*, *Parkinsonia praecox*, *Hintonia latiflora*, *Vachellia campechiana*, *Senna atomaria*, and *Cylindropuntia thurberi*.

Sierra Chivato, municipality of Santa Cruz, Sonora (April 25, 2019). Rancho Las Gallinitas, 8.6 Km SE Santa Cruz. In this region, we were able to observe the strong disturbance in the grassland because of overgrazing; however, we looked for *Pectis imberbis* in this less disturbed area of the ranch but found nothing. Grassland with oak woodland, several interesting plants recorded here are *Quercus arizonica*, *Quercus emoryi*, *Quercus oblongifolia*, *Pinus discolor*, *Dasilyrion wheeleri*, *Yucca madrensis*, *Muhlenbergia emersleyi*, *Asclepias nummularia*, *Opuntia chlorotica*, *Cylindropuntia spinosior*, *Echinocereus santaritensis*, *Prosopis velutina*, *Krameria erecta*, *Baccharis bigelovii*, *Mirabilis linearis*, *Spermolepis lateriflora*, *Cirsium neomexicanum*, and *Erythranthe rubella*.

Leucosyris blepharophylla

In the search for *Leucosyris blepharophylla*, we went to Baños de San Diego, the only historic population in México, ESE from city of Chihuahua.

Baños de San Diego. It is located in San Diego de Alcalá, municipality of Aldama, Chihuahua (October 5, 2017). 65 km (by road) to the E of the city of Chihuahua. This is a private hot springs spa, where we relocated an historical *Leucosyris blepharophylla* population. Here we have about 30 spots of live adult plants, each containing between 20 and 100 plants. In the disturbed surroundings, we recorded other interesting alkaline water plants such as *Typha*, *Flaveria chlorifolia*, *Samolus ebracteatus*, *Eustoma exaltatum*, *Asphodelus* and the invasive *Tamarix*. Actually, the constructions and modifications to the land by the owners have altered the natural condition of the spring. In addition, the introduction of several exotic plant species such as palm trees, has caused the loss of habitat for at least five species of animals, endemics to this ecosystem.

In February 2018, the NGO Pronatura Noreste A.C. denounced that the San Diego de Alcalá wetland, unique in the world, with five aquatic species that only exist there, was in serious danger of disappearing. This is due to the construction work that is carrying out

there and that endangers not only the five species of aquatic animals, but also plant species that are unique in the world. (Periódico El Diario, 2018).

In March 2018, and in response to PRONATURA's complaint, the Mexican federal environmental protection office (PROFEPA) temporarily closed the thermal spa Baños de San Diego; this, due to the lack of authorization of environmental impact for the construction of its facilities, which the Ministry of Environment and Natural Resources must officially issue.

There is good news about the threat to the conservation of wetlands in San Diego de Alcalá. On May 2018, a meeting organized by the government of the State of Chihuahua was held to discuss the issue of Baños de San Diego, participating federal authorities such as SEDUE, PROFEPA, SEMARNAT, CONANP, and CONAGUA. Also present were representatives of Pronatura Noreste, Ejido San Diego de Alcalá, Universidad Autónoma de Chihuahua, Universidad Autónoma de Ciudad Juárez, and Baños de San Diego Hot Spring Spa. As result of the meeting, participants agreed that the government of the State of Chihuahua request CONANP that the wetlands of San Diego de Alcalá be declared a RAMSAR site and a Voluntary Conservation Area. (Pronatura Noreste 2018). If the wetlands of San Diego de Alcalá were declared as a Protected Natural Area by the Mexican government, then there would be great hope for the conservation of the only known population of *Leucosyris blepharophylla* in Mexico.

Pediomelum pentaphyllum

East of Agua Prieta, municipality of Agua Prieta, Sonora (March 20, 2018). 36.5 km (by air) E from Agua Prieta. To explore potential locations of *Pediomelum pentaphyllum*, we traveled to this locality in a semi-desert grassland with secondary vegetation characteristic of the Chihuahuan desert. Among the species that define the vegetation of this place, include *Cupressus arizonicus*, *Prosopis velutina*, *Fouquieria splendens*, *Opuntia clorothica*, *Rhus microphylla*, *Mortonia scabrella*, *Yucca madrensis*, *Dasylirion wheeleri*, *Opuntia sp.*, and *Agave palmeri*. We did not find *Pediomelum* here.

Rancho El Valle, municipality of Agua Prieta, Sonora (March 20, 2018). 59 Km (by air) E Agua Prieta. Belonging to Cuenca Los Ojos, this site is located in the Mexican extension of Animas Valley. Here we explored a semi-desert grassland and the probability of finding *Pediomelum pentaphyllum* at this site was very low due to the absence of *Prosopis*, *Larrea tridentata* and *Yucca elata*. Anyway, we found some interesting plants here, such as *Bouteloua*, *Muhlenbergia*, *Dasilyrion gentryi*, *Agave palmeri*, *Cylindropuntia spinosior*, *Acmispon greenei*, *Cymopterus multinervatus*, *Thamnosma texanum*, *Dalea versicolor*, *Dichelostemma capitatum*, and *Myriopteris lindheimeri*.

Antelope grassland, municipality of Janos, Chihuahua (October 2, 2017). This site is located between Agua Prieta, Sonora and Janos, Chihuahua, on federal highway MEX 2, 6 km NW of the intersection with the road to Antelope Wells border crossing. This locality

corresponds to a semi-desert grassland with *Prosopis glandulosa* and *Yucca elata*, with potential to find *Pediomelum pentaphyllum*; however, we did not find it. In this site, we registered species considered with interest for the conservation such as *Opuntia pottsii* and *Coryphantha vivipara*. Other plant species recorded here were *Gutierrezia sarothrae*, *Mimosa biuncifera*, *Cylindropuntia spinosior* and *Opuntia phaeacantha* and the invasive *Salsola tragus*.

Rancho San Bernardino, municipio de Agua Prieta, Sonora (October 9, 2018). We explored desertscrub at the exit of the ranch to look for *Pediomelum pentaphyllum*. We did not find *Pediomelum*, however the site presented an environment with sandy and gravelly soil and plants that usually are associated with these species such as *Prosopis*, *Yucca* and *Larrea*. We recorded here some interesting plants such as *Gutierrezia sarothrae*, *Gutierrezia microcephala*, *Aristida purpurea*, *Hilaria mutica*, *Bouteloua gracilis*, *Zinnia acerosa*, *Xanthisma spinulosum*, *Echinocereus fendleri*, *Cylindropuntia spinosior*, and *Opuntia macrocentra*.

Rancho El Berrendo, municipio of Janos, Chihuahua (October 9, 2018). 1.6 Km (by air) S Antelope Wells border crossing; 57.8 Km (by air) NW Janos. For the search of *Pediomelum pentaphyllum*, we requested the permission of the owner but he did not allow us to explore his ranch. This is an interesting desert grassland with plant species such as *Hilaria mutica*, *Bouteloua gracilis*, *Aristida*, *Yucca elata*, *Leuciva dealbata*, *Acleisanthes chenopodioides*, *Psilostrophe cooperi*, *Euphorbia exstipulata*, *Malvella lepidota*, *Clerodendrum coulteri*, *Cucurbita digitata*, *Apodanthera undulata*, *Hoffmannseggia glauca*, *Dalea brachystachya*, *Sanvitalia abertii*, *Jatropha macrorhiza* and *Salsola tragus*. In future surveys, it is advisable to carry out a more extensive search for *Pediomelum pentaphyllum* in the semi-desert grassland areas south of the Mexican border, both in Sonora and Chihuahua.

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Property owners and managers

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Local informants

Héctor Ramón Carrillo (Colonia Madero, Chihuahua), and Adrián Hernández-Cárdenas (La Angostura, Galeana), and Santos Hernández (Ojo Caliente, Buenaventura).

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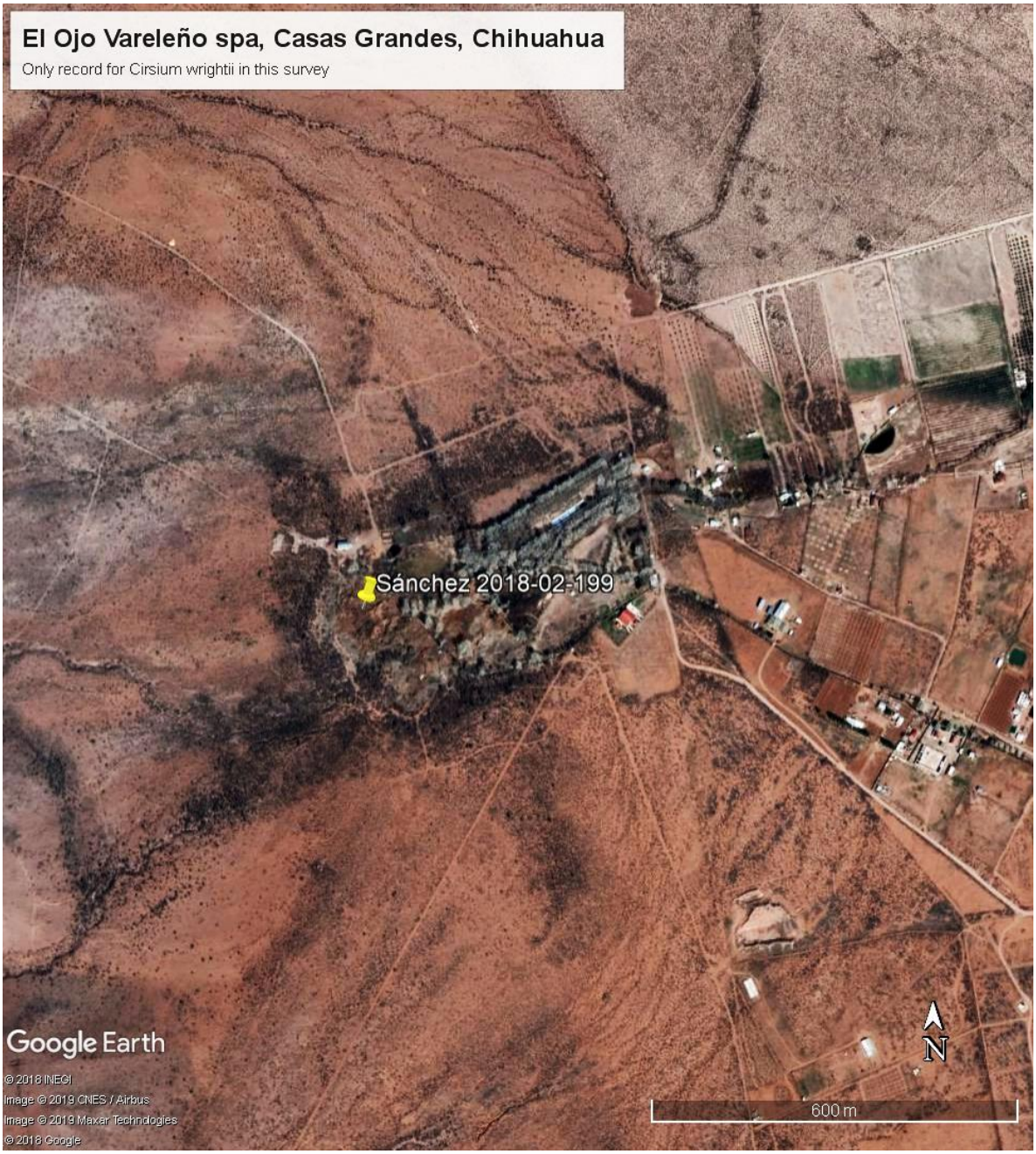
Ciénega San Bernardino, municipality of Agua Prieta, Sonora. 24 km east of Agua Prieta. 31.33312, -109.26393; 1,130 meters. We look for *Cirsium wrightii* on the Mexican side of the Ciénega San Bernardino, very close to where the type specimen was collected in 1851. We did not find *Cirsium wrightii* nor another species of thistle here.

October 8, 2018. We explored the Mexican side of Ciénega San Bernardino (image above) but we did not find any *Cirsium*. Very close is San Bernardino National Wildlife Refuge (image below) where the holotype of *Cirsium wrightii* was collected by Charles Wright in 1851 (A. Gray, 1852) and no longer has suitable wetland habitat on the Arizona side of the line.



El Ojo Vareleño, municipality of Casas Grandes, Chihuahua. 4.5 km (by air) NW of Casas Grandes. 30.400611 °, -107.985353 °; 1490 meters. In this work, we found here the unique occurrence of *Cirsium wrightii*.

October 10, 2018. We found here a big population of *Cirsium wrightii* and relocated *Eryngium sparganophyllum*. The image above shows some thistles growing where the spring water comes out, while the image below shows the plants on one of the streams that feeds the spa ponds.

October 10, 2018. Above, several *Cirsium wrightii* seedlings that grow in Ojo Vareleño, where the spring water comes from. Below, heads with almost riped fruits of a plant that is next to a spa pond.

October 10, 2018. In the Ojo Vareleño, we also found a high number of *Eryngium sparganophyllum*, relocating a 1997 population. The image above shows how difficult was count the plants because the high density of plants, mainly *Arundo donax*. Picture below shows the leaves of the plant collected as herbarium specimen.

Ojos de Arrey, municipality of Galeana, Chihuahua. La Angostura, 7 km south of Galeana on Federal Highway MEX 10. 30.06009, -107.59093; 1,445 meters. This is a historic site for *Cirsium wrightii*.

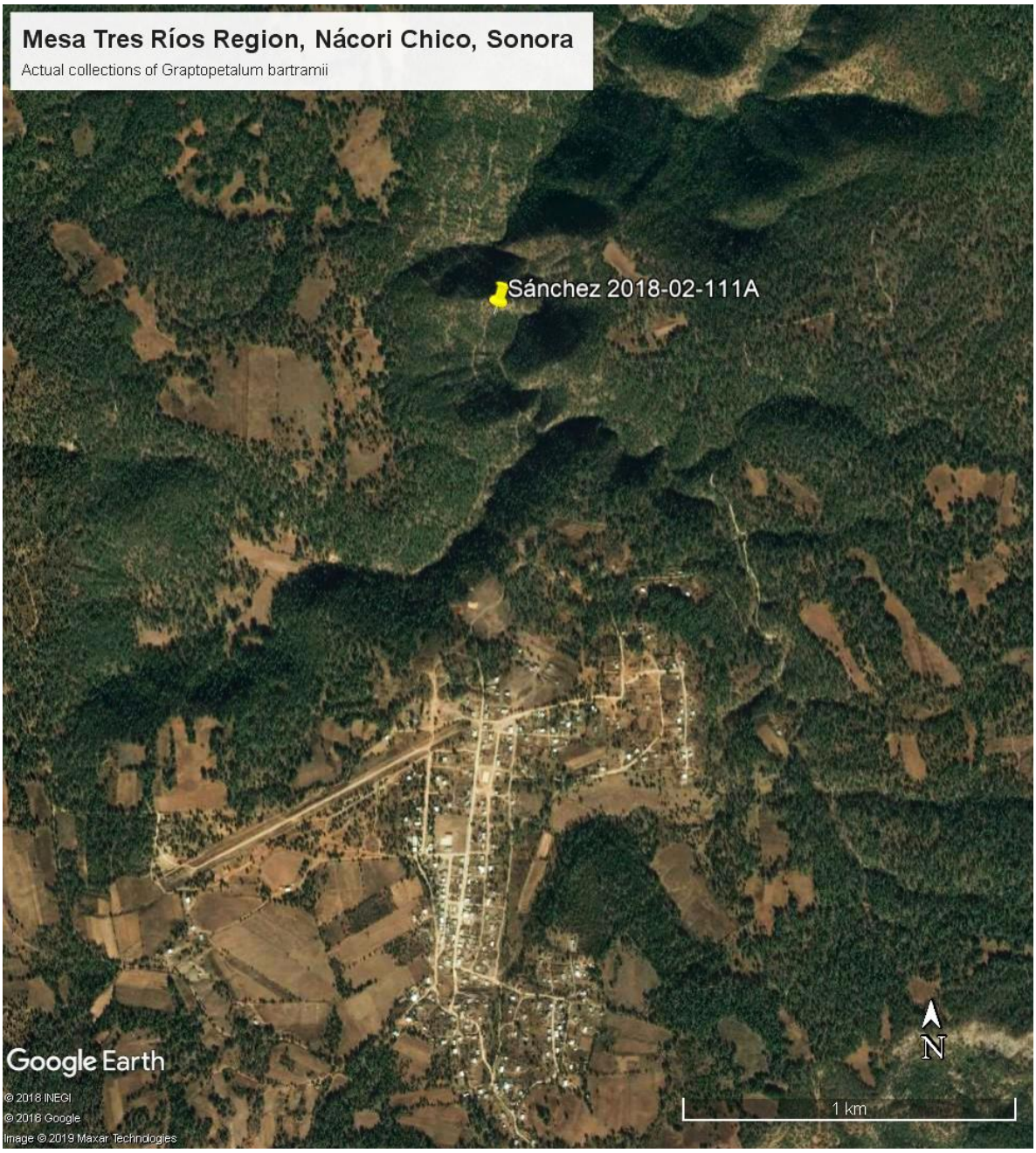
Ojos de Arrey, a destroyed historic location for lost populations of *Cirsium wrightii*. Picture above is from October 1982 (Photo courtesy of Frank Reichenbacher), picture below taken during this survey by October 4, 2017.

Río Piedras Verdes crossing, municipio of Casas Grandes, Chihuahua. Sierra Madre Occidental, Puente Steven, 3 Km (by road) N from Colonia Pacheco, 46 Km (by air) SW from Casas Grandes. 30.108137°, -108.337947°; 1885 meters. Exploration area.

October 11, 2018. Inflorescence of *Graptopetalum bartramii* (below) growing on the crevices of the vertical rocky canyon walls (above) carved by Río Piedras Verdes.

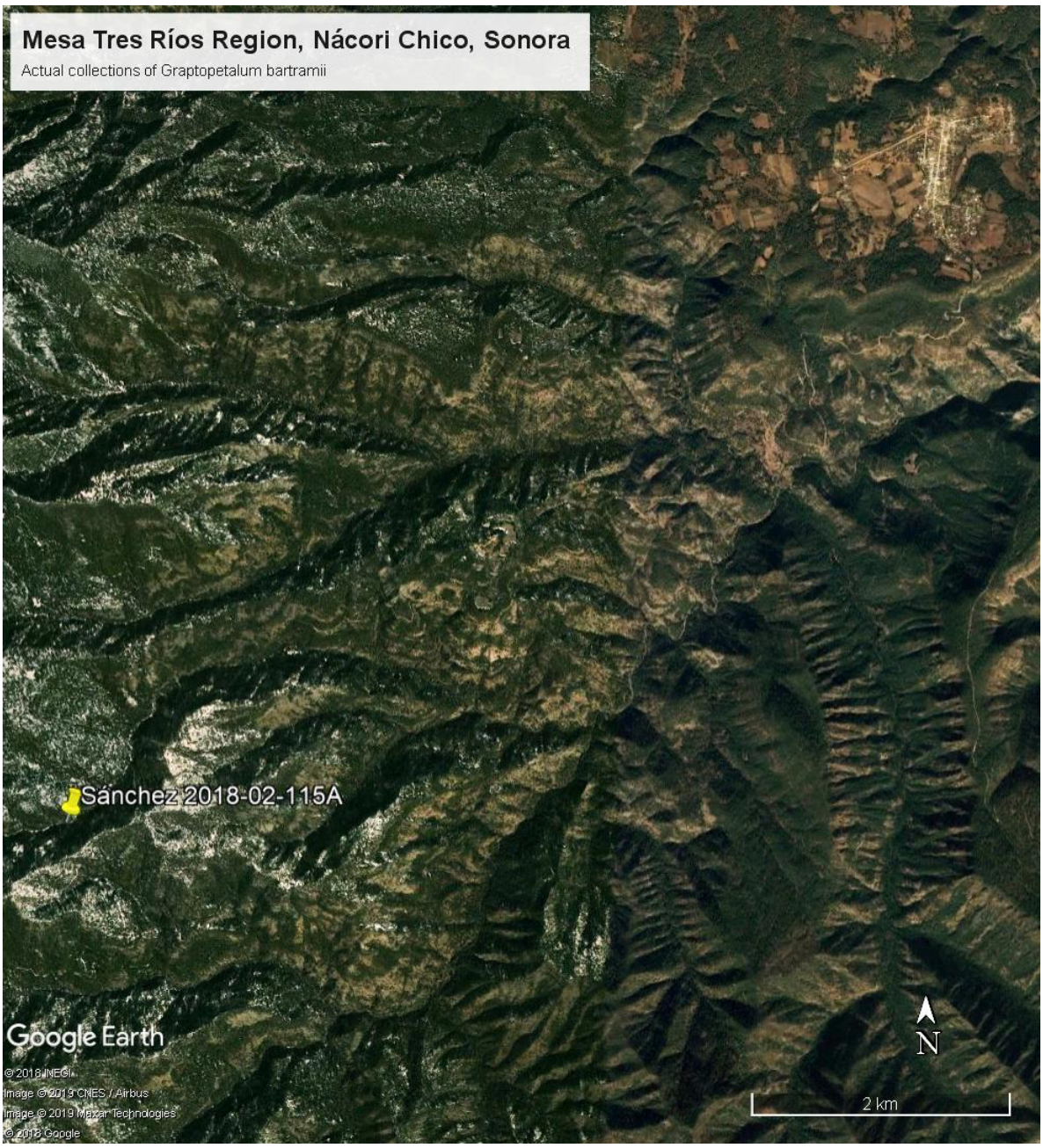
Sierra Las Avispas, municipality of Nogales, Sonora. SON 43, 15 Km (by road) SW MEX 15 on road to Sáric; 18.7 Km (by air) SSW Nogales. 31.122222, -111.069444; 1,305 meters. We did not find any Graptopetalum from 2002 record (Van Devender 2002-743) in this coordinates. However, we found three individuals in the locality labeled Sánchez 2019-014A.

March 21, 2019. The image above shows the habitat of a very small population of *Graptopetalum bartramii* that we relocated from a 2002 record. Picture below shows a mature adult plant with about eight cm diameter.



On road to Rancho San Antonio, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, on road to Rancho San Antonio, 1.8 km (by air) N Mesa Tres Ríos. 29.856580°, -108.711810°; 1771 meters. This is a new location for *Graptopetalum bartramii* in Sierra de Nácori Chico.

August 8, 2018. Habitat for a small population of *Graptopetalum bartramii* with George Ferguson and Stephen Hale taking data and photos. Image below shows a mature plant with about 10 cm diameter and developing a flower stalk.

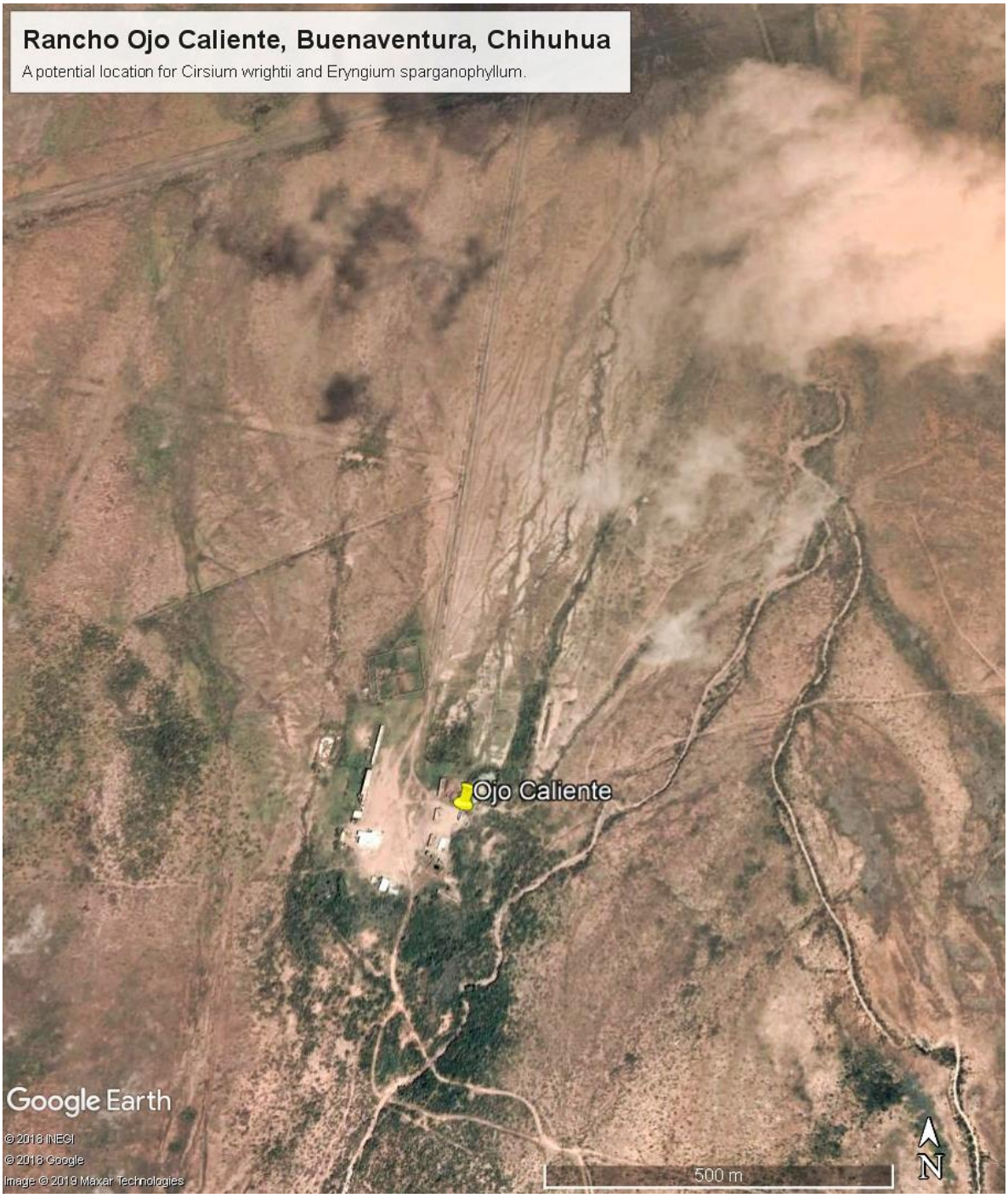


Arroyo El Macho, on road to Nácori Chico, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 8.95 km (by air) SW Mesa Tres Ríos. 29.789010°, -108.784350°; 1990 meters. Another new location for *Graptopetalum bartramii* in Sierra de Nácori Chico.

August 9, 2018. Arroyo El Macho, on road to Nácori Chico, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 8.95 km (by air) SW Mesa Tres Ríos. 29.789010°, -108.784350°; 1990 meters. This is the locality for a population of *Graptopetalum bartramii* discovered by Susan Carnahan 26 June 2018. Image below shows a mature plant with about 10 cm diameter and developing a flower stalk.

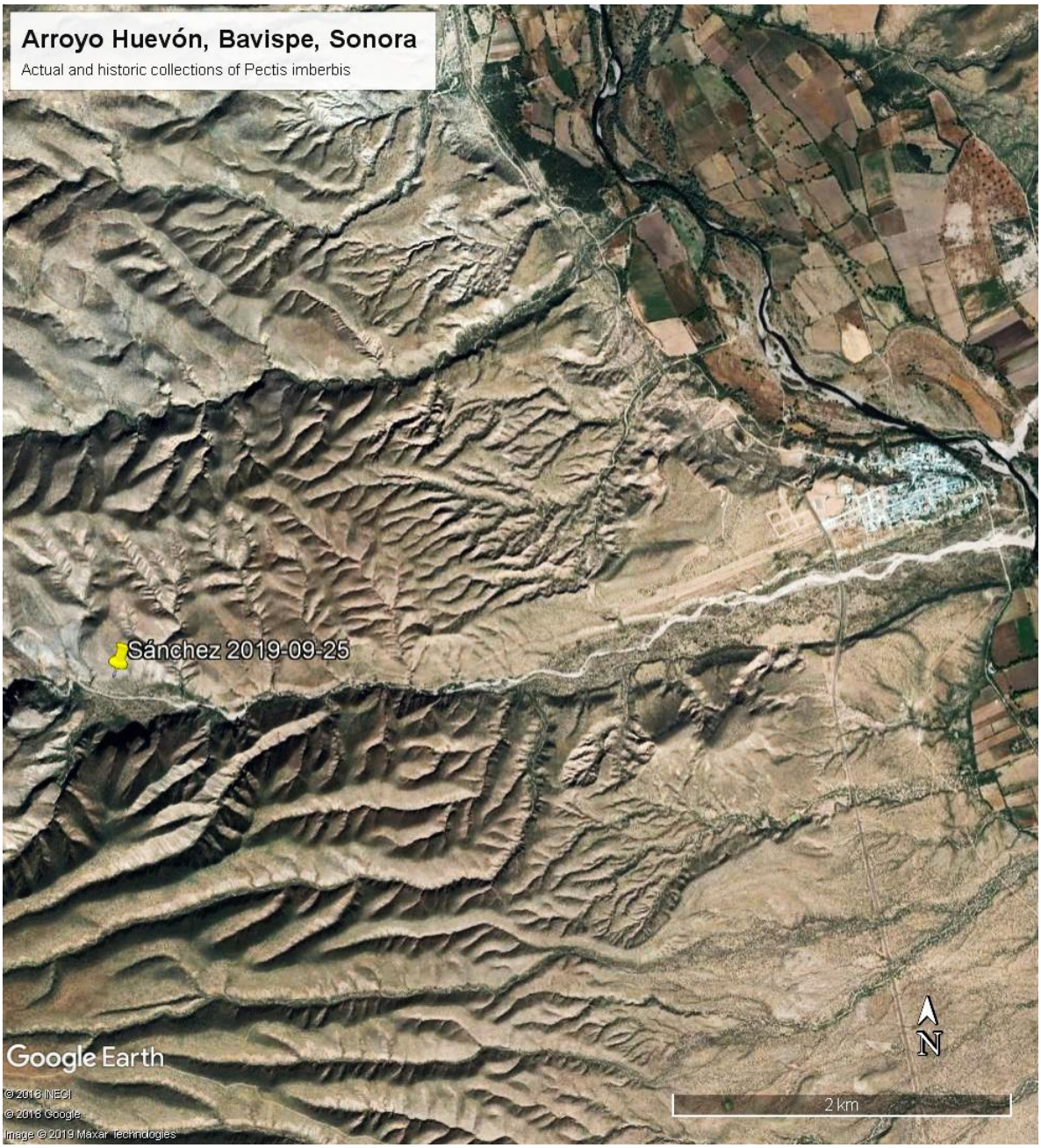
Ciénega Agua Caliente, Rancho Agua Caliente, municipality of Nacozari de García, Sonora. 17.5 Km (by air) E Esqueda. 30.64694, -109.42566; 940 meters. We relocated here a 2003 big population of *Eryngium sparganophyllum*.

March 21, 2018. With hundreds of plants, Rancho Agua Caliente is the only known population for *Eryngium sparganophyllum* in Sonora.



Rancho Ojo Caliente, municipality of Buenaventura, Chihuahua. 21 km (by road) to the E of Buenaventura, 1.3 km south of the federal highway MEX 10. 29.90278, -107.25774; 1,575 meters. A new and potential location for *Cirsium wrightii* and or *Eryngium sparganophyllum*.

October 4, 2017. In a brief search in the surroundings of the Ojo Caliente pond (above), we did not find *Cirsium wrightii* and or *Eryngium sparganophyllum* here but a wider exploration of this area in the future is recommended. Picture below shows *Almutaster pauciflorus*, a plant species common in almost all locations with alkaline water habitats explored.



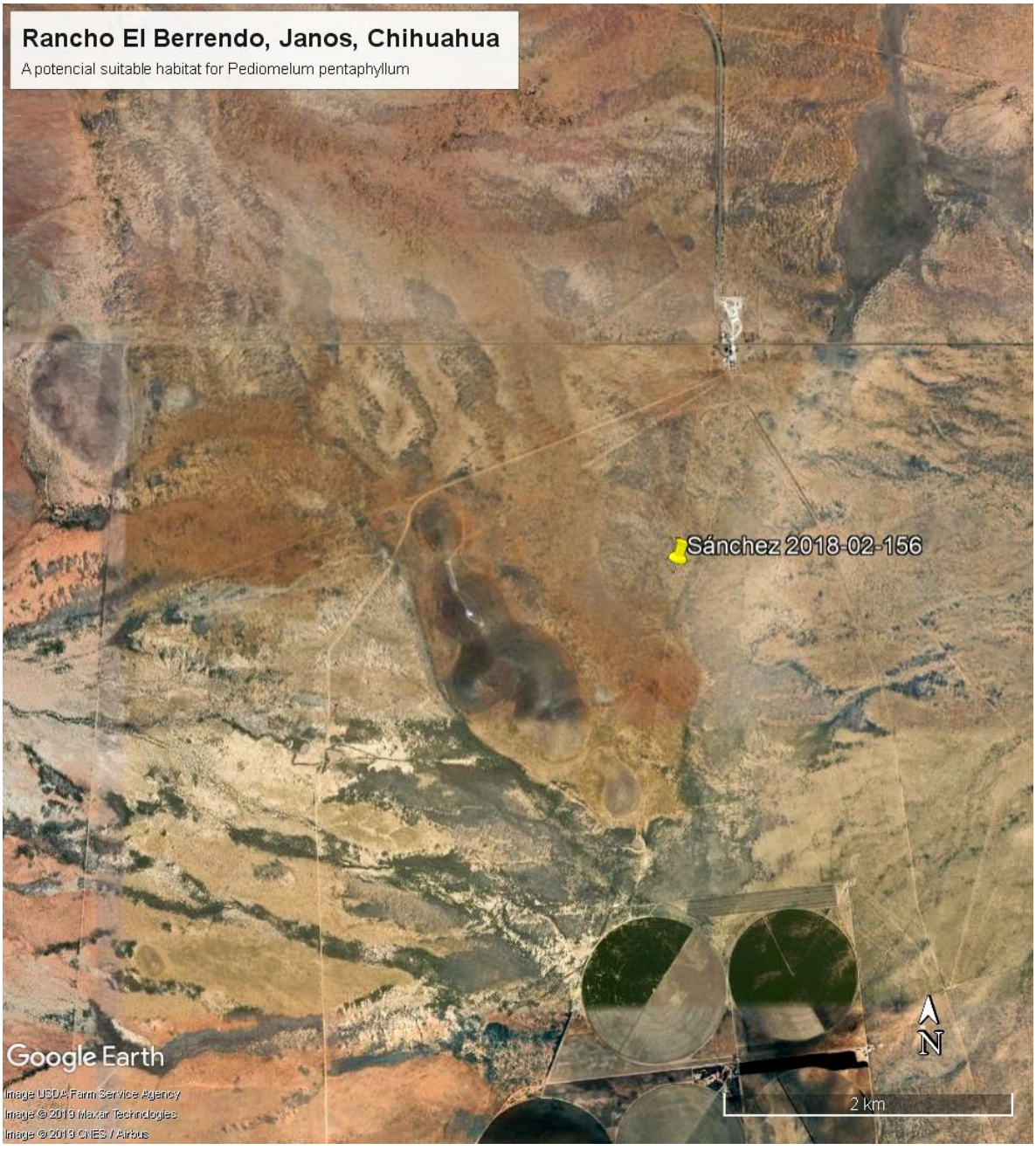
Arroyo Huevón (Arroyo La Petaquilla), municipality of Bavispe, Sonora. 4 Km (by air) W of Bavispe. 30.468889°, -108.990555°; 1107 meters. In the presidencia municipal of Bavispe, we were informed that, in fact, this historic location of *Pectis imberbis* is located at the E of Bavispe in the Sierra Madre Occidental.

September 25, 2018. Picture above shows Arroyo Huevón, there would most likely be a mistake with the coordinates of La Petaquilla as historic location for *Pectis imberbis*, since is located several kilometers east of Bavispe, in the Sierra Madre Occidental. We did not find *P. imberbis* here but found a small population of *Graptopetalum rusbyi* (image below).

April 10, 2018. Los Bajíos (Ejido Los Conejos), municipality of Quiriego, Sonora. 40 km (by air) E Quiriego. 27.675°, -108.99°; 390 meters. The small hill behind houses (center of image below) is the southernmost historic location for *Pectis imberbis* in Sonora. This area shows a great habitat disturbance because severe overgrazing.

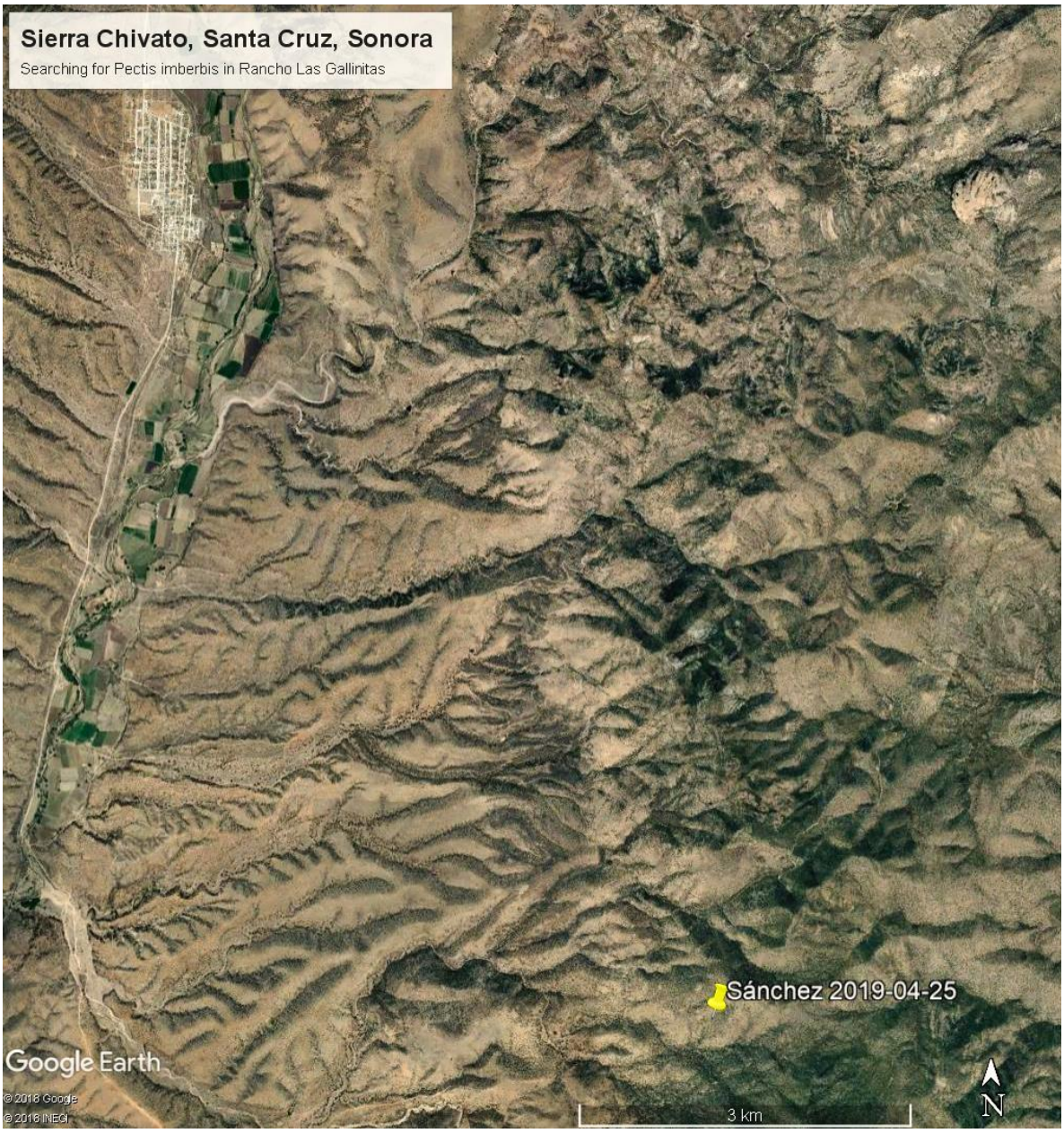
Baños de San Diego (above), San Diego de Alcalá, municipality of Aldama, Chihuahua. 65 km (by road) ESE from the city of Chihuahua. 28.58814, -105.54761; 1,140 meters. This is a historic location for an existing but threatened population of *Leucosyris blepharophylla.*

October 5, 2017. Picture above shows the Baños de San Diego pond where the hot water is pumped to the private bathrooms. Image below shows a spot with more than 100 adult plants of *Leucosyris blepharophylla*, we count in the surroundings of the spa about 35 spots of plants.



Rancho El Berrendo, municipality of Janos, Chihuahua. 1.6 Km (by air) S Antelope Wells border crossing; 57.8 Km (by air) NW Janos. 31.319080°, -108.534540°; 1409 meters. This locality seems to be a suitable habitat for *Pediomelum pentaphyllum*, especially near the base of the nearby hills.

October 9, 2018. Rancho El Berrendo shows a suitable habitat for *Pediomelum pentaphyllum*, especially at the base of the nearby grassland hills; however, we could not explore them because they denied us permission to do so. Picture below shows *Acleisanthes chenopodioides*, one of the interesting plant species found in the semi-desert grassland of this ranch.



Sierra Chivato, municipality of Santa Cruz, Sonora (April 25, 2019). Rancho Las Gallinitas, 8.6 Km SE Santa Cruz. 31.16422, -110.5424; 1570-1668 meters.

April 25, 2019. We were able to observe the strong disturbance in the grassland of Sierra Chivato because of overgrazing (above); however, we looked for *Pectis imberbis* in a less disturbed area as Rancho Las Gallinitas but found nothing (below). We suggest conduct a search in this region during the summer in the future.

Appendix 1

Gazetteer

1. **Ciénega de Tonibabi**, municipality of Moctezuma, Sonora. Rancho Tonibabi, 11.9 Km (by air) ENE Moctezuma. 29.838888°, - 109.5637777°; 785 meters.
2. **On road to Sierra Alta**, municipality de Moctezuma Sonora. Sonora 14 road, 22.8 km E from Moctezuma towards Huásabas. 29.86095°' N, -109.46941°' W; 995 meters.
3. **Rancho La Estancia**, municipality of Bacerac, Sonora. 7.5 Km (by air) N Huachinera. 30.4672830°, 108.9850920°; 1065 meters.
4. **Norte de Horconcitos**, municipality of Bacerac, Sonora. Ciénega de Horcones, Rancho El Bajío del Oso, 10.4 km (by road) N Huachinera. 30.29528 -108.95833; 1,054 meters.
5. **Rancho Bajío del Oso**, municipality of Huachinera, 6 Km (by air) NNE of Huachinera. 30.259890°, -108.932780°; 1100 meters
6. **Paseo campestre at Río Bavispe**, municipality of Bacerac, Sonora, 2.5 km (by road) SSW Bacerac. 30.34266, -108.94801; 1,037 meters.
7. **Cañón de La Petaquilla**, municipality of Bavispe, Sonora. This locality was confused with Arroyo Huevón. The true Arroyo La Petaquilla is located several kilometers east of Bavispe, in Sierra Madre Occidental.
8. **Arroyo Huevón**, municipality of Bavispe, Sonora. 4 Km (by air) W Bavispe. 30.279120°, -108.950390°; 1070 meters.
9. **Rancho San Bernardino**, municipality of Agua Prieta, Sonora. Federal highway MEX 2, 24 km east of Agua Prieta. 31.33312, -109.26393; 1,130 meters.
10. **Rancho San Bernardino**, municipality of Agua Prieta, Sonora. Near entrance door, 23 Km (by air) E Agua Prieta. 31.315453°, -109.272579°; 1135 meters.
11. **Rancho Los Ojos**, municipio of Agua Prieta, Sonora. 48.7 Km (by air) E Agua Prieta. 31.283954°, -108.999119°; 1350 meters.
12. **East of Agua Prieta**, municipality of Agua Prieta, Sonora. 36.5 km (by air) E from Agua Prieta. 30.64694, -109.42566; 940 meters.
13. **Rancho El Valle,** municipality of Agua Prieta, Sonora. 59 Km (by air) E Agua Prieta. 31.309722, -108.896388; 1609 meters.
14. **Antelope grassland**, municipality of Janos, Chihuahua. Federal highway MEX 2, 6 km NW of the intersection with the road to the Antelope Wells border crossing. 31.295 -108.648333; 350 meters.
15. **Rancho El Berrendo**, municipality of Janos, Chihuahua. 1.6 Km (by air) S Antelope Wells border crossing; 57.8 Km (by air) NW from Janos. 31.319080°, -108.534540°; 1409 meters.
16. **Sierra Chivato**, municipality of Santa Cruz, Sonora (April 25, 2019). Rancho Las Gallinitas, 8.6 Km SE Santa Cruz. 31.16422, -110.5424; 1570-1668 meters.

17. **El Ojito hot spring**, municipality of Nuevo Casas Grandes, Chihuahua. 4.3 Km (by air) SW Colonia Francisco I. Madero and 17 Km (by air) SSW Nuevo Casas Grandes. 30.24978, -107.97793; 1506 meters.
18. **El Ojo Vareleño**, municipality of Casas Grandes, Chihuahua. 4.5 km (by air) NW of Casas Grandes. 30.400611 °, -107.985353 °; 1490 meters. We found here *Cirsium wrightii* and relocated *Eryngium sparganophyllum*.
19. **Cueva de la Olla/Cueva de las Golondrinas**, municipality of Nuevo Casas Grandes, Chihuahua. 43 Km (by air) SW Casas Grandes. 30.15302, -108.32571; 1,850 meters.
20. **Río Piedras Verdes, Colonia Pacheco**, municipality of Casas Grandes, Chihuahua. 49.3 km SW of Casas Grandes. It is a historic location for *Graptopetalum bartramii*. 30.08063, -108.34063; 1915 meters.
21. **Río Piedras Verdes crossing**, Sierra Madre Occidental, municipio of Casas Grandes, Chihuahua. Puente Steven, 3 Km (by road) N from Colonia Pacheco, 46 Km (by air) SW from Casas Grandes. 30.108137°, -108.337947°; 1885 meters. We found *Graptopetalum bartramii* in this site.
22. **Ojos de Arrey**, municipality of Galeana, Chihuahua. La Angostura, 7 km south of Galeana on Federal Highway MEX 10. 30.06009, -107.59093; 1,445 meters. This is a historic site for *Cirsium wrightii* and *Eryngium sparganophyllum*.
23. **Rancho Ojo Caliente**, municipality of Buenaventura, Chihuahua. 21 km (by road) to the E of Buenaventura, 1.3 km south of the federal highway MEX 10. 29.90278, -107.25774; 1,575 meters.
24. **Baños de San Diego**, municipality of Aldama, Chihuahua. San Diego de Alcalá, 65 km (by road) E from the city of Chihuahua. 28.58814, -105.54761; 1,140 meters. This is a historic locality for an existing population of *Leucosyris blepharophylla.*
25. **Ciénega Agua Caliente**, municipality of Nacozari de García, Sonora. 17.5 Km (by air) E Esqueda. 30.64694, -109.42566; 940 meters. This is the only known site for *Eryngium sparganophyllum* in Sonora and is located at Rancho Agua Caliente.
26. **Los Bajíos (Ejido Los Conejos)**, municipality of Quiriego, Sonora. 40 km (by air) E Quiriego. 27.675°, -108.99°; 390 meters. This is one of the two southernmost historic locations for *Pectis imberbis* in Sonora.
27. **La Estrella**, municipality of Rosario, Sonora. 12 km (by air) E Rosario Tesopaco. It is another of the two southernmost historical localities of *Pectis imberbis*.
28. **Near Cajón Cruz del Diablo**, municipality of Huásabas, Sonora. 6.2 Km (by air) NE Huásabas 29.938784°, -109.246966°; 1000 meters. Just a stop on road to Mesa Tres Ríos.
29. **Near El Coyote**, municipality of Bacadehuachi, Sonora. On road to Huachinera, 1.6 Km W of the crossing with road to Bacadehuachi. 29.973678°' N, -109.141734°; 1070 meters. Another stop on road to Mesa Tres Ríos.

30. **Arroyo El Riíto**, municipality of Nácori Chico, Sonora. Between Nácori Chico and Mesa Tres Ríos, 11 Km (by air) NE Nácori Chico. 29.753480°, -108.893430°; 997 meters. The third stop on road to Mesa Tres Ríos.
31. **Arroyo La Cueva**, municipality of Nácori Chico, Sonora. Roadside between Nácori Chico and Mesa Tres Ríos, 2.5 Km (by air) SW Mesa Tres Ríos. 29.816920°, -108.72701°, 1597 meters. Last stop before the La Cueva campsite.
32. **La Cueva campsite,** near Mesa Tres Ríos, Municipio of Nácori Chico, Sonora. Sierra Madre Occidental, 3.5 km (by air) SSW of Mesa Tres Ríos. 29.80942°, -108.72079°; 1679 meters.
33. **On road to Pico La India**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 3 km (by air) S Mesa Tres Ríos. 29.813179°' N, -108.718063°' W, 1635 meters. Pine-oak forest with *Pinus spp*., *Quercus spp*., *Tigridia pavonia*, *Sedum stelliforme*, *Houstonia wrightii*, *Cosmos pringlei*, *Tradescantia pinetorum*, *Glandularia chiricahensis*, *Euphorbia macropus*, and *Commelina erecta*.
34. **On road to Pico La India**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 2.6 km (by air) S of Mesa Tres Ríos. 29.81643°' N, -108.71359°' W, 1680 meters.
35. **On road to Pico La India**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 2.8 km (by air) SSE Mesa Tres Ríos. 29.81603°, -108.70449°, 1771 meters.
36. **On road to Arroyo Largo**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 3.2 km (by air) SSE Mesa Tres Ríos. 29.812111°, -108.703194°; 2384 meters.
37. **On road to Pico La India**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 6.5 km (by air) SSE Mesa Tres Ríos. 29.782°' N, -108.70062°' W, 2208 meters.
38. **On road to Arroyo Largo**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 7 km (by air) SSE Mesa Tres Ríos. 29.773914°, -108.691855°, 2346 meters. Pine-oak forest with *Pinus spp*., *Quercus spp*., *Agastache pallida*, *Sambucus*, and *Phytolacca icosandra*.
39. **On road to Arroyo Largo**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 7.2 km (by air) SSE Mesa Tres Ríos. 29.7725°, -108.688973°; 2384 meters.
40. **Arroyo La Cueva on road to Mesa Tres Ríos**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 2.35 km (by air) SW Mesa Tres Ríos. 29.82062°, -108.72256°; 1695 meters.
41. **Near Mesa Tres Ríos**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 1.4 km (by air) S Mesa Tres Ríos. 29.82739°, -108.71336°; 1844 meters.
42. **Near Mesa Tres Ríos**, Municipio of Nácori Chico, Sonora. Sierra Madre Occidental, 1.3 km (by air) S of Mesa Tres Ríos. 29.828540°, -108.710580°; 1899 meters.

43. **Near Mesa Tres Ríos**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 1.7 km (by air) SW Mesa Tres Ríos. 29.827120°, -108.721730°; 1769 meters.
44. **On road to Rancho San Antonio**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 1.6 km (by air) N Mesa Tres Ríos. 29.85485°, -108.71235°; 1778 meters.
45. **On road to Rancho San Antonio**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, on road to Rancho San Antonio, 1.8 km (by air) N Mesa Tres Ríos. 29.856580°, -108.711810°; 1771 meters. Locality of a small population of *Graptopetalum bartramii*.
46. **On road to Rancho San Antonio**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 2.45 km (by air) N Mesa Tres Ríos. 29.862360°, -108.711180°; 1723 meters.
47. **On road to Rancho San Antonio**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, on road to Rancho San Antonio, 2.75 km (by air) N Mesa Tres Ríos. 29.864980°, -108.709850°; 1706 meters.
48. **On road to Rancho San Antonio**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, on road to Rancho San Antonio, 4 km (by air) NNW Mesa Tres Ríos. 29.875720°, -108.719920°; 1605 meters.
49. **On road to Rancho San Antonio**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, on road to Rancho San Antonio, 4.2 km (by air) NNW Mesa Tres Ríos. 29.876080°, -108.727630°; 1598 meters.
50. **On road to Rancho San Antonio**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, on road to Rancho San Antonio, 4.5 km (by air) NNW Mesa Tres Ríos. 29.877570°, -108.730710°; 1737 meters.
51. **On road to Nácori Chico**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 5.5 km (by air) SW Mesa Tres Ríos. 29.805620°, -108.754540°; 1924 meters.
52. **Arroyo El Macho, on road to Nácori Chico**, municipality of Nácori Chico, Sonora. Sierra Madre Occidental, 8.95 km (by air) SW Mesa Tres Ríos. 29.789010°, -108.784350°; 1990 meters. This is the locality for a population of *Graptopetalum bartramii* discovered by Susan Carnahan 26 June 2018.
53. **On road to Nácori Chico**, municipality of Nácori Chico, Sonora, México. Sierra Madre Occidental, 20 Km (by air) NE Nácori Chico. 29.790150°, -108.807750°; 2202 meters.
54. **On road to Nácori Chico**, municipality of Nácori Chico, Sonora, México. Sierra Madre Occidental, 15.6 Km (by air) NE Nácori Chico. 29.777870°, -108.855710°; 1417 meters.
55. **On road to Nácori Chico**, municipality of Nácori Chico, Sonora, México. Sierra Madre Occidental, 15.3 Km (by air) NE Nácori Chico. 29.775410°, -108.858490°; 1391 meters.