**EVALUATION OF SEVEN FOREST SENSITIVE PLANT SPECIES**

**Prepared for:** Rosemont Copper

**Prepared by:** WestLand Resources, Inc.

**Date:** November 12, 2010

**Project No.:** 1049.21

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## TABLE OF CONTENTS

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WestLand Resources, Inc.
Engineering and Environmental Consultants

November 12, 2010

Mr. Tom Furgason
SWCA ENVIRONMENTAL CONSULTANTS
343 West Franklin Street
Tucson, Arizona 85701

**RE: ROSEMONT COPPER EVALUATION OF SEVEN FOREST SENSITIVE PLANT SPECIES**
**WESTLAND PROJECT NO. 1049.21**

Dear Mr. Furgason:

Enclosed please find three copies of the Seven Forest Sensitive Plant Species memorandum for Rosemont Copper prepared by WestLand Resources, Inc.

Should you have any questions or require additional information, please do not hesitate to call.

Respectfully,
WestLand Resources, Inc.

Erica M. Rehl

for James A. Tress, Jr.
Principal

JAT:emr
Enclosure: Seven Forest Sensitive Plant Species Memorandum (3 copies)



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## LIST OF FIGURES

*(follow text)*



## LIST OF APPENDICES

## EXECUTIVE SUMMARY

At the request of Rosemont Copper Company (Rosemont), WestLand Resources, Inc. (WestLand) began a review of the known range of eight Forest Sensitive Species that were included in a Preliminary Determination Table (Table) sent by the Forest Service (Forest) to Rosemont Copper Company. Three of the species have been studied in detail in other documents. The finding for Pima pineapple cactus is consistent with what is currently known of its range and abundance and, therefore, this species is not considered here. Two species, *Hexalectris arizonica* and *H. colemanii* have been extensively studied previously and a separate report on these species has been submitted to Rosemont and the Forest Service (WestLand 2010). This previous study is summarized in this report. Detailed site specific information regarding the other five species was not included in the Table and was not available for our analysis. We undertook a study of the known distribution of those species and a survey of the primary proposed area of mine operations at Rosemont (Survey Area) to locate individuals of these species, if present, to support determinations to be made by the Forest Service during their review of the Rosemont Project in accordance with the requirements of the National Environmental Protection Act.

No individuals of *H. arizonica* have been found on the Rosemont property and, based on the survey, the project is not expected to impact any individuals of this species and thus will not be likely to result in a trend toward federal listing or loss of viability. A total of 124 individuals of *H. colemanii* were found in the Survey Area. Four individuals were found in the Pit area of Wasp Canyon. One hundred twenty (120) additional plants have been found in lower portions of Wasp Canyon and in McCleary Canyon within the Survey Area. Preparation of a Conservation Plan for *Hexalectris colemanii* is underway. The goal of the conservation plan commissioned by Rosemont is no loss of viability for this species. We presume that reconfiguration of the crusher/conveyor system and electrical substation will avoid/minimize impact to *Hexalectris colemanii* and that the conservation plan being prepared will adequately address, to the Forest's satisfaction, the potential indirect effects from mining activities will not be likely to result in a trend toward federal listing or loss of viability.

We determined the known ranges of: Arizona manihot – *Manihot davisiae;* Bartram's stonecrop – *Graptopetelum bartramii;* Beardless chinchweed – *Pectis imberbis*; Santa Rita yellowshow – *Amoureuxia gonzalezii*; and Southwestern (Box Canyon) muhly – *Muhlenbergia dubiodes* using published records and online databases of herbarium records. For each of the species, the available herbarium records indicates that their ranges are broad in southern Arizona, and the known ranges of Arizona manihot, Bartram's stonecrop, and Beardless chinchweed extend into Sonora, Mexico. In late September 2010, we initiated field surveys of portions of the Survey Area that contained habitats described in the published literature as suitable for these species. A team of 16 WestLand field biologists surveyed areas for a total of 32 calendar days, expending a total of 212 person days searching suitable habitats. Surveys ended on November 9, 2010.

No plants of four species were found during this extensive survey effort. We found 5-7 individuals of Beardless chinchweed (*Pectis imberbis*) in McCleary Canyon along the proposed alignment of the secondary access road. Considering the location of the plants relative to the existing road in this canyon and the requirements of the secondary access road, direct impacts to these individuals can likely be avoided with a revised road location.

It is impossible to exclude the possibility that some plants might be present but were not found despite the extensive survey, but if present they are most likely to be very rare. In the table below, we summarize the results and possible findings of this study

| **Species** | **Survey Results** |
|---|---|
| Arizona coral-root – *Hexalectris arizonica* | No plants found |
| Arizona manihot - *Manihot davisiae* | No plants found |
| Bartram stonecrop - *Graptopetelum bartramii* | No plants found |
| Beardless chinchweed - *Pectis imberbis* | 5-7 plants found |
| Coleman's coral-root – *Hexalectris colemanii* | 124 plants found |
| Santa Rita yellowshow - *Amoureuxia gonzalezii* | No plants found |
| Southwestern muhly - *Muhlenbergia dubiodes* | No plants found |

## 1. INTRODUCTION AND BACKGROUND

An undated copy of preliminary determinations of effect was provided to representatives of Rosemont Copper Company (Rosemont). The partial and undated Preliminary Determination Table (Table) considered eight species; seven forest sensitive species and one species listed as endangered. The endangered species, Pima pineapple cactus is only found along western portions of the project area over which utility lines proposed to serve the Rosemont mine will traverse. The Table provided concludes that the project may adversely affect Pima pineapple cactus. This determination is consistent with the best available information describing the location and distribution of this plant relative to proposed transmission line and water line corridors and it is expected that this species will be considered in formal consultation between the Forest Service (Forest) and cooperating federal agencies and the US Fish and Wildlife Service (USFWS). It will not be considered further in this memorandum.

In this memorandum, we focus our attention on the status of seven forest sensitive species that the Preliminary Determination Table provided concludes that the project "may result in a downward trend toward federally (sic) listing as threatened or endangered, or loss of viability."

The seven species considered in this analysis are:

Arizona coral-root – *Hexalectris arizonica*
Arizona manihot – *Manihot davisiae*
Bartram's stonecrop – *Graptopetelum bartramii*
Beardless chinchweed – *Pectis imberbis*
Coleman's coral-root – *Hexalectris colemanii*
Santa Rita yellowshow - *Amoreuxia gonzalezii*
Southwestern (Box Canyon) muhly – *Muhlenbergia dubiodes*

In this memorandum, we analyze the distribution each of the seven species considered and present results of extensive field surveys of five of the species. The distribution and abundance of the two *Hexalectris* species have studied in detail and the results of that work can be found in WestLand (2010). Additional supporting materials, including available specimen records, maps of known localities, and more detailed descriptions of the species, are also provided as appendices to this memorandum.

## 2. SPECIES DISTRIBUTION AND HABITAT ANALYSIS

For each of the seven species, we first briefly describe the species and its natural history. We then summarize available information regarding the distribution of the species and then conclude with our assessment of the determination/finding that is supported by the available information.

## 2.1. ARIZONA CORAL ROOT

*Arizona coral-root*

Arizona coral-root – *Hexalectris arizonica* (Figure 1 and Appendix A1) was recently raised from subspecies to species status based on a molecular study (Kennedy and Watson 2010). Arizona coral-root is found in oak woodlands, on the wooded sides of canyons, and on canyon bottoms, on limestone, to calcareous sandy or organic soils. This species is known to occur in Santa Rita Mountains and is typically found at elevations of 3,480 to 6,950 ft amsl (AGFD 2008). During a careful survey of the Rosemont property in 2010 (WestLand 2010), no Arizona coral-root were found within the project area. As many as 40 plants were discovered at multiple locations outside of the Rosemont property in the Santa Rita Mountains and in other mountain ranges (WestLand 2010).

## 2.2. ARIZONA MANIHOT

*Arizona manihot*

Arizona manihot - *Manihot davisiae* **(**Figure 2 and Appendix A2) is known from three mountain ranges in Arizona, from a site in New Mexico, and from several sites in Mexico. Plants are found on rocky limestone slopes and volcanic basalts in the Baboquivari Mountains, canyons in the Santa Rita Mountains and the Santa Catalina Mountains at elevations of from 3,500 to 4,000 ft amsl (Falk et al. 2001)). It is found in a variety of habitats ranging from open grasslands to desert thorn-scrub and is associated with palo verde, ocotillo, various cacti, and numerous other species.

We have reviewed the records of this species and found 12 herbarium records in SEINet in the U.S. and 17 records in Mexico. The records we are aware of in Mexico extend approximately 355 miles south of the Rosemont project area; approximately 21 mi SSE of Navojoa. The closest known record of this species to the Rosemont holdings is 5 miles away.

## 2.3. BARTRAM'S STONECROP

*Bartram's stonecrop*

Bartram's stonecrop - *Graptopetelum bartramii* (Figure 3 and Appendix A3) is widely distributed among the mountain ranges of southern Arizona where it grows in moist areas on rocky outcrops (Falk et al. 2001) in association with other moisture-requiring species (WestLand pers. obs.). We have reviewed the records of this species in SEINet and found 24 records. The closest known record of this species to the Rosemont holdings that we are currently aware of is 4.5 miles south of the Rosemont holdings in Box Canyon where WestLand biologists found 20 plants.

## 2.4. BEARDLESS CHINCHWEED

*Beardless chinchweed*

The available records for Beardless chinchweed - *Pectis imberbis* (Figure 4 and Appendix A4) from SEINet data and specimens at the University of Arizona Herbarium showed this species is present in Santa Cruz and Cochise Counties with a number of specimens from Mexico. Plants may occur in a wide variety of habitats, including: road cuts, stream banks, canyons, rocky hillsides, grasslands, and oak grasslands.

We have reviewed the records of this species and found 30 U.S. records in SEINet and 7 records from Mexico. In Mexico, the most southern record we found for this species is near the town of Alamos, Sonora, Mexico approximately 340 miles south of the Rosemont Holdings.

## 2.5. COLEMAN'S CORAL-ROOT

*Coleman's coral-root*

Coleman's coral-root - *Hexalectris colemanii* (Figure 1 and Appendix A5) was recently elevated to species status based on molecular work (Kennedy and Watson 2010) and the Coleman's coral-root has been petitioned for listing by the Center for Biological Diversity. This species is known to occur on Rosemont property. Coleman has surveyed populations in McCleary and Sawmill Canyons since 1996. In 2010, WestLand Resources, Inc. (WestLand) undertook the most widespread and thorough survey for this species in southern Arizona that has been completed to date (WestLand 2010). This survey effort included a detailed survey of the Rosemont property. This survey detected 134 flowering stalks on the Rosemont property and approximately 140 flowering stalks were found at a site in the Dragoon Mountains on public lands managed by the Coronado National Forest.

Four flowering stalks were detected during 2010 survey within the area of mine operations at Rosemont (Survey Area) of the proposed pit in a tributary of Wasp Canyon and will be impacted by the proposed plan operations and the configuration alternatives being considered by the Forest. Additional plants occur in McCleary Canyon and will be impacted by the crusher/conveyor system and the electrical substation. We understand from Rosemont that direct impacts of these plants can be largely avoided by redesign of these facilities. We have also been commissioned by Rosemont to develop a conservation plan that addresses the direct and indirect impacts of the proposed action to Coleman's coral-root. Ultimately, the determination of effect and finding for this species depends on the efficacy of the redesign of the mine facilities that impact the McCleary Canyon population and avoidance of potential indirect impacts to this species.

## 2.6. SANTA RITA YELLOWSHOW

*Santa Rita yellowshow*

The range of Santa Rita yellowshow - *Amoreuxia gonzalezii* (Figure 5 and Appendix A6) species distribution in Arizona is not well described or known and the herbaria records for this species are sparse. Plants are found in on rocky limestone hillsides in grasslands and oak grasslands. It is also known from desert thorn-scrub habitat. We have found 12 records for Santa Rita yellowshow in SEINet, 8 of which are from Mexico. The Arizona records occur south and west of the Rosemont project area. The closest known record of this species to the Rosemont holdings is approximately 13.5 miles southwest of the Rosemont Holdings. The other records occur far west of Rosemont on the eastern

slopes of the Baboquivari Mountains (approximately 4,500 ft amsl). Of the eight records in Mexico, the southernmost record is approximately 360 miles south of the Rosemont Holdings, approximately 32 miles SE of Navojoa. Portions of the Rosemont Holdings may contain suitable habitat for this species, though we are aware of no records from this portion of the Santa Rita Mountains.

### 2.7. SOUTHWESTERN (BOX CANYON) MUHLY

*Southwestern (Box Canyon) muhly*

Southwestern muhly - *Muhlenbergia dubiodes* (Figure 6 and Appendix A7) is found on rocky slopes in grassland and oak woodlands (Falk et al. 2001). We have reviewed the records of this species and found 32 records in SEINet. The records in Arizona are widely distributed across three southern counties. A single record from Yavapai County suggests that it may be even more widespread than previously thought.

The closest known record of this species to the Rosemont holdings is 0.7 miles.

## 3. FIELD SURVEY OF FIVE FOREST SENSITIVE SPECIES

In this section, we present results of our field survey of the five Forest Sensitive Species that have not been studied previously. Sections 3.1 – 3.5 describe our methods and approach to the survey and sections 3.6 and 3.7 present the results of the work.

### 3.1. HABITAT PREFERENCES OF SENSITIVE PLANT SPECIES

Each of the five Forest Sensitive Species is associated with specific vegetation communities and geographic features. Arizona manihot is typically found in open grassy areas with herbaceous plants intermixed and is often associated with limestone slopes. Bartram's stonecrop is typically found on north facing slopes in canyons and washes in shallow soils with thick duff and is often associated with Madrean evergreen woodland communities. Moreover, it requires a moist habitat and is often associated with moss and ferns found in seeps in cliffs. Beardless chinchweed is typically found in grasslands and oak grasslands in disturbed areas along granite slopes. Vegetation often associated with this species includes ocotillo, manzanita, and some oak. Santa Rita yellowshow is typically found in rocky limestone hillsides with low granitic soils and is often associated with agave species, a variety of shrubs, and ocotillo. Southwestern muhly is typically associated with open grassland and oak woodlands and is often found in shallow soils along stream courses. Table 1 provides more detail on the habitat and biological features of each species. Detailed descriptions for each species are provided in Appendix A.

**Table 1. Southern Arizona sensitive species characteristics found in the literature**

| Species | Elevation range (ft) | Geographic features | Associated plants | Aspect/Soil | Phenology |
|---|---|---|---|---|---|
| **Arizona manihot** (*Manihot davisiae*) | 3,500-4,000 ft | Limestone slopes | Grassy, herbaceous open areas | Limestone slopes | Flowers July-Aug |
| **Bartram's stonecrop** (*Graptopetalum bartramii*) | 3,900-6,700 ft | Rocky outcrops, Arroyos, and canyons | Oaks, pinyon, juniper, moss, lichen | North facing slopes with evident moisture | Flowers Sept-Feb |
| **Beardless chinchweed** (*Pectis imberbis*) | 3,000-5,500 ft | Eroded granite South facing slopes | Grassland, oak/grassland, cane beard grass, manzanita, ocotillo | Rocky hillsides, disturbed area, road cuts | Flowers Aug-Oct |
| **Santa Rita yellowshow** (*Amoreuxia gonzalezii*) | 4,200-4,600 ft | Rocky, limestone hillsides South and southwest facing slopes | Agave sp, various shrubs, and ocotillo, and opuntia sp. | Limestone outcrops and fine granitic low soil | Flowers Aug-Sept Fruits Sept-Oct |
| **Southwestern muhly** (*Muhlenbergia dubioides*) | 2,750-6,000 ft | Rocky slopes, canyons, stream courses, often on cliffs | Grassland and oak woodland | Shallow soil pockets, gravelly soil, crevices | Flowers Aug-Nov |

Not all the Survey Area provided suitable habitat for the five species. Some areas were excluded from survey based on a variety of habitat characteristics that were determined to be unsuitable to the five species. The majority of the sensitive species are found in grassland habitat or on rocky slopes, therefore, survey efforts were focused on these habitat types to increase the probability of detection. Those areas deemed too steep with loose rocks were deemed unlikely habitat due to instability and low vegetation cover for the sensitive species and were therefore not surveyed. In general, these steep areas were concentrated around the western portions of the footprint. Areas with dense thickets of desert thornscrub, primarily wait-a-minute bush, (*Mimosa biuncifera*), whitethorn acacia (*Acacia constricta*), and/or catclaw acacia (*A. greggii*), were not surveyed because these species are not cited in the literature as associates of any of the species. In general, these areas are scattered in small pockets throughout the Survey Area. Portions with dense stands of pinyon and juniper were not surveyed due to low probability of detection because most of the sensitive species are associated with specific geological features and/or open grassland areas.

### 3.2. FIELD TRAINING

WestLand resources used a team of 16 field biologists and two project leaders for this project (Table 2). WestLand field crews observed Bartram's stonecrop in the field in Box Canyon south of the Rosemont Holdings in the Santa Rita range on September 27, 2010 to familiarize themselves with the plant and its habitat. Twenty plants were located and photographed. The habitat seemed to be quite specific for this

species making it highly likely that the WestLand biologists would be able to locate similar habitats on the Survey Area, should they exist. Field crew members unsuccessfully attempted to find Beardless chinchweed on Ruby Road, south of Pena Blanca Lake, on September 29, 2010 to examine its growth form and habitat. This was a site where the species had been collected previously based on SEINet records but no plants were found. In addition, WestLand biologists observed herbarium specimens of each species at the University of Arizona Herbarium collection prior to beginning surveys to confirm reported identifying characteristics of each species.

**Table 2. Names, credentials, and experience of the project team involved in the survey of five Forest Sensitive Species in 2010.**

| |
|---|
| **Project Leaders:** |
| Robert S. Fritz, B.A., M.S., Ph.D. - >30 years of research and field experience |
| Gabrielle F. Diamond, B.S., M.S. - 12 years field experience |
| **Field Crew:** |
| Corey Archer, A.S. – 6 years field experience |
| Scott Carroll, B.A. – 20 years of experience in field botany surveys |
| Lindsay Carney, B.A. – 18 years of field experience |
| Mike Cross, B.S. – 20 years of field experience |
| Janet Fox, B.S. – 15 years field experience |
| Jonathan Haller, B.A. – 7 years field experience |
| Elizabeth Lewis, B.S. – 20 years field experience in botany |
| James Litel - 4 years field experience |
| Anna Martin, B.A. – 4 years field experience |
| Ben Rackham, B.S. – 1 year field experience |
| Kirk Smith, BLA – 11 years field experience |
| Peter Sundt, B.S., M.S. – 20 years field experience |
| David Ward – 30 years field experience |
| Rick Ward – 30 years field experience |
| Karl Yares, B.A. – 3 years field experience |
| John Zittere, B.S. – 16 years field experience |

In the field, crews carried laminated sheets containing photographs of the plants, descriptions of habitats in which they occur for each of the five sensitive species. To maintain an accurate search image, field crews periodically returned to the known stonecrop and chinchweed (see below) sites to note plant appearance and overall growth stage during survey season. WestLand routinely took photographs and occasional plant samples for verification in the lab when necessary.

### 3.3. ADAPTIVE SEARCH PROTOCOL AND DATA COLLECTION

We used an adaptive cluster sampling method typically applied to the detection of rare plants. This adaptive method focuses survey efforts in areas where a rare plant has been located to see if other individuals of the species occur in the immediate vicinity. Random sampling has been shown to be less effective for discovering and estimating population sizes of rare species (Thompson 1990). The primary

purpose of the adaptive cluster sampling approach is to take advantage of clumped spatial patterns typical of rare plants to obtain a more precise measurement of population abundance and increase detection (Thompson 1990). Adaptive sampling methods increase efficiency for a given amount of effort above conventional random sampling designs (Thompson 1990).

We developed a specific protocol for Bartram's stonecrop (Appendix B) that was to be used in stonecrop or any other species were located. If a species was detected, field crews would survey an area within a 200 foot radius of the individual and record additional plants. If more plants are found, this process is repeated until no additional plants are found within the subsequent 200 foot radius.

### 3.4. PREPARATION AND PLANNING (TOPOGRAPHIC AND AERIAL MAPS, GPS, DATA BOOKS)

WestLand prioritized searches based on characteristics of known sites for each sensitive species and focused on high priority habitats to increase the probability of detection. A detailed description of habitat in which each species has been found is provided in Appendix A. Our survey plan was based on project areas (Figure 7), canyon and wash geography, and specific habitat features known or thought to be characteristic of the five species (Table 1). In general, we restricted our search to locations and suitable habitats occurring within the proposed primary project Survey Area boundaries. The project areas were divided as follows: Pit area (Pit); Crusher, Electric substation, Buildings area (Plant); Barrel Canyon tailings (West Barrel, East Barrel, and North Barrel); and McCleary Canyon tailings (McCleary) (Figure 7). Choices of survey locations were restricted by these areas, and we refer to them below in our discussion of our survey results, but we did not use these designations to select likely places to find the five forest sensitive species.

Before beginning surveys, WestLand made detailed evaluations of topographic and aerial maps to make a preliminary determination of potentially suitable habitats where we would begin our searches. For example, for Bartram's stonecrop we identified canyons and washes as being areas were rock outcrops and seeps might occur, which would be potentially suitable habitat for this species. Using the previously prepared maps of jurisdictional delineations (JDs), we obtained a map and list of all JDs and their UTM termini (Appendix D). We systematically surveyed each of these JDs with a team of two or more biologists equipped with maps, GPS units, a camera, field notebooks, and datasheets. Whenever a potential rock outcrop was found, the biologists would examine it in detail for the presence of Bartram's stonecrop before proceeding. Similarly, for the other species, we identified appropriate habitats from topographic maps and aerial photographs. Crews visited these sites and conducted parallel transect searches with 5m spacing between individuals searching for specimens of the plant species of interest.

### 3.5. DATA MANAGEMENT AND ARCHIVING

During the surveys, each person tracked their progress using a hand-held GPS unit (Garmin *E*trex Legend). Tracks were started at the office each morning and continued recording movement until surveys were terminated at the end of each survey day. Waypoints were taken when reaching a search location, when any feature of interest was noted, and before proceeding to the next survey destination. GPS data

were downloaded at the end of each day, when the crews returned to the office, and GPS units were cleared for the next day. Field maps were updated daily with the previous days' survey tracks.

Field crews filled out daily logs noting survey areas, dominant plants observed, and described their survey techniques (linear or parallel transects). Each crew member kept a field notebook and notes were taken daily. Crews used updated topographic maps, complete with previous GPS survey tracks, to ensure good coverage of all predetermined areas.

A designated field crew leader recorded areas surveyed and noted the general vegetation in field notes and daily log data sheets (Appendix C). Field maps, aerial photos, field photographs, field notebooks, and daily logs are stored at WestLand in designated areas each night. Field notes and annotated maps will be digitized and preserved at WestLand for future reference.

### 3.6. SURVEY EFFORT

Formal surveys of the Rosemont Survey Area began September 30 and have continued though November 9, 2010. Field biologists surveyed the Rosemont Area for approximately 7 to 8 hour days over the entire survey period. The field survey crew consisted of 2-12 WestLand field biologists who methodically inspected the delineated riparian corridors, canyons, rock-outcrops, areas of open grassland, areas of oak woodlands, and road cuts. To increase coverage, safety, and provide at least two visual perspectives on the ground, two or more people surveyed each of the areas on the Rosemont Survey Area. Crews slowly walked each area together maintaining a distance of approximately 5 meters apart.

Searches were conducted for each species individually or for two or more species simultaneously. For example, we first began searches for Bartram's stonecrop in the canyons and washes, but early in the process we found a few plants of Beardless chinchweed at the base of a rock-outcrop in McCleary Canyon. After that discovery, we searched for the two species together as we continued our search for Bartram's stonecrop. Because several of the species are described as occurring together in grassland areas or rocky slopes, we searched for these species simultaneously.

**Table 3. Rosemont rare plant field survey effort by three major drainages within Rosemont Survey Area, September 30 to November 09, 2010.**

| Canyon | Survey Dates | Total Field Survey Days |
|---|---|---|
| **Barrel** | 10/04, 10/06, 10/07, 10/08, 10/11, 10/13, 10/14, 10/15, 10/18, 10/19, 10/20, 10/25, 10/26, 10/27, 10/28, 10/29, 11/02, 11/04, 11/05 | 20 |
| **McCleary** | 09/30, 10/01, 10/04, 10/11, 10/12, 10/13, 10/14, 10/21, 10/22, 10/29, 11/01, 11/04 | 13 |
| **Wasp** | 10/05, 10/06, 10/07, 10/08, 10/22, 11/01, 11/05, 11/08 | 7 |

The extent of coverage of the Rosemont Survey Area can be seen in Figure 7. This figure illustrates the coverage of the canyons and JDs as well as the areas searched using the parallel transect method. We spent a total of 40 survey days on the canyon and wash system in the Survey Area (Table 3). The

distribution of days among the canyons depended on the time needed to complete surveys of all the JDs in each Canyon. Our latest records as of November 9, 2010 show that there have been a total of 4,378 plant species-hours (the equivalent of 547 species-days) and 212 person days spent searching for the five species over 32 calendar days (Table 4). These are hours spent at the Survey Area and do not include travel time to and from the office. The search effort based on species-hours in Table 3 is divided among the five plant species. The greatest number of species-hours was spent searching for Beardless chinchweed (about 1,400 hr) and Bartram's stonecrop (about 1,100 hr). The other species also had substantial time spent searching for them, ranging from 530-730 hr of search time for each species. Thus, we believe this amount of effort has been focused and extensive, such that we would have discovered rare clumps or individual plants. We cannot conclude that no individuals of these species are present on the Survey Area, but if they are present, they are extremely rare.

## 3.7. SURVEY RESULTS

**Arizona manihot (*Manihot davisiae*)**

- We found no individuals of Arizona manihot in the Survey Area.
- The leaves of this species are highly distinctive even when senescent.
- We found leaves of a similar looking plant, *Jatropha macrorhiza*, that was senescent but still distinctive at the time.

**Bartram's stonecrop (*Graptopetalum bartramii*)**

- We found no individuals of Bartram's stonecrop in the Survey Area.
- These plants have distinctive rosettes that are visible year round.
- They produce flower stalks at the time of year when these surveys were conduct and are therefore easy to spot.
- Survey effort – 1,095 hours.

**Beardless chinchweed (*Pectis imberbis*)**

- We found five to seven individual plants of Beardless chinchweed (Figures 7 and 8).
- The actual number of individual plants is not known since they are perennial plants that produce ramets from underground rhizomes.
- The clump of ramets is located outside the Survey Area but near an alternative access road over Lopez Pass.
- Adaptive survey methods were applied and no additional plants were found within a 200 foot radius of the group (Figure 8).
- Our latest recheck of these plants on November 5, 2010 revealed that some of the diagnostic leaves bearing distinct glands were still present on the plants.
- Survey effort – 1,408 hours.

**Table 4. Rosemont sensitive plant field effort within proposed Survey Area with respect to number of survey technicians and total survey hours per plant species per day. Totals do not include travel time for each technician (2 hours per day/technician).**

| Survey Date | Arizona manihot (*Manihot davisiae*) | | Bartram's stonecrop (*Graptopetalum bartramii*) | | Beardless chinchweed (*Pectis imberbis*) | | Santa Rita yellowshow (*Amoureuxia gonzalezii*) | | Southwestern muhly (*Muhlenbergia dubioides*) | | Total Field Survey Hours |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Techs | Field Hours | Techs | Field Hours | Techs | Field Hours | Techs | Field Hours | Techs | Field Hours | |
| 09/24* | 0 | -- | 2 | 3.5 | 0 | -- | 0 | -- | 0 | -- | **3.5** |
| 09/27* | 0 | -- | 4 | 31.5 | 0 | -- | 0 | -- | 0 | -- | **31.5** |
| 09/29* | 0 | -- | 0 | -- | 3 | 24.0 | 0 | -- | 0 | -- | **24.0** |
| 09/30 | 0 | -- | 0 | -- | 4 | 31.5 | 0 | -- | 0 | -- | **31.5** |
| 10/01 | 0 | -- | 0 | -- | 4 | 29.5 | 0 | -- | 0 | -- | **29.5** |
| 10/04 | 0 | -- | 4 | 31.0 | 4 | 29.0 | 0 | -- | 0 | -- | **60.0** |
| 10/05 | 0 | -- | 5 | 33.0 | 5 | 33.0 | 0 | -- | 0 | -- | **66.0** |
| 10/06 | 0 | -- | 7 | 54.0 | 7 | 54.0 | 0 | -- | 0 | -- | **108.0** |
| 10/07 | 0 | -- | 6 | 45.25 | 6 | 45.25 | 0 | -- | 0 | -- | **90.5** |
| 10/08 | 0 | -- | 7 | 50.0 | 7 | 50.0 | 0 | -- | 0 | -- | **100.0** |
| 10/11 | 7 | 53.75 | 7 | 53.75 | 7 | 53.75 | 0 | -- | 7 | 53.75 | **215.0** |
| 10/12 | 0 | -- | 8 | 64.5 | 8 | 64.5 | 0 | -- | 8 | 64.5 | **193.5** |
| 10/13 | 0 | -- | 7 | 78.5 | 7 | 78.5 | 0 | -- | 7 | 78.5 | **235.5** |
| 10/14 | 0 | -- | 0 | -- | 11 | 78.0 | 0 | -- | 0 | -- | **78.0** |
| 10/15 | 0 | -- | 10 | 78.5 | 10 | 78.5 | 0 | -- | 0 | -- | **157.0** |
| 10/18 | 12 | 71.5 | 0 | -- | 12 | 71.5 | 12 | 71.5 | 0 | -- | **214.5** |
| 10/19 | 0 | -- | 10 | 86.0 | 10 | 86.0 | 0 | -- | 10 | 86.0 | **258.0** |
| 10/20 | 0 | -- | 11 | 88.25 | 11 | 88.25 | 0 | -- | 0 | -- | **176.5** |
| 10/21 | 7 | 48.0 | 0 | -- | 0 | -- | 7 | 48.0 | 0 | -- | **96.0** |
| 10/22 | 7 | 45.5 | 0 | -- | 7 | 45.5 | 0 | -- | 0 | -- | **91.0** |
| 10/25 | 6 | 46.5 | 6 | 46.5 | 6 | 46.5 | 6 | 46.5 | 6 | 46.5 | **232.5** |
| 10/26 | 3 | 25.5 | 0 | -- | 3 | 25.5 | 3 | 25.5 | 3 | 25.5 | **102.0** |
| 10/27 | 7 | 51.5 | 7 | 51.5 | 7 | 51.5 | 7 | 51.5 | 7 | 51.5 | **257.5** |
| 10/28 | 0 | -- | 0 | -- | 7 | 54.5 | 0 | -- | 7 | 54.5 | **109.0** |
| 10/29 | 8 | 54.0 | 8 | 54.0 | 8 | 54.0 | 8 | 54.0 | 8 | 54.0 | **270.0** |
| 11/01 | 8 | 57.75 | 0 | -- | 8 | 57.75 | 8 | 57.75 | 8 | 57.75 | **231.0** |
| 11/02 | 7 | 47.5 | 7 | 47.5 | 7 | 47.5 | 7 | 47.5 | 7 | 47.5 | **237.5** |
| 11/03 | 0 | -- | 9 | 62.0 | 0 | -- | 0 | -- | 0 | -- | **62.0** |
| 11/04 | 7 | 49.0 | 4 | 55.0 | 7 | 49.0 | 7 | 49.0 | 4 | 55.0 | **257.0** |
| 11/05 | 8 | 38.5 | 8 | 38.5 | 8 | 38.5 | 8 | 38.5 | 8 | 38.5 | **192.5** |
| 11/08 | 0 | -- | 3 | 22.5 | 0 | 22.5 | 3 | 22.5 | 3 | 22.5 | **90.0** |
| 11/09 | 3 | 19.5 | 3 | 19.5 | 3 | 19.5 | 3 | 19.5 | 0 | -- | **78.0** |
| **TOTALS** | **90 Techs** | **608.50 Hrs** | **143 Techs** | **1094.75 Hrs** | **187 Techs** | **1407.50 Hrs** | **79 Techs** | **531.75 Hrs** | **93 Techs** | **736.00 Hrs** | **4,378.50 Field Survey Hours** |

*training

**Santa Rita yellowshow (*Amoureuxia gonzalezii*)**

- We found no individuals of Santa Rita yellowshow in the Survey Area.
- Dry leaves of this species are distinctive and the seed pods, which would still be present on the plants, have diagnostically shaped seeds that would be easy to use for accurate identification.
- Survey effort - 532 hours.

**Southwestern muhly (*Muhlenbergia dubioides*)**

- We found no individuals of Southwestern muhly in the Survey Area.
- The inflorescence is persistent at this time of year.
- The awns present on the inflorescence are diagnostic.
- Survey effort – 736 hours.

# 4. CONCLUSIONS FROM FOREST SENSITIVE PLANT SURVEYS

## 4.1. SUMMARY OF *HEXALECTRIS* STUDY

WestLand's (2010) earlier study of the distribution and abundance of *Hexalectris arizonica* found that no plants of this species were found on the Rosemont Holdings. WestLand biologists found 4 *H. colemanii* in Wasp Canyon within the Pit area. One hundred twenty (120) additional plants have been found in lower portions of Wasp Canyon and in McCleary Canyon within the Plan of Operations. Discussions are underway with Rosemont officials to prepare a Conservation Plan to redesign the processing facility to protect and conserve the 120 plants currently in the project zone. We believe that a redesign with appropriate safeguards can be implemented and will be effective in protecting these plants.

## 4.2. RESULTS OF FIELD SURVEYS

No other individuals of four species were found in the Rosemont Survey Area despite intensive survey effort. Five to seven Beardless chinchweed (*Pectis imberbis*) were observed at the based on a rock-outcrop in the upper reaches of McCleary Canyon. Though not within the Survey Area, these plants are located near a proposed secondary access road coming from the west over Lopez Pass. These plants can be protected by a relocation of the access road and appropriate dust suppression measures. Rosemont Copper Company will work with the Forest Service to prepare a Conservation Plan that will ensure protection of these plant species and looks forward to beginning those discussions.

## 3. REFERENCES

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Falk, M. et al. 2001. Arizona Rare Plant Guide. Arizona Rare Plant Committee

Kennedy, A. H. and L. E. Watson. 2010. Species delimitations and phylogenetic relationship within the fully myco-heterotrophic *Hexalectris* (Orchidaceae). Systematic Botany 35:64-76.

Thompson, S.K. 1990. Adaptive cluster sampling. Journal of the American Statistical Association 85(412): 1050–1059.

WestLand Resources. 2010. Field surveys for *Hexalectris colemanii* in southeastern Arizona. WestLand Resources, Inc. 16 pp plus maps, table, and appendices.

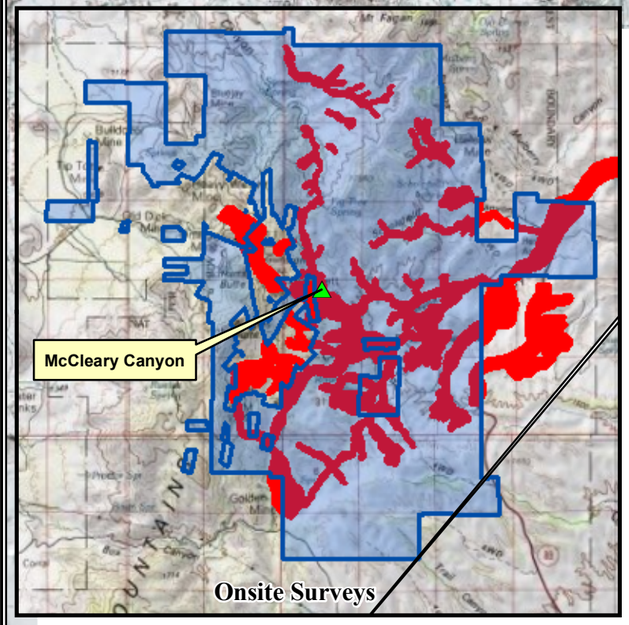
Additional references and literature provided in appendices.

# FIGURES

M:\projects\1049.14\Orchid\Forest Sensitive Species\Fig1_Regional Map.mxd

## Legend

- Locations of *Hexalectris colemanii* known prior to 2010
- Lawson & Volunteers Survey Locations
- On-Site Survey Locations (see inset)
- Offsite Survey Locations
- *Hexalectris* located
- No *Hexalectris* found




Red Ridge Trail, Upper Canada del Oro
Bear Canyon
Turkey Creek
Paige Creek
Cochise Stronghold West Canyon
Cochise Stronghold East Canyon
Solano Canyon
Baboquivari Canyon
Brown Canyon
McCleary Canyon
Box Canyon
Florida Canyon
Agua Caliente Canyon
Montosa Canyon
Cave Creek Canyon
Ophir Canyon
Fish Canyon
Sawmill Canyon
Gardner Canyon
Guindani Canyon
French Joe Canyon

N

0 10 20 Miles

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Engineering and Environmental Consultants

ROSEMONT PROJECT
Forest Sensitive Species Status

Regional Map of
Arizona Coral-root & Coleman's Coral-root
*Hexalectris* Surveys in 2010

Figure 1

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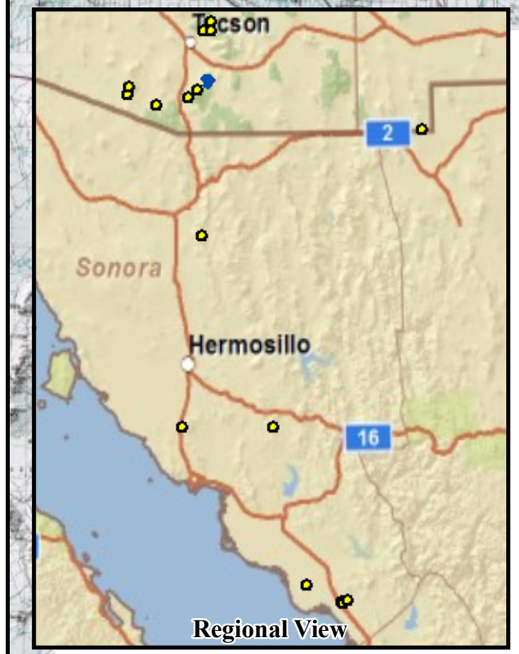


ARIZ:Plants:70287
ARIZ:Plants:70289
ARIZ:Plants:391645
ARIZ:Plants:391644
ARIZ:Plants:99432
ARIZ:Plants:99431
ARIZ:Plants:213561
ARIZ:Plants:206915
UNM:Plants:37880

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0 15 30 Miles

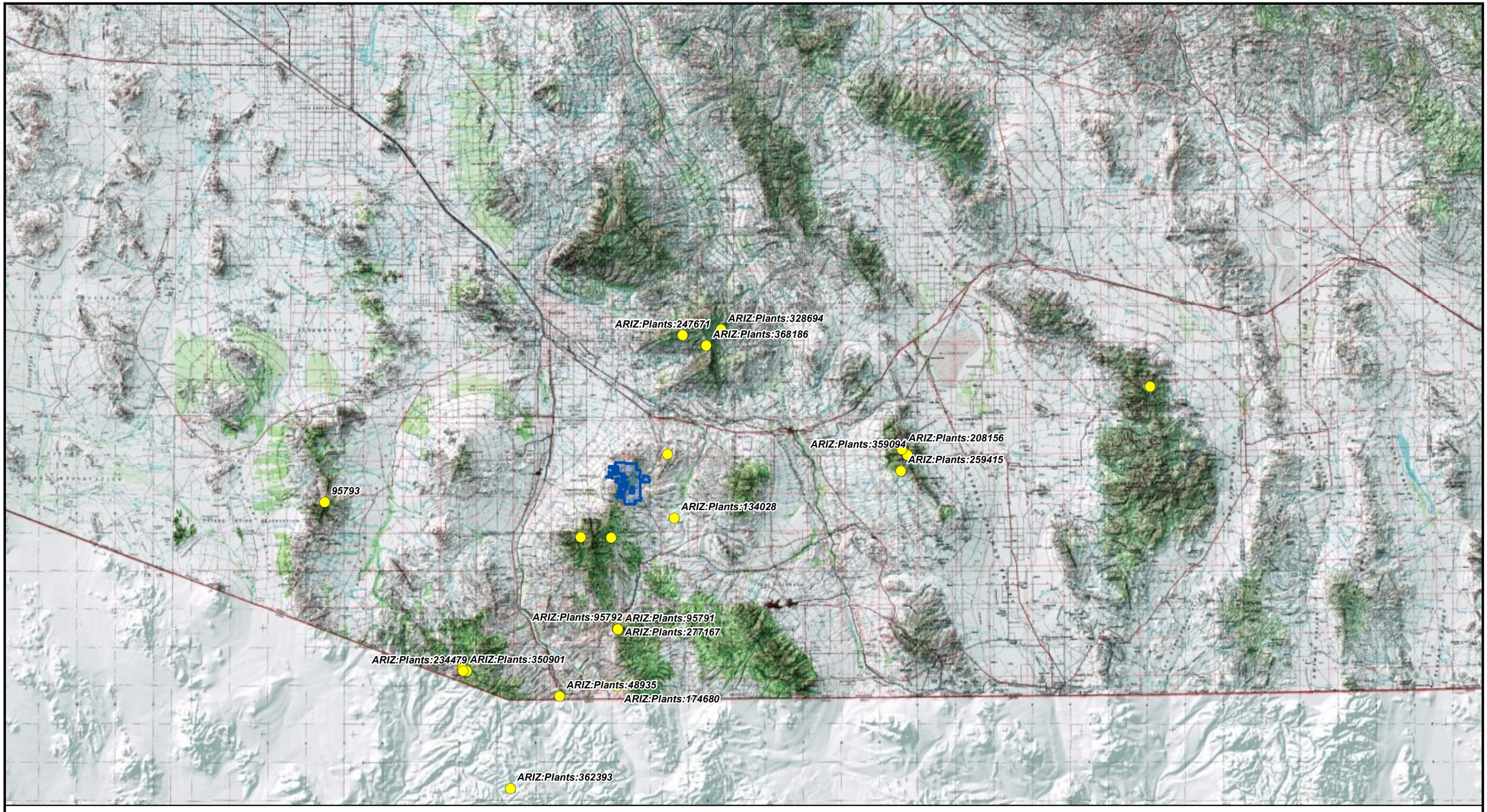
N

ROSEMONT PROJECT
Forest Sensitive Species Status

Arizona Manihot
*Manihot davisiae*

Figure 2

M:\projects\1049.14\SEINet Data\Graptopetalum bartramii\Graptopetulum_bartramii.mxd




WestLand Resources, Inc.
Engineering and Environmental Consultants

0 15 30 Miles

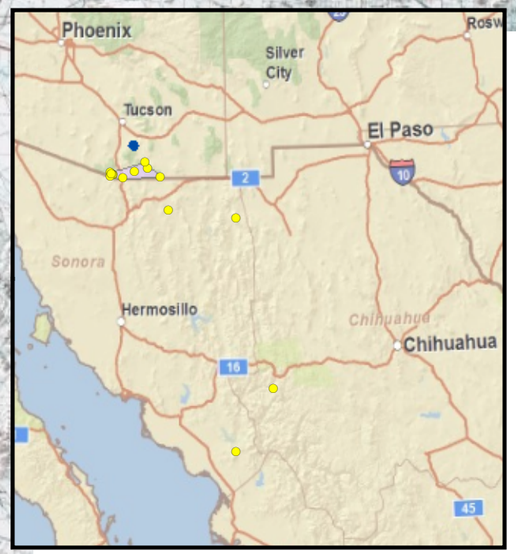
N

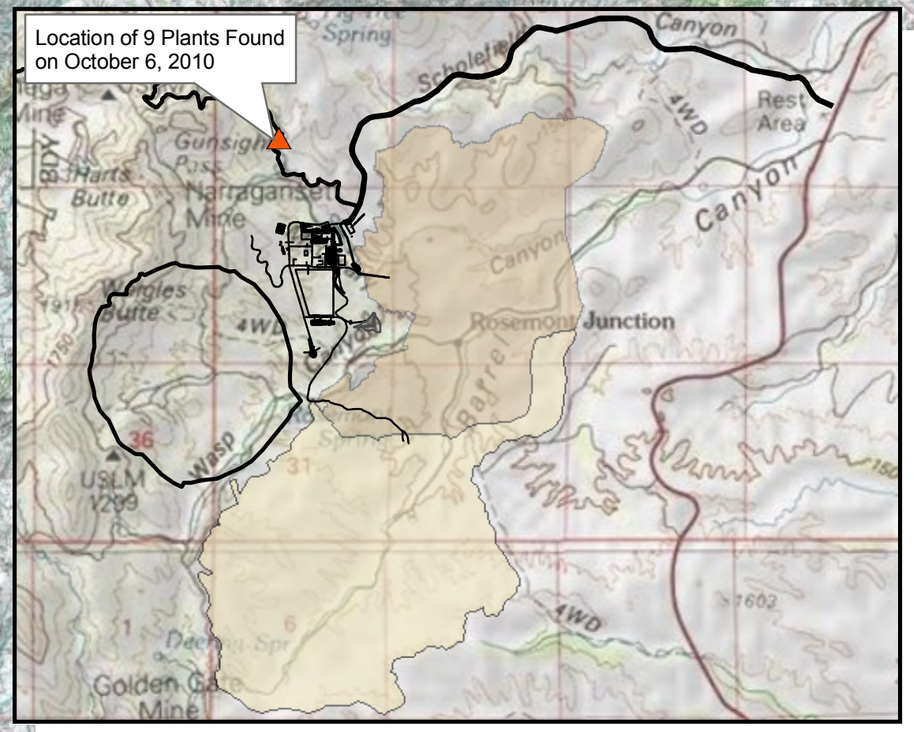
ROSEMONT PROJECT
Forest Sensitive Species Status

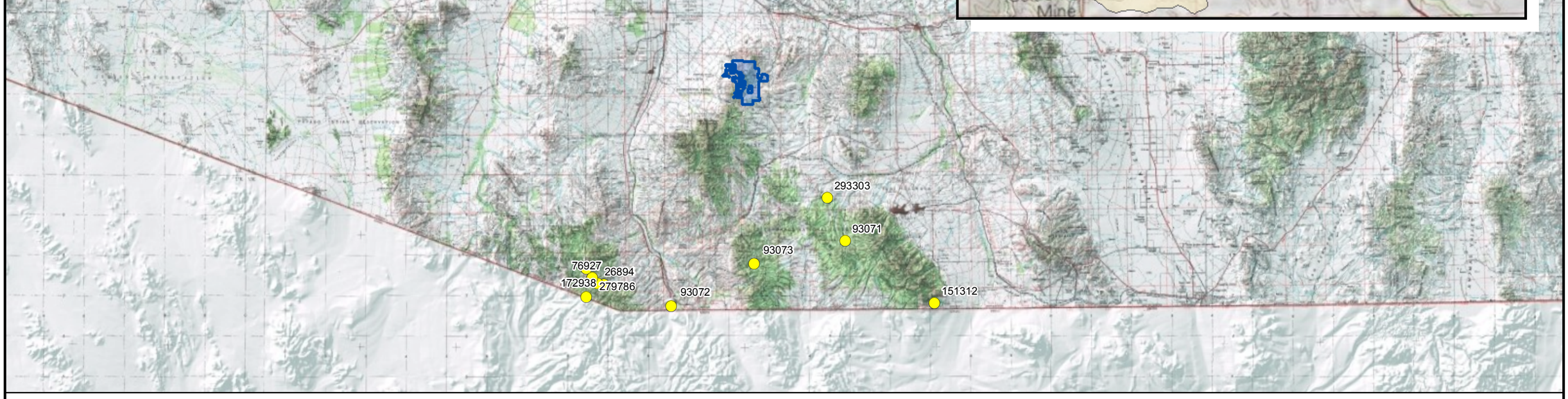
Bartram's Stonecrop
*Graptopetulum bartramii*

Figure 3

M:\projects\1049.14\SEINet Data\Pectis imberbis\Pectis imberbus.mxd




WestLand Resources, Inc.
Engineering and Environmental Consultants

0 15 30 Miles

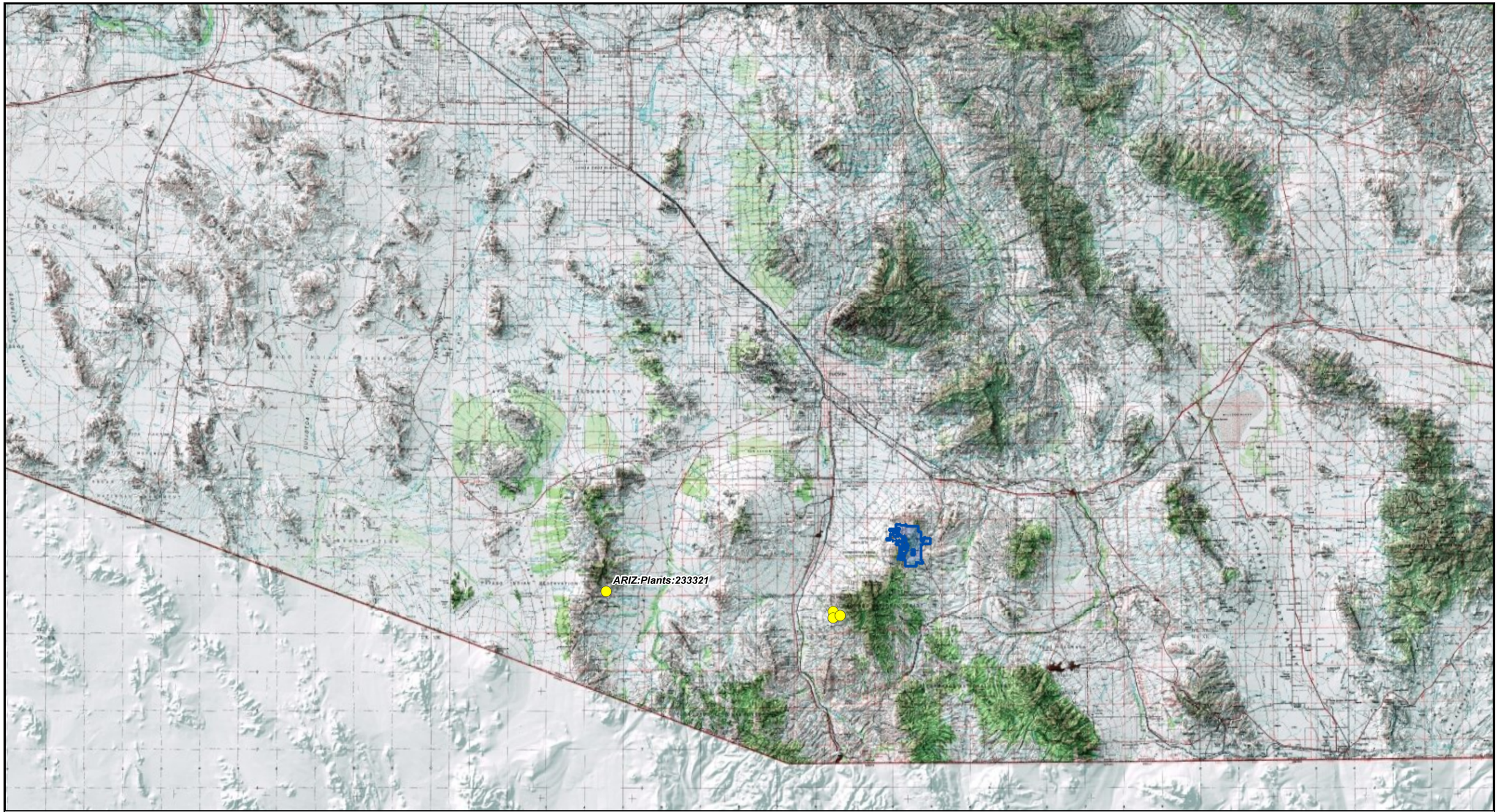
N

ROSEMONT PROJECT
Forest Sensitive Species Status

Beardless Chinchweed
*Pectis imberbis*

Figure 4

M:\projects\1049.14\SEINet Data\Amoreuxia gonzalezii\Amoreuxia_gonzalezii.mxd




WestLand Resources, Inc.
Engineering and Environmental Consultants

0 15 30 Miles

N

ROSEMONT PROJECT
Forest Sensitive Species Status

Santa Rita Yellowshow
*Amoreuxia gonzalezii*

Figure 5

M:\projects\1049.14\SEINet Data\Muhlenbergia dubiodes\Muhlenbergia dubioides.mxd

ARIZ:Plants:330533
DES:Plants:56630
DES:Plants:59937
DES:Plants:56629
DES:Plants:56262
DES:Plants:56261
ARIZ:Plants:349554
ARIZ:Plants:349558
ARIZ:Plants:32639
DES:Plants:56263
DES:Plants:56317
ARIZ:Plants:54476
ARIZ:Plants:282748
ARIZ:Plants:241737
ARIZ:Plants:334536

WestLand Resources, Inc.
Engineering and Environmental Consultants

0 15 30 Miles

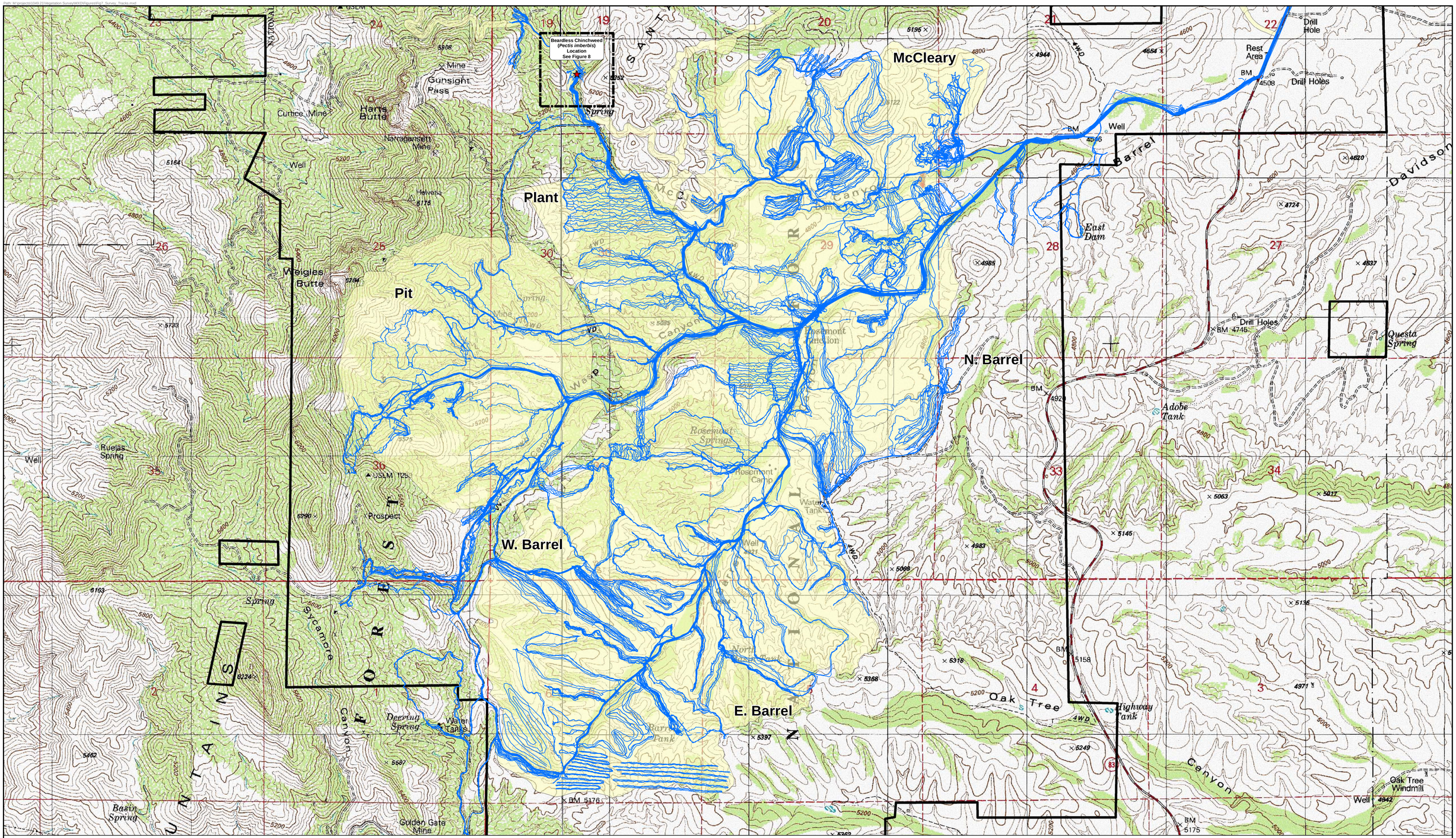
N

ROSEMONT PROJECT
Forest Sensitive Species Status

Southwestern Muhly
*Muhlenbergia dubioides*

Figure 6

Path: M:\projects\1049-21\Vegetation Survey\MXD\FiguresRig7_Survey_Tracks.mxd




0 500 1,000 Feet

0 125 250 500 Meters

N

**Legend**

- Beardless Chinchweed
- Survey Track
- Rosemont Footprint
- Rosemont Holdings Boundary

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Engineering and Environmental Consultants

ROSEMONT PROJECT
Forest Sensitive Species Status

Survey Tracks for Five Sensitive Species on Rosemont Footprint, Fall 2010

Figure 7

Path: M:\projects\1049.21\Vegetation Survey\MXD\Figures\Fig8_Chinchweed_detail.mxd


0 400 800 Feet

0 100 200 Meters

N

**Legend**

Beardless Chinchweed

Rosemont Footprint

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ROSEMONT PROJECT

Forest Sensitive Species Status

Beardless Chinchweed (*Pectis imberbis*) Locations Near Secondary Access Road to Rosemont Footprint

Figure 8

# APPENDICES

# APPENDIX A

## SPECIES DESCRIPTIONS

**APPENDIX A-1**
**Arizona Coralroot**
***Hexalectris arizonica* – Orchidaceae (Orchid family)**

## Species Description

- Perennial, herbaceous plant, subterranean except for above-ground, flowering stem pinkish-red or pale pinkish-yellow or pinkish-white, 15-70 cm tall, leafless, spicate, with 9 to 20 flowers that have sheathing bracts instead of leaves (AGFD 2005, Catling and Engel 1993).
- Sepals and petals pale creamy yellow or dull, pale pinkish-purple, with dull pinkish-red, pinkish-brown or pinkish-purple veins and with whitish margins connivent or spreading apically (Catling and Engel 1993), 1.5-2.5 x 2-2.5 cm, sepals recurved at less than a 90 degree angle (AGFD 2005).
- Flowers late July to late August (AGFD 2005).
- Similar to and overlaps mountain ranges with *H. colemanii* (WestLand 2010), in which sepals are revolute with the outer third rolled back to form a complete circle (AGFD 2004).

## Distribution

- Pima, Santa Cruz, Cochise, and Yavapai counties (Kennedy and Watson 2010, WestLand 2010)
- Santa Catalina, Dragoon, and Santa Rita mountains
- 3480-6590 feet elevation (AGFD 2005)

## Habitat Preference

- On the wooded sides of canyons and canyon bottoms in oak woodlands through mixed oak and conifers, in heavy leaf litter (Coleman 2002)

## Current Regulatory Status and Listing History

- No official status with the US Fish and Wildlife Service
- Designated Forest Service Sensitive in 2004

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Coleman, R.A. 2002. The wild orchids of Arizona and New Mexico. Comstock Publishing Associates, a division of Cornell University Press. Ithaca, New York. Pp. 98-102.

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WestLand Resources, Inc. 2010. Field surveys for *Hexalectris colemanii* in southeastern Arizona. Accessed on October 8, 2010 at: http://rosemonteis.us/techreports/westland_hexalectris.pdf.

**List of records for *Hexalectris arizonica* Catling & V.S. Engel**

| *Hexalectris arizonica* Catling & V.S. Engel | | | |
|---|---|---|---|
| **Source and Accession #** | **Date Collected:** | **Habitat:** | **Locality:** |
| **ARIZ** 247753 | 01 Aug 1982 | Among boulders in pine-oak woodland | Pima Co.: Along the Rincon Peak Trail, Rincon Mtns, 6,001’ |
| **ARIZ** 141186 | 05 Aug 1958 | | Cochise Co.: U.S. Forest Service fenced administrative plot in lower Pinery Canyon at junction of Pima Canyon Road, Chiricahua Mtns |

**ARIZ = University of Arizona Herbarium, ASU = Arizona State University Vascular Plant Herbarium, DES = Desert Botanical Garden Herbarium Collection, UCR = University of California, Riverside Plant Herbarium, NY = New York Botanical Garden, USON = Herbario de la Universidad de Sonora (DICTUS), UNM = University of New Mexico Herbarium**

**APPENDIX A-2**
**Arizona Manihot**
***Manihot davisiae* – Euphorbiaceae (Spurge family)**

## Description

- Perennial herb with underground tuber, palmately compound leaves 6-19cm long including petiole, primary leaf lobes broadly lobed toward the apex
- Monoecious flowers on spike with staminate flowers above and pistillate flowers below, no petals
- Flowers July-August (Arizona Rare Plant Committee [ARPC] 2001)

## Distribution

- Arizona: Pima and Santa Cruz counties
- Las Guijas Mountains (Arizona State University Herbarium), Baboquivari and Santa Catalina mountains, canyons of Santa Rita Mountains, 3500-4000 feet elevation (ARPC 2001).
- Also in Sonora and Chihuahua, Mexico and New Mexico (Herbaria at Arizona State University, Universidad de Sonora, University of Arizona, University of California Riverside, and University of New Mexico). Distribution of *M. davisiae* and *M. angustiloba* seems to follow altitudinal lines (Croizat 1942).

## Habitat Preference

- Limestone slopes (ARPC 2001), stony slope (Croizat 1942).

## Current Regulatory Status and Listing History

- No status with the US Fish and Wildlife Service
- Forest Service Sensitive
- No status with Arizona Native Plant Law

## Bibliography

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Arizona State University Herbarium. Accessed online at: http://swbiodiversity.org

Croizat, L. 1942. A sudy of *Manihot* in North America. Journal of the Arnold Arboretum XIII: 216-225.

Universidad de Sonora Herbarium. Accessed online at: http://swbiodiversity.org

University of Arizona Herbarium. Accessed online at: http://swbiodiversity.org

University of California Riverside Herbarium. Accessed online at: http://swbiodiversity.org

University of New Mexico Herbarium. Accessed online at: http://swbiodiversity.org

**List of records for Arizona Manihot - *Manihot davisiae* Croziat**

| *Manihot davisiae* Croziat | | | |
|---|---|---|---|
| **Source and Accession #** | **Date Collected:** | **Habitat:** | **Locality:** |
| **ARIZ** 330274 | 28 Sep 1996 | Foothills thornscrub on top of steep volcanic hill | Mexico; Sonora; Navojoa Municipio ca. 2 km north of Teachive, southwest end of Cerro Terucuchi, 26.8002780 -109.2344440, 459’ |
| **ARIZ** 192633 | 05 Sep 1974 | Low shrubs on rocky hillside, east side of stream | Pima Co.: 0.1 miles below Molino Basin parking lot; Santa Catalina Mtns, 32.3356000 -110.6965000 (±500 m), 3,999’ |
| **ARIZ 1**31976 | 01 Sep 1941 | Rocky hillside | Mexico; Sonora; 2.5 miles east of main highway between La Palma and Cienequita |
| **ARIZ** 206915 | 23 Aug 1977 | Top of limestone hill | Santa Cruz Co.: South of Agua Caliente Canyon at the southwest end of the Santa Rita Mtns, 31.6882000 -110.9614000 (±3000 m) |
| **ARIZ** 391805 | 11 Aug 2008 | Beside a rock outcrop | Pima Co.: Catalina Mtns, Molino Basin, AZ trail near the road by the group ramada, 32.3345830 -110.6949330, 4,324’ |
| **ARIZ** 391644 | 17 Jun 2008 | | Pima Co.: Catalina Mtns, Molino Basin, Arizona trail near the road past the group picnic area. One large plant by a rocky outcrop in Desert Grassland, 32.3333330 -110.6950000, 4,390’ |
| **ARIZ** 391645 | 17 Jun 2008 | One plant here | Pima Co.: Catalina Mtns, Molino Basin parking lot. Scattered herbaceous perennial, 32.3370670 -110.6914170, 4,324’ |
| **ARIZ** 347189 | 05 Sep 1998 | Unmodified hillslopes of basaltic hill at the archaeological site of Juanaquena | Mexico; Chihuahua, 7 km NE of the town of Janos, UTM 342460 mE 0774700 mN Zone 12S, 4,856’ |
| **ARIZ** 70289 | 12 Aug 1908 | | Pima Co.: St. Catalina Mtns, Sabino Canyon Trail, Near the House, 32.3327000 -110.7908000 (±2000 m) |
| **ARIZ** 70288 | 11 Aug 1906 | | Pima. Co.: St. Catalina Mtns Carillos Research |
| **ARIZ** 99432 | 03 Aug 1932 | | Pima Co.: Baboquivari Canyon, 31.7834000 -111.6240000 (±3000 m) |
| **ARIZ** 369827 | 11 Aug 1985 | Rhyolite mountain with desert-subtropical scrub ecotone | Mexico; Sonora; Guaymas Municipio Microondas Avispas, Sierra Baviso, south end of Sierra Libre; 11 km by road (Mex 15) south of La Pintada (ca 60 km by road south of Hermosillo) and 6 km by road eastward from highway, 28.4833300 -111.0333330, 1,969’ |
| **ARIZ** 334431 | 19 Jul 1993 | Sinoloan thornscrub; *Alvordia congesta*, *Croton sonorae*, and *Bursera laxiflora* | Mexico; Sonora; Mesa Masiaca vicinity. Summit of Mesa Masiaca microwave tower. 6.5 km (by air) west-northwest of San Jose Masiace, 2.5 km (by air) northeast of Mexico 15. N29 62 400m E6 69 100m, 26.7816670 -109.2950000, 656’ |
| **ARIZ** 70280 | 17 Jul 1938 | | Mexico; Sonora; Bavispe Municipio, Santa Rosa Canyon, near Bavispe |

| Source and Accession # | Date Collected: | Habitat: | Locality: |
|---|---|---|---|
| **ARIZ** 213561 | 15 Aug 1978 | *Fouquieria, Erythrina, Opuntia* | Pima Co.: Florida Canyon, behind Santa Rita Experimental Range headquarters, Santa Rita Mountains, 31.7666000 -110.8495000 (±1000 m), 4,400’ |
| **ARIZ** 206489 | 17 Jul 1977 | | Mexico; Sonora; Magdalena Municipio, Palm Canyon, 17 m SE o fMagdalena, Cerro Cinta de Plata |
| **ARIZ** 243773 | 14 Aug 1983 | On rocky slopes above wash | Mexico; Sonora; Magdalena Municipio, Palm Canyon, about 17 miles southeast of Magdalena on road to Cucurpe, Cerro Cinta de Plata, 30.3500000 -110.8000000, 3,937’ |
| **ARIZ** 301542 | 08 Oct 1992 | Sinaloan thornscrub on steep, rugged basalt slopes | Mexico; Sonora; Mesa Masiaca along road to microwave tower, 6.5 km (by air) west-northwest of San Jose de Masiaca, 2.5 (by air) northeast of Mexico 15, 26.7677780 -109.2858330, 656’ |
| **ARIZ** 320552 | 29 Sep 1995 | Foothills thornscrub on basalt lava bedrock | Mexico; Sonora; Navojoa Municipio, Base of Cerro (Mesa) Masiaca on road to microwave tower, 1.3 mi. east of Mexico 15 (southeast of Navojoa), 26.7763890 -109.3083330, 328’ |
| **ARIZ** 243044 | 14 Aug 1983 | | Mexico; Sonora; Palm Canyon, about 17 mi SE of Magdalena, on road to Cucurpe, Cerro Cinta de Plata, 30.3500000 -110.8000000 |
| **ARIZ** 70287 | 14 Aug 1910 | Stony slopes | Pima Co.: Along Soldiers Canyon trail, Soldier Canyon, Santa Catalina Mtns, 32.4302800 -110.7047200 |
| **ARIZ** 337804 | 02 Sep 1996 | Uncommon in rocks below the road; Desertscrub/thornscrub | Mexico; Sonora; Guaymas Municipio, Sierra Libre, ca. 2 km. (by road) east of the junction with MEX 15 along the road leading to Microondas Las Avispas, 28.4805560 -110.0286110, 984’ |
| **ASU** 87929 | 08 Sep 1976 | SW slope, bottom of small steep-walled canyon; Palo Verde and Saguaro | Pima Co.: Catalina Mtns, Bear Canyon Rd., 1.4 mi above Coronado National Forest boundary, 31.7175007 -111.6500015 |
| **ASU** 107691 | 19 Aug 1979 | One plant in detritus filled crevice of granite boulder in steep gully above intermittent stream in Desert Grassland; *Quercus, Prosopis, Mimosa, Fouquieria, Haplophyton* | Pima Co.: 4 miles north of Arivaca in the Las Guijas Mtns, Sec. 9 of R 10E, T 21 south of the Salt and Gila River Baseline and Meridian, 31.6158009 -111.3259964, 3,950’ |
| **USON** 11018 | 11 Aug 1985 | | Mexico; Sonora; Municipio de Guaymas, Microondas Avispas, Sierra Basviso, south end of Sierra Librea; 11 km by road (Mex 15) south of La Pintada (ca 60 km by road south of Hermosillo) and 6 km by road eastward from highway, 28.4833330 -111.0333330, 1,969’ |
| **USON** 06999 | 29 Jul 1989 | | Mexico; Sonora; Etchojoa Basconcobe, 26.9522220 -109.6716670 |

| Source and Accession # | Date Collected: | Habitat: | Locality: |
|---|---|---|---|
| **USON** 07000 | 29 Sep 1995 | | Mexico; Sonora; Navojoa, Base of Cerro (Mesa) Masiaca on road to microwave tower, 1.3 mi east of Mexico 15 (Southeast of Navojoa), 26.7763890 -109.3083330, 328’ |
| **UCR** 57567 | 20 Sep 1982 | | Mexico; Sonora; Palm Canyon, 15.5 miles, by dirt road, from Magdalena to Cucurpe, SE of Mex. Hwy 15 at Magdalena, SW slopes of Cerro Cinta de Plata, 3,842’ |
| **UNM** 37880 | 15 Jul 1964 | Around man-made pond near house | New Mexico: Hidalgo, 31.3501330 -108.3190433 (±1138 m), WGS84, 4,872’ |

**ARIZ = University of Arizona Herbarium, ASU = Arizona State University Vascular Plant Herbarium, DES = Desert Botanical Garden Herbarium Collection, UCR = University of California, Riverside Plant Herbarium, NY = New York Botanical Garden, USON = Herbario de la Universidad de Sonora (DICTUS), UNM = University of New Mexico Herbarium**

**APPENDIX A-3**
**Bartram Stonecrop**
***Graptopetalum bartramii* – Crassulaceae (Orpine family)**

## Species Description

- A perennial succulent with solitary or few 7-16 cm wide rosettes of 15-70 basal leaves on a stem 1-3 cm thick with distinctive leaf shape
- Somewhat glaucous, smooth leaves are cuneate-oblanceolate to – obovate, acuminate, 3-9 cm long, 1-4 cm wide, and 2-4 mm thick
- Annual floral stems are 30 cm tall, with 5-15 leaves, 7-18 branches up to 8 cm long,
- 1-6 flowers per stalk with 4-18-mm-long pedicels
- Flowers are 5-merous, sepals triangular-lanceolate, 2-6 mm long and 1.5-2.5 mm wide
- The corolla is 19-28 mm wide with a 3-3.5 mm long tube
- The pistils abruptly narrowed to styles 0.5-1 mm long
- Flowering occurs August – February (Moran 1994)

### *Habitat*

- Rock crevices and gravelly slopes in mountains (Moran 1994)
- Specimens have been collected on lower canyon slopes and along banks of washes, in shallow soil and thin oak duff on bedrock outcrops, sometimes restricted to north-facing slopes
- Substrates from which they have been collected include granitic hills and along granite-limestone interface
- Suitable habitat is found in isolated pockets
- Elevation range of 3900-6700 feet (Moran 1994)
- In association with scrub oaks (Kearney and Peebles 1960), oak, pine-oak woodland, grassland, Madrean evergreen woodland communities (Center for Biological Diversity [CBD] 2010), oak-pinyon pine association, riparian oak woodland, and in rock with *Selaginella* (Herbaria at Arizona State University [ASU] and University of Arizona [UA])
- Other associated plants include *Agave schottii and A. palmeri, Opuntia, Fouquieria, Dasylirion, Yucca, coral bean, silk tassel*, and *Eriogonum wrightii*

***Distribution***

- Known only from southern Arizona and northern Mexico (Kearney and Peebles 1960)
- Cochise, Pima, and Santa Cruz counties, Arizona, and Sonora and Chihuahua, Mexico (Moran 1994, Van Devender and Reina 2005).
- Found in the Patagonia, Tumacacori, Baboquivari, Santa Rita, Dragoon, Mule, Rincon, and Chiricahua mountains in Arizona (Arizona Game and Fish Department [AGFD] 2001).
- Specimens from the Atascosa Mountains are also on file at the ASU and UA Herbaria, and one from the Empire Mountains is at the UA Herbarium.
- AGFD Heritage Data Management System record within 1 mile of Rosemont.
- The UA and ASU Herbaria specimens from the Santa Rita Mountains include Gardner Canyon, Sweetwater Spring in Cave Creek (a tributary of Gardner Canyon), Madera Canyon, and Sycamore Canyon (a tributary of Box Canyon – but specimen sheet contains inconsistent location information), the latter of which is the nearest record to the mine project site, if it is a correct location.

**Other**

The CBD (2010) cites threats to the species are mainly collection and mining. They noted additional threats include grazing and pedestrian recreation trampling, OHVs, buffelgrass, herbicide application against illegal drugs, road construction, agricultural clearing, border patrol, rodent uprooting, cattle herbivory, floods, and drought (citing WestLand 2007).

**Current Regulatory Status and Listing History**

- No status with the US Fish and Wildlife Service
- Salvage Restricted by the Arizona Native Plant Law
- Forest Service Sensitive and Bureau of Land Management Sensitive (AGFD 2001)
- Petitioned for listing in 2010 (CBD 2010)

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**List of records for *Graptopetalum bartramii* Rose**

| *Graptopetalum bartramii* Rose | | | |
|---|---|---|---|
| **Source and Accession #** | **Date Collected:** | **Habitat:** | **Locality:** |
| **ARIZ** 275171 | 09 Oct 2007 | Granitic hills, north-facing slope; *Agave Schottii* | Pima Co.: Empire Mtns, ca 1.6 mi east of Hwy 83 on first left south of south Old Sonoita Highway turnoff, 31.9117355 -110.6353683, 4,147’ |
| **ARIZ** 95792 | 21 Nov 1924 | | Santa Cruz Co.: Flax Canyon, Patagonia Mtns, 31.5000000 -110.7750000 |
| **ARIZ** 174680 | 16 Nov 1956 | | Santa Cruz Co.: Sycamore Canyon, 31.3649999 -110.7756000 (±500 m) |
| **ARIZ** 259415 | 29 Aug 1985 | On local edges along granite-limestone interface; *Opuntia, Fouquieria, Pinus, Agave, Dasylirion, Yucca,* and grasses | Cochise Co.: Dragoon Mtns, just SE of Sheepshead pass on steep south-facing slope, 31.8682000 -109.9892000 (±1000 m), 6,152’ |
| **ARIZ** 95793 | 25 Sep 1927 | | AZ: Plant grown in greenhouse |
| **ARIZ** 247671 | 26 Sep 1982 | In shallow soil on bedrock outcrops | Pima Co.: Saguaro National Park, Rincon Mtns, Manning Camp Trail, 32.1916670 -110.5916670 (±6000 m), 5,259’ |
| **ARIZ** 48935 | 01 Oct 1940 | | Santa Cruz Co.: Near Nogales, 31.3404000 -110.9349000 (±1000 m) |
| **ARIZ** 359094 | 20 Jul 2001 | On steep granite knobs, ranging from 20 cm to 4 m above canyon bottom; *Sotol, Agave schottii,* coral bean, silk tassel | Cochise Co.: Coronado National Forest, Stronghold Canyon, Dragoon Mtns, 31.9049400 -109.9702800, 5,440’ |
| **ARIZ** 208156 | 27 Dec 1970 | | Cochise Co.: Indian Creek Canyon, near Cochise Head, Chiricahua Mtns, 31.9193000 -109.9862000 (±5000 m), 5,699’ |
| **ARIZ** 368186 | 24 Sep 2001 | | Pima Co.: Saguaro National Park, Rincon Mountain District, 32.1679400 -110.5263300, 6,598’ |
| **ARIZ** 234479 | 22 Oct 1981 | | Santa Cruz Co.: Penasco Canyon, Atascosa Mtns, 31.3992000 -111.1898000 (±1000 m), 3,901’ |
| **ARIZ** 95791 | 19 Jan 1935 | *Quercus* | Santa Cruz Co.: Flux Canyon, Patagonia Mtns, 31.4985000 -110.7734000 (±500 m), 4,498’ |
| **ARIZ** 35901 | 31 Dec 1972 | Rocky crevices or thin oak duff | Santa Cruz Co.: Sycamore Canyon, N. slope at confluence of Penasco Canyon, Tumacacori Mtns, 31.4000000 -111.2000000, 3,937’ |
| **ARIZ** 134028 | 06 Feb 1960 | Oak-pinyon pine association | Pima Co.: Gardner Canyon, Santa Rita Mtns, 31.7608000 -110.6169000 (±10000 m), 5000’ |
| **ARIZ** 277167 | 30 Jan 1954 | Riparian Oak-woodland; common on rock lower canyon slopes with *Selaginella* | Santa Cruz Co.: Flux Canyon, Patagonia Mtns, 31.4985000 -110.7734000 (±500 m) |
| **ARIZ** 383706 | 30 Jan 1955 | Common on banks of streams of lower part of rocky, narrow and deep canyon, oak woodland; *Selaginella* | Santa Cruz Co.: Flux Canyon, Patagonia Mtns |
| **ARIZ** 328694 | 23 Jun 1988 | On rocks just above canyon bottom; *Eriogonum wrightii, Agave palmeri* | Pima Co.: Sycamore Canyon (tributary of Box Canyon), Santa Rita Mtns, 32.2052800 -110.4850000, 5000’ |

| Source and Accession # | Date Collected: | Habitat: | Locality: |
|---|---|---|---|
| **ARIZ** 362393 | 12 Sep 2002 | On rock walls in shady canyon | Mexico; Sonora; Nogales, Sierra Las Avispas, 14.6 km W of Mex 15, on SON 43 (to Saric), Mpio. Nogales, Son. 31.1222200 -111.0694000 |
| **ASU** 235579 | 14 Oct 1997 | Growing along bank of a wash | Santa Cruz Co.: Madera Canyon, 31.7157993 -119.8750000, 5,600’ |
| | 14 Oct 1997 | Along bank of a wash | Santa Crua Co.: Sweetwater Spring, 31.7150002 -110.7910004, 5,600’ |
| **ASU** 27991 | 06 Oct 1967 | Rocky canyon in oak woodland area | Santa Cruz Co.: Sycamore Canyon, 31.4060001 -111.2020035, 3,501’ |
| **ASU** 86287 | 20 Jul 1975 | Oak-pine woods | Cochise Co.: Echo Canyon, upper portion of Echo Creek between dam and parking lot, 6,699’ |
| **NY** 387950 | | | Arizona, ‘Flowering prop. house.’ |
| **NY** 387949 | 21 Nov 1924 | | Santa Cruz Co.: Flux Canyon, Patagonia Mtns |

**ARIZ = University of Arizona Herbarium, ASU = Arizona State University Vascular Plant Herbarium, DES = Desert Botanical Garden Herbarium Collection, UCR = University of California, Riverside Plant Herbarium, NY = New York Botanical Garden, USON = Herbario de la Universidad de Sonora (DICTUS), UNM = University of New Mexico Herbarium**

**APPENDIX A-4**
**Beardless Chinchweed**
***Pectis imberbis* – Asteraceae (Composite Family)**

## Species Description

- Erect, many-branched, perennial herb from a slender to stout woody caudex; ray corollas 6-11 mm long (Keil 1978)
- 1' to 4' high with yellow flowers and thick, narrow leaves that have visible oil glands
- Achenes usually partly of erect or subulate awns and partly of short squamellae ("beardless") (Phillips et al. 1982 in: Arizona Game and Fish Department [AGFD] 2003)
- Fernald (1897) references reports of a strong terebinthine odor, but Keil (1978) reports detecting no odor in Arizona specimens he examined.
- Flowers August-October (Kearney and Peebles 1960)
- Very difficult to see in field

## Habitat

- Sonoran Desert and Mexican Highland sections of Basin and Range Province (AGFD 2003)
- Open grassland and oak grassland 4000-5500' (Arizona Rare Plant Committee [ARPC] 2001), disturbed area (road cuts) 3600-6475' (AGFD 2003)
- Eroded granite, generally steep, southern exposure (AGFD 2003)
- Dominants include *Andropogon barbinodis* (cane bluestem), *Arctostaphylos pungens* (point-leaf manzanita), *Bothriochloa tenuifolia*, *Eragrostis* sp. (lovegrass), *Erythrina flabelliformis* (coral bean), *Fouquieria splendens* (ocotillo), *Prosopis velutina* (velvet mesquite), *Quercus* sp. (oak), and *Viguiera multiflora* var. *nevadensis* (Nevada viquiera) (AGFD 2003).
- Fishbein and Warren(1994 in: CBD 2010) suggest that natural occurrence includes rocky slopes above arroyos.
- Ecosystem Management Area, Coronado National Forest, Arizona.
- Photo of habitat in Arizona Rare Plant Field Guide (ARPC 2001) shows flat grassland

## Distribution

- Cochise, Santa Cruz, and Pima Counties
- 13 known locations in AZ, 8 in Coronado NF (Center for Biological Diversity [CBD] 2010)
- Several Coronado NF populations not confirmed since late 1970s (ARPC 2001)
- Atascosa, Huachuca, Santa Rita, Patagonia, Mtns, and Canelo Hills (ARPC 2001)
- Also Coronado NM, Audubon Research Ranch, possibly Ft Huachuca (AGFD 2003)
- Cited as having extremely broad range (AGFD 2003) but rarest U.S. *Pectis* (ARPC 2001)
- Known within 3 miles of Rosemont footprint (AGFD 2010 in: CBD 2010)

**Current Regulatory Status and Listing History**

- Petitioned for listing under the Endangered Species Act in 2010 (Center for Biological Diversity [CBD] 2010).
- *Pectis imberbis* has no official status with the US Fish and Wildlife Service and but is considered a Species of Concern by them (CBD 2010)
- Forest Service Sensitive (AGFD 2003)

**Other**

Threatened mainly by grazing, road maintenance (AGFD 2003), as well as OHVs, mining (CBD 2010)

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**List of records for Beardless Chinchweed – *Pectis imberbis*.**

| *Pectis imberbis* A. Gray, Asteraceae | | | |
|---|---|---|---|
| **Source and Accession #** | **Date Collected:** | **Habitat:** | **Locality:** |
| **ARIZ** 202106 | 09 Sep 1976 | Grassland with oak and manzanita | Santa Cruz Co.: between Pena Blanca and Ruby (AZ 289) 2 mi. W of stream crossing from Pena Blanca Lake |
| **ARIZ** 76927 | 13 July 1949 | | Santa Cruz Co.: along bank of the Nogales-Ruby Road near the start of the Atascosa Peak Trail, 4700’ |
| **ARIZ** 305151 | 06 Sep 1992 | | Sheet missing from herbarium |
| **ARIZ** 102023 | 30 Sep 1950 | Rocky soil on hillside, oak woodland association | Santa Cruz Co.: base of Atascosa Peak, Atascosa Mtns 23 mi. NW of Nagales, 4400’ |
| **ARIZ** 151312 | 09 Sep 1961 | Timbered south-facing slope and in more open spaces | Cochise Co.: Coronado National Monument |
| **ARIZ** 306821 | 03 Oct 1993 | *Quercus emoryi, Juniperus deppeana, Bouteloua curtipendula, Bouteloua hirsuta, Heteropogon contortus, Lycurus setosus, Muhlenbergia emersleyi, Trachypogon secundus, Eragrostis intermedia, Elyonurus barbiculmis, Lasianthaea podocephala, Artemisia ludoviciana, Pectis longipes, Dalea grayi, Dalea albiflora, Baccharis thesioides* | Sheet missing from herbarium |
| **ARIZ** 26894 | 30 Sept 1944 | Scattered along roadside banks | Santa Cruz Co.: Atascosa Mtns, 13 mi. from Nogales on Nogales-Ruby Road, 4300’ |
| **ARIZ** 93071 | 03 Oct 1937 | | Santa Cruz Co.: Sunnyside to Elgin, 5450’ |
| **ARIZ** 93073 | 24 Aug 1940 | | Santa Cruz Co.: Patagonia Mtns, 5450’ |
| **ARIZ** 172938 | 14 Aug 1962 | | Santa Cruz Co.: Below Summit Motor Way near Sonora border, Atascosa Mtns |
| **ARIZ** 279786 | 14 Aug 1988 | Roadside | Santa Cruz Co.: 3.7 mi. W of Pena Blanca Lake on Ruby Road, Atascosa Mtns, ~4800’, T23S, R12Em, S30 NE¼ |
| **ARIZ** 93072 | 07 Aug 1927 | | Nogales |
| **ARIZ** 293303 | 02 Sep 1988 | Open oak woodlands and along stream | The Research ranch, 61 mi. SSE of Tucson and 6 mi. S of Elgin: Post Canyon, ~4800-4900’ |
| **ARIZ** 83318 | 06 Sep 1940 | | N of Horconcitos, Huachinera region of Rio Bavispe, Sonora, Mexico |
| **ARIZ** 119858 | 15 Aug 1040 | | Cañon de Petaquilla, Mexico |
| **ARIZ** 24667 | 26 Sep 1935 | Steep oak slope, Upper Sonoran | Guasaremos, Rio Mayo, Chihuahua, Mexico |
| **ARIZ** 24669 | 01 Oct 1933 | Warm hillside, canyon, Upper Sonoran | Canyon Estrella, Distr. Alamos, Sonora, Mexico |
| **ARIZ** 24668 | | | |
| **ARIZ** 24666 | 09 Sep 1936 | Upper Sonoran, oak savanna, rising out of tall and thriving grass | Batopilillas, Rio Mayo, Chihuahua, Mexico |
| **ARIZ** 272007 | 26 Oct 1934 | Upper Sonoran hill slopes and canyons | Los Conejos, Rio Mayo, Sonora, Mexico |
| **ASU 163546** | 31 August 1989 | *Oak, pinyon, juniper* | USA; Arizona; Cochise County |

| Source and Accession # | Date Collected: | Habitat: | Locality: |
|---|---|---|---|
| **ASU 196185** | 15 September 1990 | Oak grassland | USA; Arizona; Cochise County |
| **ASU 78470** | 06 September 1975 | Hillside in grassland area *Oak, Ocotillo, manzanita, coral bean* | USA; Arizona; Santa Cruz County |
| **ASU 77861** | 06 September 1975 | Oak-Mimosa grassland area; on rocky roadcut | USA; Arizona; Santa Cruz County |
| **ASU 77862** | 06 September 1975 | Oak-Mimosa grassland area; on rocky roadcut | USA; Arizona; Santa Cruz County |
| **ASU 77860** | 06 September 1975 | Oak-Mimosa grassland area; on rocky roadcut | USA; Arizona; Santa Cruz County |
| **ASU 36161** | 19 September 1970 | Grassland | USA; Arizona; Santa Cruz County |
| **ASU 87697** | 09 September 1976 | Grassland *Oak, manzantia* | USA; Arizona; Santa Cruz County |
| **ASU 26012** | 18 August 1966 | Hillside | USA; Arizona; Santa Cruz County |
| **ASU 211297** | 06 September 1992 | *Quercus emoryi, Q arizonica, Nolina* | USA; Arizona; Cochise County |
| **ASU 208676** | 03 October 1993 | S-facing slope on rocky soil and roadcut in oak woods *Quercus emoryi, Juniperus deppeana, Bouteloua curtipendula, B hirsuta, Heteropogon contortus* | USA; Arizona; Cochise County |
| **DES 15127** | 09 September 1976 | grassland with oak and manzanita | USA; Santa Cruz |
| **DES 2905** | 19 September 1970 | grassland | USA; Santa Cruz |
| **DES 29345** | 11 September 1985 | Roadside, on roadcut slope, soil powdery white *Prosopis, Quercus, Mimosa dysocarpa, Agave parviflora* | USA; Santa Cruz |
| **UCR-54718** | 14 August 1988 | perennial on roadside | USA; Arizona; Santa Cruz |
| **UCR-42089** | 11 September 1985 | Roadside, on roadcut slope, soil powdery--white, with Prosopis, Quercus, Mimosa dysocarpa, Agave parviflora locally common on slope | USA; Arizona; Santa Cruz |
| **NY 230916** | 1851 | isotype | Mexico; Sonora |

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**APPENDIX A-5**
**Coleman's Coralroot**
***Hexalectris colemanii* – Orchidaceae (Orchid family)**

## Species Description

- Perennial, herbaceous plant, subterranean except for above-ground, maroon flowering stem that is leafless, spicate, 40 to 50 cm tall, with 10 to 20 flowers that have sheathing bracts instead of leaves (AGFD 2004).
- Flowers pale pink to rose-tan to whitish, 2.1 cm x 2.0 cm x 1.8 cm. Sepals pale rose-tan with light veining, revolute with the outer third rolled back to form a complete circle (AGFD 2004).
- Flowers May-June (AGFD 2004).
- Similar to and overlaps mountain ranges with *H. arizonica* (WestLand 2010), in which sepals are recurved at less than a 90 degree angle (AGFD 2005).

## Distribution

- Pima, Santa Cruz, and Cochise counties (WestLand 2010)
- Baboquivari, Santa Rita, and Dragoon mountains; Baboquivari population not confirmed since 1981 (WestLand 2010)
- 4500-5200 feet elevation (AGFD 2004)

## Habitat Preference

- Edges of the canyon bottoms and on hillsides leading up from the canyon, often under oaks (*Quercus* spp.) in heavy leaf litter or very thin humus layers (Coleman 2002, WestLand 2010).

## Current Regulatory Status and Listing History

- No official status with the US Fish and Wildlife Service, but petitioned for listing in September 2010 (CBD 2010). Prior to the taxonomic change separating *H. colemanii* from *H. revoluta* (Kennedy 2009, Kennedy and Watson 2010), the USFWS determined that listing *H. revoluta* may be warranted (74 FR 66866), although that determination does not automatically apply to *H. colemanii*.
- *H. revoluta* was listed as a Forest Service (FS) Sensitive Species in 2004 and Bureau of Land Management (BLM) Sensitive in 2005, also prior to the taxonomic change. It is therefore likely that the sensitive designations for both agencies apply to *H. colemanii*.
- No status under the Arizona Native Plant Law.

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**List of records for Coleman's Coral-root - *Hexalectris colemanii* Catling**

| *Hexalectris colemanii* Catling | | | |
|---|---|---|---|
| **Source and Accession #** | **Date Collected:** | **Habitat:** | **Locality:** |
| **ARIZ** 252881 | 16 Jun 1981 | Growing in leaf litter under Quercus oblondifolia in the stream bed in the bottom of Baboquivari Canyon | Pima Co.: in the Baboquivari Mtns 12 individuals—this is the westernmost population known for this species. About ½ mile up-canyon from the end of the road, 4,501' |
| **ARIZ** 271012 | 03 May 1986 | In dense litter below *Quercus emoryi* | Pima Co.: Northern Santa Rita Mountains, McCleary Canyon, 5,000' |

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**APPENDIX A-6**
**Santa Rita Mountain Yellowshow**
***Amoreuxia gonzalezii* - Bixaceae (Lipsticktree family)**

## Species Description

- Small herbaceous perennial, up to 8 cm (3.2 in) tall with tuberous rootstock.
- Alternate, long-petioled, 5-7 parted leaves.
- Flowers bilaterally symmetrical, 5-petaled, bright yellow-orange with carmine spots at base, or pale salmon, closing after midday.
- Flowering triggered by mid-summer rain, late July-September, fruits mature September-mid October.
- Overlaps with the similar *A. palmatifida* and could be confused with *Manihot* (AGFD 2003).

## Habitat Preference

- Rocky, limestone hillsides in Arizona and fine granitic, low soils (ARPFG 200x), decomposed granite on slopes in Sonora; in full sun on open, south- and southwest-facing slopes (AGFD 2003).
- Associated species in Arizona include *Eysenhardtia, Erythrina, Cercidium floridum, Tecoma, Agave schottii, Heteropogon, Fouquieria, Calliandra, Opuntia* ssp., *Krameria, Janusia gracilis, Agave palmeri* and *Hibiscus coulteri* (AGFD 2003).

## Distribution

Pima and Santa Cruz counties, Santa Rita Mountains and Baboquivari Mountains, 4200-4500 feet elevation (ARPFG 2001), Sonora and probably Baja California, Mexico; one population on a single limestone outcrop known in Arizona (AGFD 2003). SEINet shows collection from two locations in Arizona.

**Current Regulatory Status and Listing History**

- No status with the US Fish and Wildlife Service
- Highly Safeguarded by the Arizona Native Plant Law
- Forest Service Sensitive

**Other**

Herbivory cited as the major threat, due to its limited range and high palatability to cattle (AGFD 2003).

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SEINet. http://swbiodiversity.org/seinet/taxa/index.php?taxon=2422

**List of records for Santa Rita Yellowshow - *Amoreuxia gonzalezii* Sprague & Riley**

| *Amoreuxia gonzalezii* Sprague & Riley | | | |
|---|---|---|---|
| **Source and Accession #** | **Date Collected:** | **Habitat:** | **Locality:** |
| **ARIZ** 331684 | 09 Sep 1996 | Rocky canyon with *Populus brandegei*, tropical deciduous forest on slopes, on rocky slope | Mexico; Sonora; 1.5 km southwest of Santa Ana on road to Guadalupe Tayopa, 28.3816670 -109.1583330, 2,543’ |
| **ARIZ** 240055 | 06 Aug 1982 | Sonoran desertscrub; *Olneya tesota, Mimosa laxiflora, Fouquieria diguettii, Stenocereus thurberi* | Mexico; Sonora; 13.7 mi by Tecolote Rd. (1.2 mi N. of El Oasis) W of Mex. Hwy 15, about ½ mi. N of road at base of quartz outcrop, 29.7908330 -111.2619440, 2,362’ to 2,428’ |
| **ARIZ** 75535 | 11 Sep 1934 | | Mexico; Sonora; 17 mi. E of Magdalena |
| **ARIZ** 131938 | 26 Aug 1941 | Rocky hillside of fractured shale and quartz nodules and intrusives | Mexico; Sonora; 7 miles south of Santa Ana |
| **ARIZ** 233321 | 28 Aug 1981 | Oak woodland/grassland | Pima Co.: Area of Old Riggs Ranch in Thomas Canyon, E side of Baboquivari Mtns, Baboquivari Peak, 31.7340000 -111.5750000, 4,199’ to 4,498’ |
| **ARIZ** 302422 | 09 Aug 1992 | | Mexico; Sonora; Guirocoba crossing of Rio Cuchujaqui, 12.3 km (by air) south-southeast of Alamos, 26.9375000 -108.8833330, 853’ |
| **ARIZ** 308452 | 24 Sep 1983 | Tropical deciduous forest / Sinaloan thornscrub transition | Mexico; Sonora; 1 km south of Yocogigua, 26.7861110 -109.0319440, 525’ |
| **ARIZ** 320273 | 23 Sep 1994 | Tropical deciduous forest, on rocky slope | Mexico; Sonora; Arroya El Cobre, near Choquincahui, 26.9800000 -108.6813890, 1,837’ |
| **ASU** 183819 | 14 Aug 1988 | Rocky, limestone soil; *Agave schottii, Mammillaria grahamii, Heteropogon, Notholaena cochisensis* | Santa Cruz Co.: Santa Rita Mtns, foothills called Devil’s Cash Box, ridgetop, first ridge north of sadle, 31.6877003 -110.9520035 (±700 m), 4,301’ |
| **ASU** 183818 | 27 Jul 1989 | Limestone; top of ridge, also to N on same ridgetop and S-facing slope at S end of ridge; apparently absent on nearby ridge to S; *Agave schottii, Mamillaria grahamii, Heteropogon, Notholawna cochisensis* | Pima Co.: Santa Rita Mtns, foothills called Devil’s Cash Box, between Forest Service Roads 183 and 184; first ridge top south of Forest Service Road 183, 31.6875000 -111.9329987, 4,301’ |
| **ASU** 186469 | 12 Oct 1991 | Steep, S-facing limestone; 75-80° slope; deposited alluvium beneath large cobbles in open; *Jatropha cardiophylla, Acacia greggii, Ericameria, Brickellia baccaridea, Vauquelinia californica* | Santa Cruz Co.: Foothills of Santa Rita Mtns, Devil’s Cash Box, southeast end, 31.6730995 -110.9520035 (±700 m), 4,600’ |
| **USON** 01774 | 24 Sep 1993 | | Mexico; Sonora; Alamos, 1 km. south of Yocogigua, Municipio de Alamos, 26.7861110 -109.0319440, 525’ |

**ARIZ = University of Arizona Herbarium, ASU = Arizona State University Vascular Plant Herbarium, DES = Desert Botanical Garden Herbarium Collection, UCR = University of California, Riverside Plant Herbarium, NY = New York Botanical Garden, USON = Herbario de la Universidad de Sonora (DICTUS), UNM = University of New Mexico Herbarium**

**APPENDIX A-7**
**Southwestern (Box Canyon) Muhly**
***Muhlenbergia dubioides* – Poaceae (Grass family)**

## Species Description

- Perennial, erect grass, leaves up to 50 cm long and 1-2 mm wide
- Densely tufted panicle up to 35 cm long and 1.5 cm wide, straight awn 3-10 mm long
- Flowers August-November (Gould 1951)
- Similar to and overlaps with *M. rigens*, which is awnless

## Distribution

- Pima, Santa Cruz, Cochise, and Yavapai counties
- Baboquivari , Santa Catalina, Santa Rita, Huachuca, Pajarita/Atascosa mountains, Canelo Hills (Arizona Game and Fish Department [AGFD] 2000)
- The Arizona State University Herbarium has one specimen collected in Copper Canyon south of Camp Verde, Prescott National Forest, Yavapai County
- 2800-6000 feet elevation (Arizona Rare Plant Committee [ARPC] 2001)

## Habitat Preference

- Rocky slopes in grassland and oak woodland, along stream courses (ARPC 2001) where it can be found in sandy soil (Gould 1951)

## Current Regulatory Status and Listing History

- No official status with the US Fish and Wildlife Service
- Forest Service Sensitive (AGFD 2000)

## References

Arizona Game and Fish Department. 2000. *Muhlenbergia dubioides* (Box Canyon muhly). Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 3 pp.

Arizona Rare Plant Committee. 2001. Arizona rare plant field guide: a collaboration of agencies and organizations. Washington: U.S. Government Printing Office.

Gould, F.W. 1951. Grasses of the Southwestern United States. The University of Arizona Press. Tucson, AZ.

**List of records for Southwestern (Box Canyon) Muhly - *Muhlenbergia dubioides* C.O. Goodding**

| *Muhlenbergia dubioides* C.O. Goodding | | | |
|---|---|---|---|
| **Source and Accession #** | **Date Collected:** | **Habitat:** | **Locality:** |
| **ARIZ** | 30 Sep 1942 | South-facing slope, very rocky soil; Desert grassland plant association | Pima Co.: Santa Rita Experimental Station, Box Canyon, 31.8018000 -110.8084000, 4,698’ |
| **ARIZ** 143014 | 02 Oct 1939 | | Pima. Co.: Box Canyon, 31.8083330 -110.783330 (±2000 m) |
| **ARIZ** 109338 | 20 Sep 1954 | Gravelly soil in Riparian Community, stream bed | Pima Co.: Lower end Bear Canyon, 32.3127000 -110.7976000 (±6000 m), 2,799’ |
| **ARIZ** 62463 | 06 Oct 1948 | Rocky streamside, in partial shade | Pima Co.: Sabino Canyon, Southwestern slopes of the Santa Catalina Mtns, 32.3333330 -110.7976000 (±6000 m), 3,199’ |
| **ARIZ** 147741 | 27 Sep 1961 | *Prospopis sp.*, and *Saguaro* | Pima Co.: Lower Bear Canyon Picnic area, Santa Catalina Mtns, near Tucson, 32.3127000 -110.7976000 (±6000 m), 3,199’ |
| **ARIZ** 330533 | 28 Nov 1936 | | Pima Co.: Bear Canyon, Catalina Mtns, 32.3720000 -110.6970000 (±8000 m) |
| **ARIZ** 349554 | 08 Oct 1998 | Area of oaks, junipers, and scattered pines. Small colony at edge of a small rocky draw with considerable *M. rigens* | Cochise Co.: along A-83, ca. 2 km E of the Cochise-Santa Cruz Co. line, 32.1137000 -109.9217000 (±5000 m), 5,249’ |
| **ARIZ** 352434 | 21 Sep 1999 | Growing in crevices on rock face, forming clumps, blades involute | Pima Co.: Box Canyon, along Greaterville to Continental Rd., ca. 11 km W of its jct. with AZ-83, 31.8083330 -110.783330 (±2000 m), 4,757’ |
| **ARIZ** 282748 | 14 Sep 1986 | Growing on precipitous wall | Pima Co.: Box Canyon, Santa Rita Mtns, 31.8083330 -110.783330 (±2000 m), 4,400’ |
| **ARIZ** 215761 | 25 Sep 1977 | Frequent on the precipitous canyon wall | Pim Co.: Santa Rita Mtns, Box Canyon, on the Greaterville road, 31.8083330 -110.7833330 (±2000 m), 4,692’ |
| **ARIZ** 141187 | 16 Oct 1939 | | Pima Co.: Box Canyon, 31.8083330 -110.7833330 (±2000 m) |
| **ARIZ** 334536 | 09 Sep 1937 | | Santa Cruz Co.: Sycamore Canyon, 31.4166670 -111.1916670 (±5000 m) |
| **ARIZ** 241737 | 24 Sep 1949 | Creek bottom | Cochise Co.: Garden Canyon, Huachuca Game Preserve, 31.4666670 -110.3583330 (±3000 m), 5,184’ to 6,201’ |
| **ARIZ** 32639 | 12 Nov 1945 | Rocky sites | Pima Co.: Moristo Canyon, Baboquivari Mtns, 31.7897200 -111.5861100, 5,997’ |
| **ARIZ** 54476 | 25 Sep 1938 | Wet rocky bank, along road | Pima Co.: Box Canyon, Santa Rita Mtns, 31.8083330 -110.7833330 (±2000 m) |
| **ASU** 267317 | 17 Jun 2003 | Creekbed; *Salix sp., Quercus sp. (scrub), Mimosa biuncifera, Juniperus sp., Mimulus guttatus, Rhus trilobata, Melilotus sp., Fraxinus velutina* | Yavapai Prescott National Forest, South of Camp Verde, Copper Canyon, UTM Zone 12S 414852E 3821663N, 3,901’ |

| **Source and Accession #** | **Date Collected:** | **Habitat:** | **Locality:** |
|---|---|---|---|
| **DES** 56317 | 26 Oct 2005 | Semidesert grassland; *Muhlenbergia cf. monticola, Muhlenbergia dubioides, Muhlenbergia emersleyi, Muhlenbergia rigens, Gossypium thurberi, Leptochloa dubia, Feracactus wislizeni, Lycurus setosus, Bouteloua chondrosioides, Prosopis velutina, Dasylirion wheeleri, Eragrostis lehmanniana, Eragrostis intermedia, Bouteloua curtipendula, Agave palmeri, Opuntia engelmannii, Heliomeris longifolia annua, Quercus emoryi, Quercus grisea, Opuntia chlorotica, Artemesia ludoviciana, Schizachyrium cirratum, Boerhavia coccinea, Brickellia californica, Boerhavia coccinea, Yucca baccata, Eriogonum wrightii, Elytraria imbricate, Heteropogon melanocarpus, Chenopodium, Yucca sp., Bouteloua gracilis, Aristida ternipes* | Pima Co.: Coronado National Forest, Foothills in the Santa Rita on a ridge north above the Greaterville Road, in a south-flowing drainage, 31.8045000 -110.7808670, 4,997’ |
| **DES** 59937 | 23 Oct 2006 | Riparian within Arizona Upland, SOnoran Desert Scrub; *Acacia angustissima, Ambrosia ambrosioides, Arundo donax, Baccharis sarothroides, Brickellia, Cylindropuntia, Cynodon dactylon, Dodonaea viscose, Fraxinus, Melinis repens, Muhlenbergia rigens, Pennisetum setaceum, Platanus wrightii, Populus fremontii, Salix gooddingii, Sorghum halapense, Toxicodendron rydbergii, Xanthium* | Pima Co.: Sabino Canyon, Pusch Ridge Wilderness, Coronado National Forest, Santa Catalina Mtns, 32.3222000 -110.8095830, 2,792’ |
| **DES** 56629 | 04 Oct 2005 | Desert riparian, sandy soil; *Muhlenbergia sp., M. emersleyi, M. dubioides, Eragrostis mexicana(?), E. cilianensis, Panicum, Digitaria sanguinalis, Fraxinus velutina, Celtis pallida, Cercidium floridum, Prosopis velutina, Ambrosia ambrosioides, Cephalanthus occidentalis* | Pima Co.: Coronado National Forest, Foothills of Santa Catalina Mtns, Bear Canyon, where saguaros meets riparian floor, 32.3111830 -110.7984330, 2,779’ |

| Source and Accession # | Date Collected: | Habitat: | Locality: |
|---|---|---|---|
| **DES** 56263 | 05 Oct 2005 | Exposed limestone cliff/wall, southfacing; *Opuntia ellisiana, Agave palmeria, Anisacanthus thurberi, Leptochloa dubia, Fouquieria splendens, Erythrina flabelliformis, Brickellia californica, Baccharis sarothroides, Muhlenbergia rigens, Eysenhardtia orthocarpa, Leptochloa dubia, Yucca schottii, Heliomeris, Dasylirion wheeleri, Jatropha macrorhiza, Hibiscus, Bothriochloa barbinodis, Astrolepis cochisensis, Epilobium canum, Aloysia wrightii, Boerhaavia scandens, Trixis califonicus, eragrostis lehmaniana, E. intermedia* | Pima Co.: Coronado National Forest, Foothills of Santa Rita Mtns, 15.2 miles east of I-19 and 7.1 miles east of Madera Canyon Road on Greaterville Road, north side of road at pullout, 31.7996670 - 110.7763500, 4,744’ |
| **NY** 381384 | 25 Sep 1938 | | Box Canyon slopes, Santa Rita Mtns |

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# APPENDIX B

## BARTRAM STONECROP SAMPLING PROTOCOL AND DATASHEET

# APPENDIX B.
# BARTRAM STONECROP SAMPLING PROTOCOL AND DATASHEET.

## SAMPLING FOR BARTRAM STONECROP

The sampling procedure we have chosen for searching for Bartram Stonecrop (BSC) is based on documented and verified habitat features and an adaptive cluster sampling approach. Based on the published literature (Falk et al. 2001) and a field visit to a documented site of BSC, we confirmed that BSC occurs on steep rock outcrops where evident moisture is present. Associated plants such as mosses on rock surfaces, which are able to be seen from a distance, may also be present. Narrow habitat requirements that are sporadically distributed result in highly patchy distributions of BSC. This is a principal consideration in our protocol to search for possible BSC localities on the Rosemont footprint.

## PROTOCOL

1. Preparation
    a. Identify steep, rocky areas along canyons and washes using aerial photographs covering the entire Rosemont property.
        i. Select candidate sites along all canyons and washes.
        ii. Examine each selected site with inspection of aerial photographs at smaller scales to confirm or reject site.
        iii. Rank confirmed sites from 1 to 3 based on subjective judgment of site characteristics.
    b. Create a search list for field crews based on proximity and rank.

2. Field Surveys
    a. Crews of two will drive and walk washes to the locations indicated on the maps and the list.
        i. Technicians will examine the length of the wash for other possible sites not initially identified in the Preparation phase of the work while traveling to the high priority sites.
        ii. Additional sites will be inspected as describe below or marked using UTM coordinates for later visit.
    b. When sites are reached, search for BSC will entail the following procedure
        i. Conduct a thorough foot search for BSC.
        ii. Record in field notes and photographically the presence of seeps and moisture and associated plants such as moss and ferns.
        iii. If BSC is found, all plants will be counted and a UTM coordinate will be taken for the site.
        iv. Notes will record plant size (SML), reproductive stage (flowering, fruiting, old reproductive stalk, and live/dead status).
        v. If BSC is not found, technicians will record UTM for site, make notes on moisture status, presence of indicator species, and over story plants.

c. Once all observable plants in the immediate locality are found and recorded, we will implement an adaptive, cluster sampling search routine.
    i. A two hundred foot radius will be searched surrounding the center point of the BSC locality.
    ii. Areas of the described circle laying outside of suitable habitat will be excluded from further search (e.g., open grassland, wash bottoms).
    iii. Technicians will search each portion of the included within the circle on foot looking for additional plants.
    iv. If plants are found procedures in section 2.b. will be followed
    v. A new radius will be established and the process will be repeated until no additional plants are found.
d. Go to next site on the list.

**Data Sheet for Stonecrop**

Date: _____

Techs: _____

Location Name: _____

Site UTM: Northing _____ Easting _____

| Plant # | Plant size [1] (S, M, L) | Reproduction (Y/N) | Stalk # | Bud or fruit # | Dead (Y/N) | Comments |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
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| 26 | | | | | | |
| 27 | | | | | | |
| 28 | | | | | | |
| 29 | | | | | | |
| 30 | | | | | | |

1 – S - 1-2”, M - 2-3”, L - >3”

# APPENDIX C

## DAILY LOG DATASHEET

## APPENDIX C.
### DAILY LOG DATASHEET

Rosemont Footprint Sensitive Plant Survey
Daily Field Log

---

Biologist _____ Date _____

Other team members: Plants Surveyed

_____ _____

_____ _____

_____ _____

Areas Searched (provide canyon or wash name, tributary number, or description of field areas searched and how searches were performed).

_____

_____

_____

_____

_____

_____

_____

Plant Codes:

Arizona Manihot - MADA
Bartram Stonecrop – GRBA
Beardless Chinchweed – PEIM
Santa Rita Yellowshow – AMGO
Southwestern Muhly - MUDU

# APPENDIX D

**LIST OF DRAINAGES SEARCH DURING THIS STUDY, THE CANYON WHERE THEY ARE LOCATED, AND THE UTM COORDINATES OF THEIR TERMINI**

# APPENDIX D.

## LIST OF DRAINAGES SEARCH DURING THIS STUDY, THE CANYON WHERE THEY ARE LOCATED, AND THE UTM COORDINATES OF THEIR TERMINI.

| Drainage ID | Easting | Northing | Canyon | | Drainage ID | Easting | Northing | Canyon |
|---|---|---|---|---|---|---|---|---|
| A07 | 527030 | 3522809 | Barrel | | G01 | 522755 | 3519780 | Barrel |
| A08 | 527010 | 3522859 | Barrel | | G02 | 522403 | 3519738 | Barrel |
| A09 | 526957 | 3522957 | Barrel | | C01 | 522331 | 3520370 | Wasp |
| A10 | 526832 | 3522707 | Barrel | | C02 | 524829 | 3521962 | Wasp |
| A12 | 526760 | 3522978 | Barrel | | C03 | 523128 | 3520947 | Wasp |
| A13 | 526729 | 3522981 | Barrel | | C05 | 522868 | 3521413 | Wasp |
| A14 | 526180 | 3521319 | Barrel | | C06 | 523113 | 3521542 | Wasp |
| A15 | 525806 | 3521218 | Barrel | | C07 | 522729 | 3521580 | Wasp |
| A16 | 525847 | 3521413 | Barrel | | C09 | 522709 | 3521749 | Wasp |
| A17 | 525749 | 3521536 | Barrel | | C11 | 522567 | 3521812 | Wasp |
| A18 | 526048 | 3521768 | Barrel | | C12 | 522654 | 3521928 | Wasp |
| A19 | 525718 | 3521675 | Barrel | | C14 | 522761 | 3522100 | Wasp |
| A21 | 525649 | 3521687 | Barrel | | C15 | 522845 | 3522109 | Wasp |
| A22 | 525628 | 3521815 | Barrel | | C16 | 524110 | 3521878 | Wasp |
| A23 | 525541 | 3521866 | Barrel | | C17 | 522682 | 3522398 | Wasp |
| A25 | 525560 | 3521298 | Barrel | | C19 | 523009 | 3522519 | Wasp |
| A26 | 525597 | 3521305 | Barrel | | C20 | 523463 | 3522405 | Wasp |
| A27 | 525841 | 3519910 | Barrel | | C22 | 524187 | 3522347 | Wasp |
| A28 | 525274 | 3520701 | Barrel | | C23 | 524063 | 3522615 | Wasp |
| A29 | 525636 | 3519923 | Barrel | | C24 | 524721 | 3522280 | Wasp |
| A30 | 525051 | 3519924 | Barrel | | D02 | 525904 | 3522548 | Wasp |
| A31 | 525266 | 3519488 | Barrel | | D04 | 525613 | 3522619 | Wasp |
| A32 | 524610 | 3519899 | Barrel | | D05 | 525449 | 3522555 | Wasp |
| A33 | 524301 | 3519425 | Barrel | | D06 | 525442 | 3522635 | Wasp |
| A34 | 523154 | 3518968 | Barrel | | D08 | 524999 | 3522501 | Wasp |
| A35 | 523193 | 3519680 | Barrel | | D09 | 524993 | 3522557 | Wasp |
| A36 | 523454 | 3519556 | Barrel | | D10 | 524913 | 3522602 | McCleary |
| A37 | 523779 | 3519903 | Barrel | | E02 | 525145 | 3522883 | McCleary |
| A38 | 523910 | 3520163 | Barrel | | E04 | 523846 | 3522760 | McCleary |
| A39 | 524254 | 3520093 | Barrel | | E05 | 523846 | 3522860 | McCleary |
| A40 | 524027 | 3520349 | Barrel | | E06 | 523991 | 3522932 | McCleary |
| A42 | 524126 | 3520577 | Barrel | | E07 | 523899 | 3523138 | McCleary |
| A43 | 524118 | 3520635 | Barrel | | E09 | 523266 | 3523514 | McCleary |
| A44 | 524541 | 3520670 | Barrel | | E10 | 523351 | 3523632 | McCleary |
| A45 | 524797 | 3520801 | Barrel | | E11 | 523361 | 3524260 | McCleary |
| A46 | 525165 | 3521972 | Barrel | | E12 | 523489 | 3524511 | McCleary |
| A55 | 525907 | 3520503 | Barrel | | E14 | 524580 | 3523382 | McCleary |
| A56 | 525920 | 3520675 | Barrel | | E15 | 524387 | 3523796 | McCleary |
| B01 | 523900 | 3520873 | Barrel | | E16 | 524523 | 3524042 | McCleary |
| B03 | 524229 | 3520827 | Barrel | | E17 | 525103 | 3523701 | McCleary |
| B04 | 524346 | 3520960 | Barrel | | E18 | 525795 | 3523921 | McCleary |
| B05 | 524289 | 3521150 | Barrel | | E19 | 526136 | 3523510 | McCleary |
| B06 | 524570 | 3521021 | Barrel | | E21 | 526363 | 3523734 | McCleary |
| B07 | 524536 | 3521265 | Barrel | | E22 | 526506 | 3524002 | McCleary |
| A07 | 527030 | 3522809 | Barrel | | E23 | 526652 | 3523988 | McCleary |
| A08 | 527010 | 3522859 | Barrel | | | | | |