Vegetation and Flora of the Chocolate Mountains Aerial Gunnery Range, California

Final Report, 2018

Cooperative Agreement W9126G-15-2-0035

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Summary

The purpose of this Cooperative Agreement was to develop a comprehensive vegetation map and flora for the Chocolate Mountain Aerial Gunnery Range (CMAGR) under management by the Marine Corps Air Station Yuma (MCAS Yuma), Yuma, Arizona. The vegetation map and flora will allow effective management of the vegetation communities on the BMGR West and also provide a baseline for ecosystem management. The vegetation survey and mapping effort was conducted in support of the Integrated Natural Resources Management Plan (INRMP) prepared by MCAS Yuma under the Sikes Act Improvement Amendments of 1997.

Items delivered:

- Shapefiles, GPX, and KML files of field routes
- Access database of 208 relevés (field samples)
- 260 digital photos of the relevés
- Species list recording the 287 species and 1403 plant collections at University of California (Riverside) and Arizona Western College (Yuma)
- Final report

A total of 208 relevés were taken from 2015 to 2018. The resulting database holds quantitative and qualitative data – site description, ground cover, prominence, and height – for perennial species and invasive species across the CMAGR. From these data, and inspection of aerial imagery, we expect at least 15 vegetation associations to be present in the CMAGR. All mapped units (vegetation types) will be named following the conventions of the National Vegetation Classification (NVC).

The majority of the CMAGR falls under three NVC Macrogroups that cover most of the Mojave and Sonoran deserts in the southwestern United States. These macrogroups include: (1) Mojave- Sonoran Semi-Desert Scrub; (2) North American Cliff, Scree and Rock Vegetation; and (3) North American Warm-Desert Xeric-Riparian Scrub. Within these macrogroups there are at least seven alliances: (1) *Opuntia bigelovii* Cacti Scrub Alliance, (2) *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance, (3) *Larrea tridentata - Fouquieria splendens* Upper Bajada & Rock Outcrop Desert Scrub Alliance, (4) *Ambrosia dumosa* Desert Dwarf Scrub Alliance, (5) *Encelia farinosa* Desert Scrub Alliance, (6) *Atriplex hymenelytra* Scrub Alliance, and (7) *Acacia greggii - Hyptis emoryi - Justicia californica* Desert Wash Scrub Alliance.

We have made 1403 collections for the flora that include 287 species, including a Baja California species, *Hoffmannseggia peninsularis*, that had previously never been documented in the United States.

Contents

Introduction

The Chocolate Mountains Aerial Gunnery Range (CMAGR) encompasses 185,346 hectares (458,000 acres) of southeastern California. Because public access is prohibited, the CMAGR is a relatively undisturbed element of our nation's biodiversity. There has never been a comprehensive survey of the vegetation. The range is mostly roadless, and spotted with ordinance of all sorts

Utilizing those times when the range was closed for target maintenance, we collected and identified 1403 specimens from 287 species of plants. We collect enough material, at a minimum, from each species to create two archival herbarium sheets. One sheet is housed at the herbarium at University of California, Riverside, and the other is housed at the herbarium of Arizona Western College in Yuma, close to MCAS Yuma.

The only previous vegetation map, the GAP map of ecosystems across the entire continental United States, was created by the US Geologic Survery without field work in the CMAGR. In other words, they had to guess, based soley on imagery. The resulting map is rife with errors, and this project begins with a blank page. This means there are no existing criteria between some of the different vegetation types, requiring us to gather data (rapid assessment relevés) so we can establish the criteria for the CMAGR. At the same time, the resulting map must fit with exiting vegetation maps of neighboring lands.

We've adopted, so far as possible, the protocol of Malusa and Sundt (2015), who mapped the vegetation of the Barry M. Goldwater Range – West, and the releve/rapid assessment data sheets and database of California Department of Fish and Wildlife (Protocol for RA/Relevé Database Entry – Appendix A). Ultimately, the resulting vegetation map reflects the hierarchical structure of the Federal Geographic Data Committee's standards for the National Vegetation Classification (2008).

The Study Area

The Chocolate Mts Aerial Gunnery Range (CMAGR) is situated in the desert of the southeastern California, northeast of the Salton Sea and Algodones Dunes (Fig. 1). The CMAGR is roughly 80 km (50 miles) from east to west and 30 km (18 miles) north to south. Elevations span from 14 meters (45 feet) below sea level to 933 meters (3060 feet) at an unnamed summit. There are no long-term climate data on the range proper, but a fair indication of the climate can be seen in the 85 year record from the nearby Yuma Citrus Station: an average high of 41.2° C (106.1°F) in July to an average low of 3.9° C (39.1°F) in January, and an average annual precipitation of 87 m (3.4 in) (http://www.wrcc.dri.edu/; Yuma Citrus Station). These data are from 58 meters (190 feet), so we can expect cooler temperatures and more precipitation at the higher elevations within the range, and hotter temperatures below sea level.

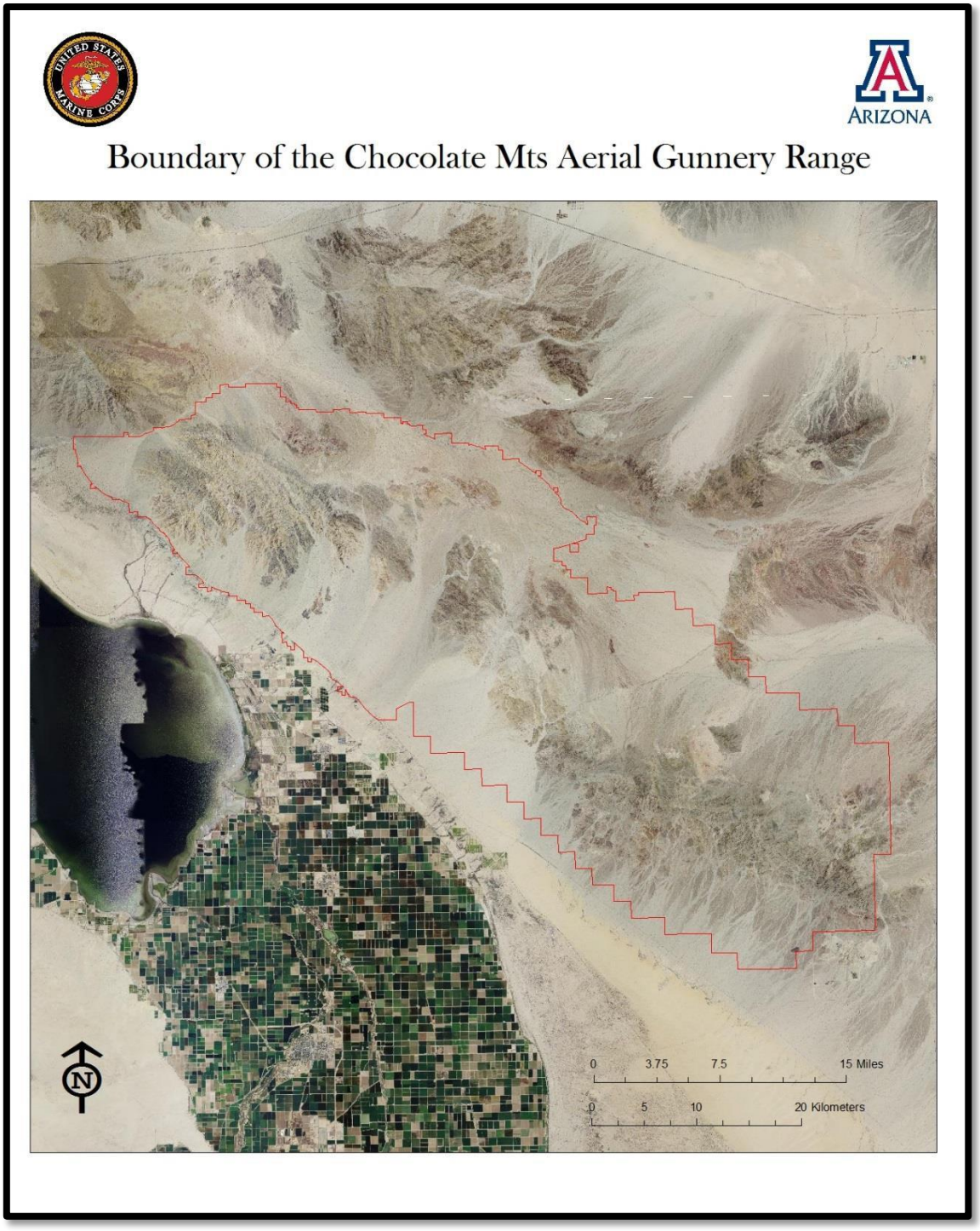

Figure 1. The boundary of the Chocolate Mountains Aerial Gunnery Range, in southeastern California, near the Salton Sea. The range is crossed, SW to NE, by only three dirt roads. Most of the range is roadless.

Geology

The present topography began to form about 15 – 20 million years ago. The last five million years have seen the formation of Gulf of California/Salton Sea trough, with subsequent rerouting of the Colorado and Gila Rivers. The rocks, however, themselves are typically much older than the faulting that lifted them (Figure 2). The oldest are Early Proterozoic granitoid rocks, such as gneiss, over a billion years old. The youngest rocks are basalts only 8 to 23 million years old.

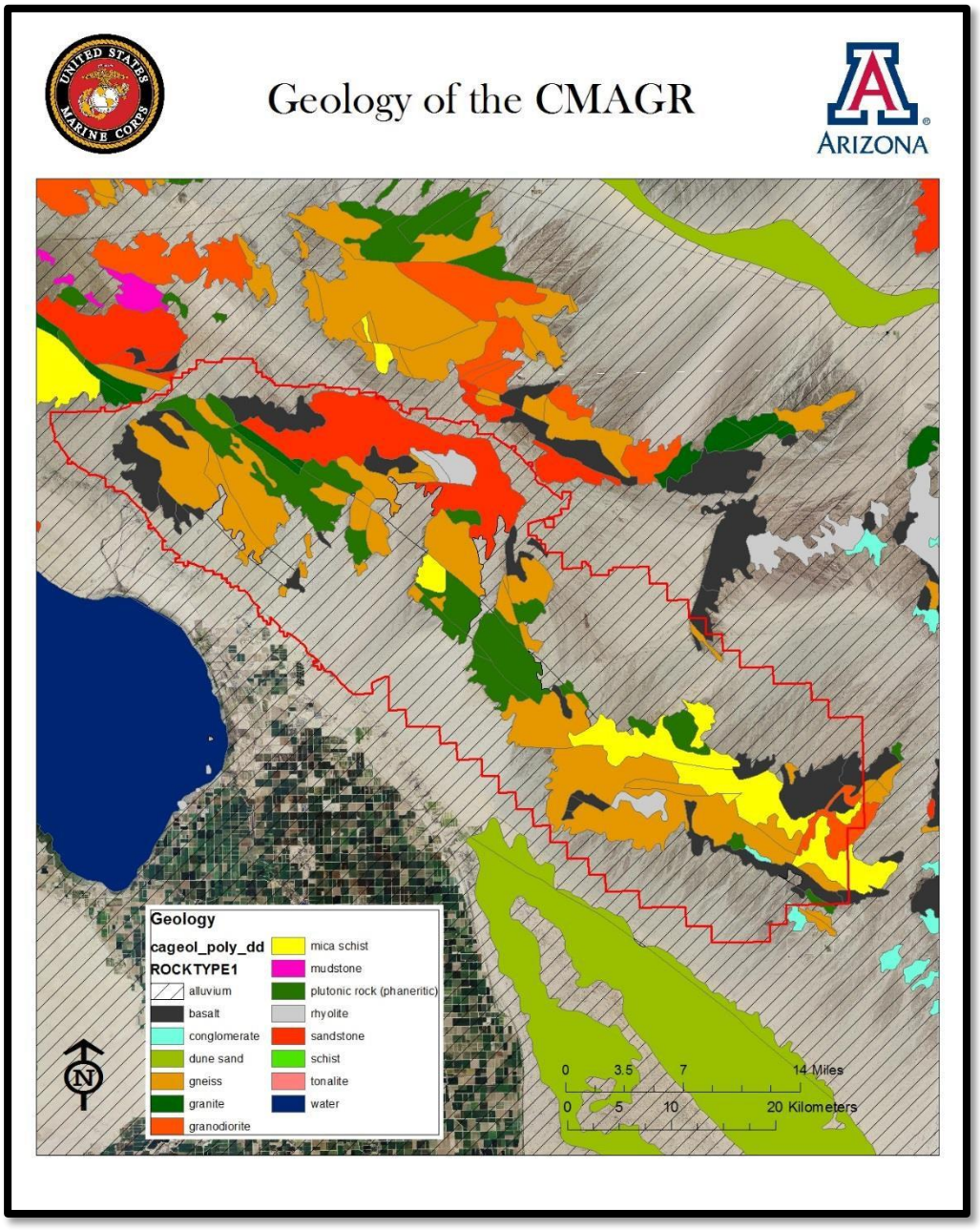

Figure 2. The geology of the CMAGR, in southeastern California (California Geologic Survey, 2015).

Previous vegetation maps of the CMAGR

Early vegetation maps of North America show all of the CMAGR as simply 'barren desert', as did J. Bartholomew's 1907 map of North America. But even a casual observer can see that the mountains are not like the valleys. This distinction between mountain and valley, between mesa and floodplain, was the focus of the excellent article "Vegetation and soil relations in the lower Colorado Desert," by John Brady Marks (1950). Marks observed that the vegetation from one valley to the next was different, and he sought to explain why. Lacking the sort of aerial imagery that is commonplace nowadays, he makes no attempt to define the precise borders between plant associations on the CMAGR, but instead reveals the relationship of soil and plants in southwestern Arizona and southeastern California.

The most often cited vegetation map for the southwestern United States and northwestern Mexico is Brown and Lowe's "Biotic Communities of the American Southwest-United States and Mexico" (1982). This encyclopedic work built upon their earlier effort to create a hierarchical classification of vegetation (Brown et al., 1979; Brown and Lowe, 1974). The resulting map covers such a vast area that there is no distinction between vegetation types on the CMAGR – it's all one color on their map, representing the "Lower Colorado River subdivision" of Sonoran desert scrub. The importance of their contribution was not the map, but the hierarchical classification.

A hierarchical vegetation classification is like the United States Marine Corps: just as there are several Staff Sergeants for every Sergeant Major, there are several creosote and bursage vegetation associations in what we call the Sonoran Desert. Warren et al. (1981) used the Brown and Lowe classification in their vegetation map of Arizona's Organ Pipe Cactus National Monument. This work set a standard for Sonoran desert mapping that served as the template for further work in the Sonoran desert, including, most recently, the vegetation map of the Barry M. Goldwater Range – West (Malusa and Sundt, 2015).

However, despite efforts to standardize a single classification system, it's still difficult to try and get everyone to agree on the names of vegetation types, and where they belong in the hierarchy. This confusion has diminished somewhat over the past decade with the advent of the National Vegetation Classification (FGDC, 2008). At the same time remote sensing has improved. Landsat ETM+ imagery was used to create the US Geologic Survey GAP map (http://gapanalysis.usgs.gov/gaplandcover/), which is currently the only digitized vegetation map of the CMAGR (Figure 3). This map shows ecosystems, which are broadly defined assemblages such as "Sonoran-Mojave Creosote-White Bursage Desert Scrub." Ecosystems are the appropriate scale for the GAP map, which mapped the entire continental United States. However, for effective land management on the CMAGR – for instance, choosing a new target, or a drop zone – the vegetation map needs to be more precise, with a minimum mapping unit closer to a hectare, or 100 m square. Such a map should be at the alliance or association level, using the criteria of the Federal Geographic Data Committee, and listed by the National Vegetation Classification System (http://usnvc.org/). For example, within the Sonoran-Mojave Creosote-White Bursage Desert Scrub

Ecosystem, the National Vegetation Classification System reports 26 different associations, all of which differ by the species associated with the creosote and white bursage. These vary with soils and landform. Some of these species may be critical forage – for example, salt bush (*Atriplex*) and/or big galleta grass (*Pleuraphis rigida*) – which is why a good vegetation map is also good animal map.

Other associated species affect the military mission – for example, teddy-bear cholla (*Cylindropuntia bigelovii*), which is a serious hazard to foot soldiers or parachutists. None of this detail is possible on the existing GAP vegetation map. In addition, a review of the GAP map in the 2013 INRMP for the CMAGR suggests that many of the ecosystems were not correctly identified, even at this generalized level. Note that virtually the entire alluvial slope on the southwest side of the CMAGR is mapped as "North American Warm Desert Wash." Even a cursory review of Google Earth shows that reality is far more complex.

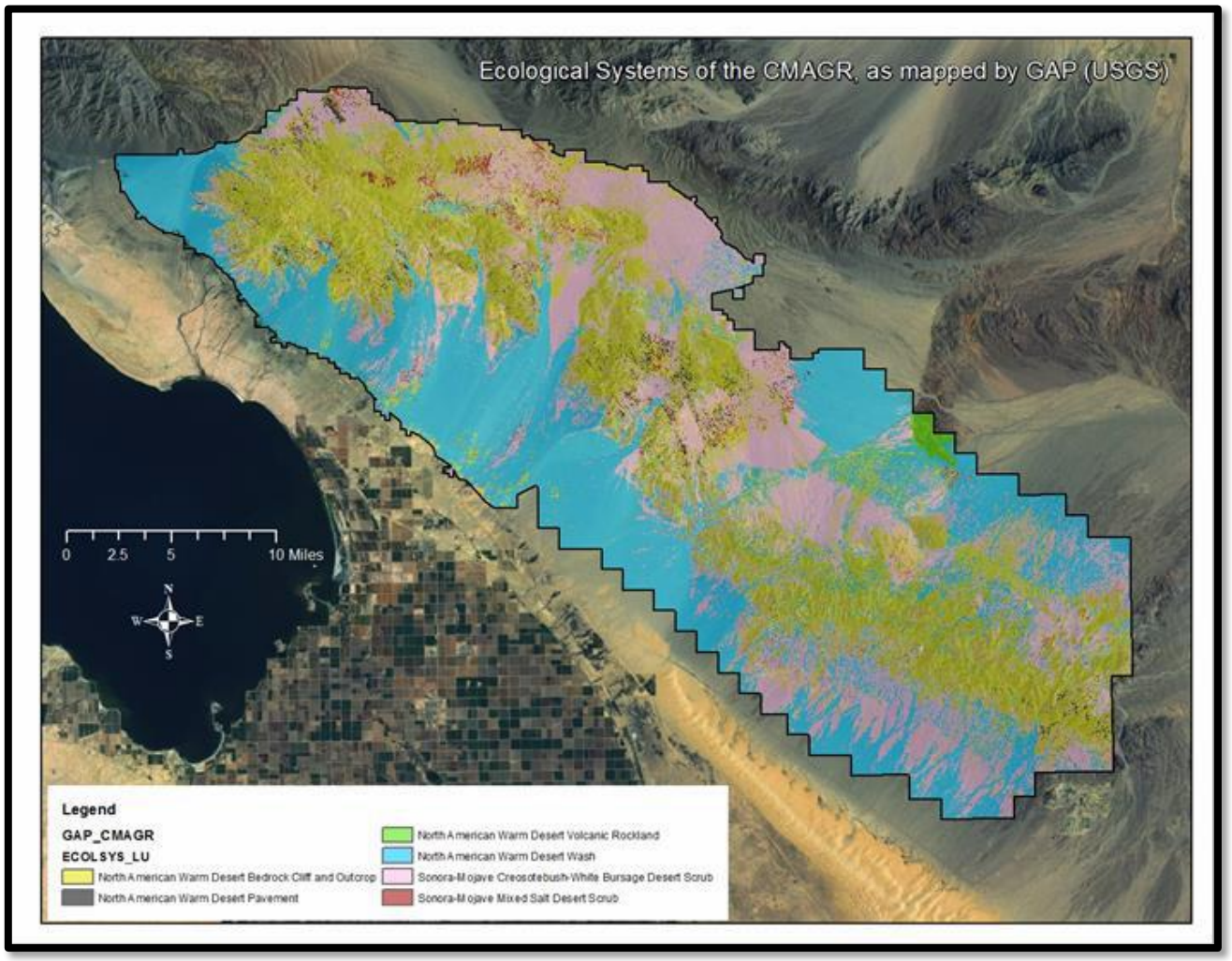

Figure 3. The GAP vegetation map, showing the ecosystems on the CMAGR.

Previous floras of the CMAGR

The Chocolate Mountains are very poorly represented in herbaria because of the highly restricted access. Previous to this study, there is no comprehensive flora. A recent tortoise study documented 115 species of plants (La Rue, 2013). From 2015 to 2018, we documented 287species on the CMAGR.

Methods

Vegetation Mapping

Our job was to develop a comprehensive vegetation map and GIS database for the CMAGR, for managing the vegetation communities on the CMAGR and to provide a baseline for ecosystem management. This is anticipated to be a five-year effort, given the size of the CMAGR (458,000 acres), the unforgiving summer heat, and difficulty of access due to range activity and extensive roadless areas (435,000 acres). Hence, the first four year's work (2015-2018) summarized in this report (1) establishes the range of vegetation associations/subassociations within those areas previously lumped under a single ecosystem; and (2) ensures that the map shall, so far as possible, use the same vegetation alliances and/or associations as those published for nearby Joshua Tree National Park (Keeler-Wolf et al., 2005), Anza Borrego Desert State Park (Keeler-Wolf et al., 1998), and the nearby lands between the Eagle Mountains and the Colorado River (Menke et al, 2013). After the range of vegetation is established, digitization of the vegetation map can proceed in the final year of the five year study.

Vegetation field sampling combined the data needs of the California Department of Fish and Wildlife (specifically, the Rapid Assessment form used by VEGCAMP 2015) with the protocol established for lands on the Cabeza Prieta National Wildlife Refuge ([CPNWR] Malusa, 2003a, b), the BMGR East (McLaughlin et al, 2007; Osmer, 2009; Shepherd, 2011; Whitbeck, 2013), and the BMGR West (Malusa and Sundt, 2015). This basic method is to become familiar with both the land and aerial images of the land – so familiar, in fact, that you can interpret an aerial image to determine to which vegetation type it belongs. Once proficient at the task, you can then draw the boundary of the vegetation (creating a "polygon") directly on the image displayed on a computer monitor while using a program called ArcGIS (Figure 4).

Figure 4. An example of how three different vegetation types might appear, using the view of an area about 400 meters across (1/4 mile) on the northeast side of the Gila Mountains of the BMGR – West. The two crooked black lines are the boundaries between three vegetation types in this example. In this particular example, it's easy to make the distinction between the desert pavement on the left, and the large arroyo in the middle. More difficult is placing the line between the arroyo and the vegetation to the far right, especially near the top right of the image, where the arroyo splits into many channels. The change is gradual, and an arbitrary rule must be created to distinguish the two.

Imagery used during this study includes the various vintages available on Google Earth and Bing, the 2012 Digital Ortho Quarter Quad (DOQQ) images from the National Agricultural Inventory Program (NAIP), and the 2015 Valley Air imagery commisioned by MCAS – Yuma. The images have a resolution of 1 meter of less, which renders vegetation and landscape as patterns: stippled creosote flats, wavy drifts of dunes, linear arroyos, teardrops of desert pavements, and more. This sounds easy enough – and sometimes it is easy, especially when they are associated with particular landforms, such as desert pavements.

More often it is not easy. No matter what level of detail you are mapping, you must have a rule for when one vegetation becomes another. These rules are often left unsaid, as they are with all previous vegetation maps of southwestern Arizona discussed above. To use the example of the GAP map and its two large mapping units, "North American Warm Desert Wash" and "Creosotebush-White Bursage Desert Scrub" – how is the line between them determined? There is no such line in nature, that instead there are fewer and fewer paloverde (and ironwood, *Olneya tesota*) as we move away from the active watercourses. The line on the map is a threshold created by the vegetation mapper. We strive to make rule sets by which we try to abide, e.g., if cheeseweed (*Ambrosia salsola*) is the dominant species, and ironwood is common and more than 1% cover, then it part of the Warm Desert Wash.

Such rules as of yet are in flux for the California desert, and there are no alliances or associations currently described for desert washes (March, 2016). There is instead only the higher level of "*Chilopsis linearis - Fallugia paradoxa - Prunus fasciculata* Desert Wash & Colluvial Slope Group" (Desert-willow - Apache Plume - Desert Almond Desert Wash & Colluvial Slope Group). This group "may be dominated by shrubs and small trees such as *Acacia greggii, Brickellia laciniata, Baccharis sarothroides, Chilopsis linearis, Ephedra californica, Ericameria paniculata, Fallugia paradoxa, Forestiera pubescens, Hymenoclea salsola, Hymenoclea monogyra, Hyptis emoryi, Juglans microcarpa, Lepidospartum squamatum, Olneya tesota, Parkinsonia florida, Prosopis spp.,Psorothamnus spinosus, Prunus fasciculata, Rhus microphylla, Salazaria mexicana, Sarcobatus vermiculatus, or Viguiera reticulata."*

In the Field

Fieldwork is necessary not only to figure out what we're looking at on the aerial imagery and help draw the bounds of each vegetation type, but also to give a statistical picture of the diversity and structure of the vegetation – how common is a species, what is its canopy cover, and how tall is it? To this end, we sampled 208 "relevés" during 2015. Relevés are not random. They are not the best way to "discover" vegetation types, but a way to describe them. In other words, the field biologists in this study – Malusa and Sanders – recognize different vegetation and seek to describe it in a way that is useful to other biologists. For instance, if you are interested in the bird known as Le Conte's thrasher, the relevé method and the resulting vegetation map are ideal, because you'll have a good idea of the species composition, the canopy cover, and height in every mapping unit.

For the purposes of this report, a relevé is the same as a rapid assessment. The method is simple. We used a data sheet based on that prescribed by California Department of Fish and Wildlife (Figure 5). Let's assume we're working as a team, Malusa and Sanders, and we seek to describe the vegetation on a desert pavement. I (Malusa) place myself squarely within a place that is, so far as possible, appears to be at least 50% devoid of vegetation on interfluves; in other words, all the vegetation is packed into the fluves, or small watercourses, between the nude interfluves (which are typically small stones, tightly fitted together). I pick a point on the horizon, then toss my walking stick over my shoulder; wherever it lands is the random starting point. From this point I first name the relevé with the first letters of the name of the 7.5 minute quad sheet, sequentially numbered, e.g., the first sample from the Little Mule Mountains quad is LMM-1. Sanders records the location with a GPS (UTM, Zone 11, NAD 1983) and takes a geo-tagged photo oriented along the path to be taken. The photo is later given the same name as the relevé. A brief environmental description is recorded: slope (a variety of inclinometers were used, from a simple protractor to an

iPhone app; and in areas of less than 3% slope, we just guessed), aspect, geomorphology, lithology, and dominant surface texture. See Appendix A for the protocol, per the requirements of California Dept. of Fish and Wildlife.

Then I begin walking toward the point on the horizon chosen earlier, keeping track of the number of paces with a hand clicker. An average step was 0.7 meters (2.3 feet). Each time the tip of my boot falls atop or under a plant canopy (including branches that may/may not be alive), that species is noted on the data sheet. More than one species can occupy the space above the point, especially in the case of a palo verde or ironwood, which often sheltered other species.

A list of all perennial species in the relevé is gathered as I walk, whether it receives a 'hit' or not. The precise width of the relevé depends on the sort of vegetation and the species observed – a lone ocotillo, for instance, can be spotted a mile away, while a pincushion cactus is a different story. The CMAGR is relatively open vegetation, and in most instances, such as relevé among creosote and bursage, it was possible to scan everything within ten meters to either side while 'walking the line". In the case of a typical 500 step relevé, this works out to 7000 square meters, or 0.7 hectares, or 1.7 acres.

I keep walking until no new perennial species are being added to the list. Transects ranged from 200 to 1000 points (about 200 to 700 meters), depending on the terrain and plant cover, with a lower number of points on steep slopes with higher cover, and a higher number of points on, say, a creosote flat with few species.

Watercourses and desert pavements have special protocols for relevés. Care is taken on desert pavements to walk perpendicular to the many small watercourses; otherwise, you can easily end up paralleling either the pavement or the watercourse, each of which differs dramatically from the other.

Watercourses are sampled along a single bank for 100 paces (about 70 meters). While walking in the watercourse, I pause with each step and made an imaginary line with my walking stick extending 2 meters back from the bank. Every species that fell along, above, or below that line was included as a 'hit'. This method was chosen because it was very difficult to run a point transect anywhere near the bank, which was a dense tangle of wolfberry and catclaw. Consequently, and unfortunately, the cover values generated from the watercourse relevés cannot be compared to those from other vegetation types. Instead, these cover values were solely to establish which species are dominant/co-dominant within the relevé, and to provide a picture for the reader of what the typical vegetation resembled.

Concluding the relevé, I'll tally up the number of 'hits' to figure out (1) the canopy cover and (2) the prominence of each perennial species. If a species got 20 hits in 500 paces, that's 4% canopy cover. The species with the highest cover value is the dominant species for that relevé. If the cover values of two or more species are close – say, with 1 or 2 % - they are considered co-dominant. If they are

neither dominant nor co-dominant, yet plain to see, they are common. (Expressed as a cover value, this is greater than 0.4% cover). Uncommon species have lower cover values, and you have to search for them unless they are very tall and obvious. In other words, a relevé with 5 saguaros over 300 meters would rank them as uncommon, though it was no trouble at all to find them. Finally, rare species are those with only one or two individuals discovered in the relevé. Keep in mind that doesn't mean one or two that received 'hits' from the point transect, but instead only one or two seen anywhere in the relevé.

The canopy cover and prominence values (as a code, Table 1) were entered on the data sheet (Fig. 5).

I then measure the mean height (n=10) from each perennial species that ranks as common, co-dominant, or dominant. Individuals were chosen haphazardly, which means that if there are a lot of juveniles in the population the mean height is skewed. To limit this effect in populations with many young recruits, I didn't measure individuals that were less than 1/10 the estimated mean height of adult plants, which in itself is merely an estimate. For instance, if a typical palo verde looked to be 2 meters tall, I didn't count juveniles 20 cm or less.

Height was estimated to the nearest 10cm, with the exception of trees and ocotillos, whose height was estimated to the nearest 0.5 m. Abundant annuals were noted in the relevé data and included in the association descriptions, although they may or may not be characteristic of a particular association – the seed banks of annuals can 'migrate' as conditions change. Regardless of their cover values, annuals were not assigned prominence values higher than 'common', and not as dominant or co-dominant, because the National Vegetation Classification is built on the relative abundance of only perennial species.

Ultimately, the boundaries between vegetation types will be drawn on a computer directly from imagery, but there were plenty of lines drawn in the field, too. For each of the approximately 30 "quarter quadrangles" (1/4 of a standard 7.5 minute topo sheet) within the CMAGR, a field map was created by printing out the DOQQ image at 1:10,000. At this scale, each millimeter on the map equals ten meters on the ground. When equipped with a GPS and ruler, it was then possible to place yourself within ten meters anywhere on the range, where notes could be appended directly to the map (Fig. 6).

Finally, binoculars and a spotting scope were especially useful in the mountains, where certain species, like desert beargrass (*Nolina bigelovii*), could be seen from up to a mile away. Each trip was recorded by our Garmin 550t GPS units as a GPX/shapefile/kml file that is included with the delivered data.

All relevé data were entered into a Microsoft Access database initiated by California Department of Fish and Wildlife. An example (screen shot) is shown in Figure 7.

CNPS and CDFW Combined Rapid Assessment and Releve Field Form Created September 3, 2015							
I. Location							
Project Code: CHOC	Stand ID:				Date:		
Name of Recorder:	Other surveyors:						
Location:							
UTME:	UTMN:				Photo #:		
UTME:	UTMN:				Orientation°:		
Elevation feet:	Exposure: N NE E SE S SW W NW Flat Variable						
Steepness, Actual°:_____ 0° 1-5° 5-25° >25°							
Macro-topography: top (saddle/summit/ridgeline) upper mid lower bottom entire slope bajada valley dunes pavements pediment broad wash narrow wash braided/flood plain bar/swale playa other							
Lithology: Mixed alluvium sandy alluvium schist basalt rhyolite granitic conglomerate sandstone							
% Surface Cover (Incl outcrops)	(>60cm diam)	(25-60cm)	(7.5-25cm)	(2mm-7.5cm)	(.0125-0.2cm)	(<.0125cm)	
Litter: Bedrock:	Boulder:	Stone:	Cobble:	Gravel:	Sand:	Silt/Clay:	
Cover Method Ocular Point intercept paces							
Site history, stand age, comments:							

Strata	Species	% Cover	Rank	Height / Notes

Figure 5. The data sheet used while taking relevés.

Table 1. Prominence codes (= 'rank') entered on the relevé data sheet during the study.

Prominence Codes
5 = dominant
4 = co-dominant
3 = common
2 = uncommon
1 = rare

Figure 6. A heavily annotated field map. Note the red grid, with each square covering 500 meters square.

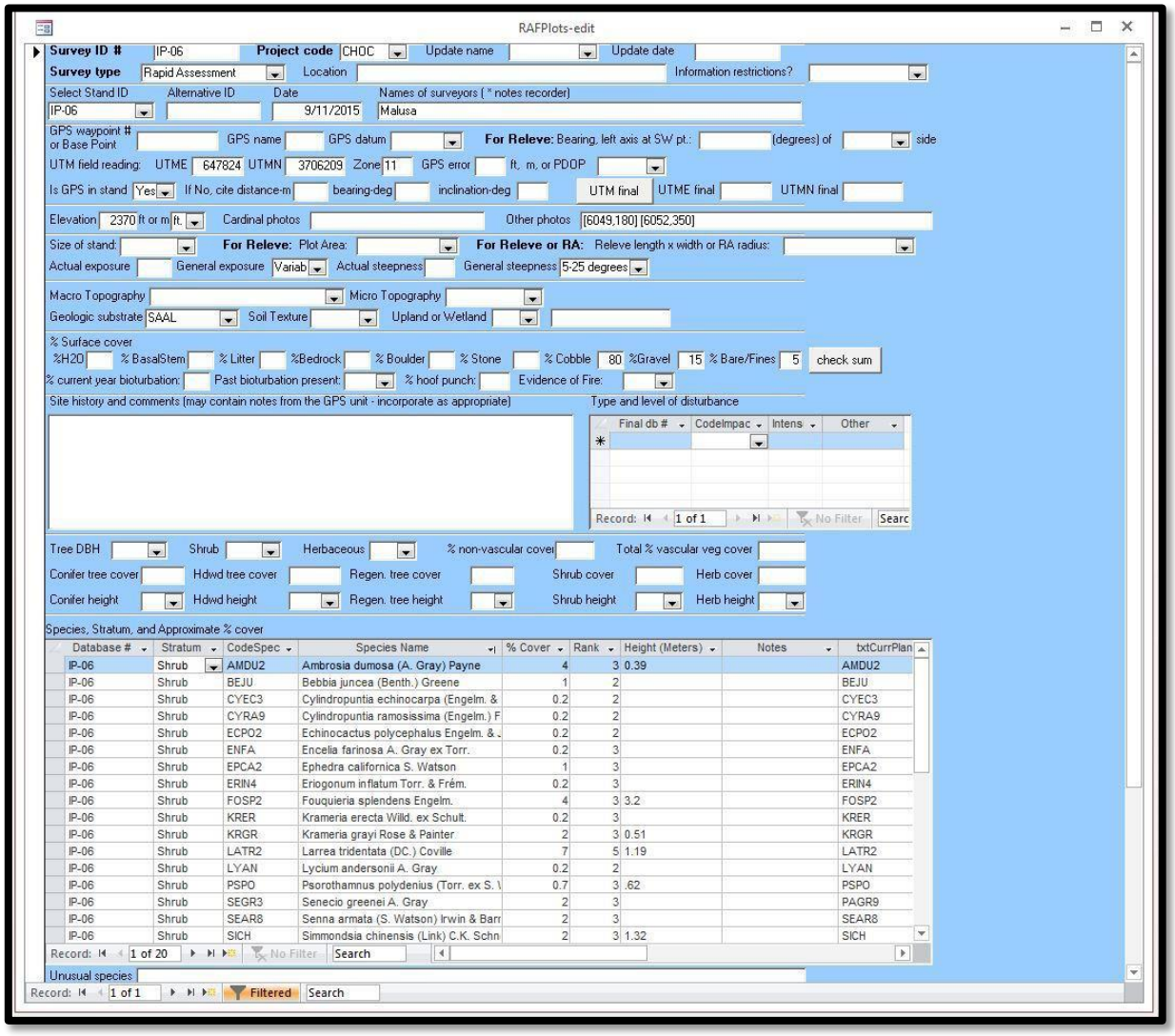

Figure 7. An example of a completed data table in the Access database, for releve IP-06.

Flora

Mr. Sanders collected intensively, both perennials and annuals, as species are encountered during closure periods from 2015 to 2018. Collections were typically made within a 100 to 1000 m radius of a point determined by topography and diversity. Enough material for at least two herbarium sheets is the minimum. Special note is taken of invasive species. The primary need in the Chocolates is for extensive documentation, especially of the more uncommon taxa that infrequently appear on maps in digital repositories such as SEINet or CCH. To this end, this study not only documents the flora for the first time, but improve the 'dot maps' botanists are building of species distributions in all dimensions -- lat/long, elevation, and season.

Results

Vegetation mapping and Flora

A total of 207 relevés were collected from 2015 to 2018. Each species encountered was assigned a taxonomic code currently in use by the California Department of Fish and Wildlife. All fields from the data sheets were entered in their respective tables. Photos from the relevés are renamed to match the relevé. As mentioned above, a relevé name is alpha-numeric. The letters are the first letters of the name of the 7.5 minute quad sheet in which it is found, sequentially numbered, e.g., the first sample from the Iris Pass quad is IP-1. The sixth releve from Iris Pass is IP-06, and the completed Access data table is shown, as an example, in Figure 7 above.

The GPX files from the Garmin GPS units were downloaded and transformed into shapefiles that work with ArcMap. The routes traveled during 2015 are shown if Figure 8.

Our reconnaissance of the CMAGR led us to withhold designation of the mappable vegetation units until we have more data from releves in the extreme NW and SE parts of the range. We expect that all the vegetation types will likely fall under three National Vegetation Classification (NVC) Macrogroups that cover most of the Mojave and Sonoran deserts in the southwestern United States. These macrogroups include: (1) Mojave-Sonoran Semi-Desert Scrub; (2) North American Cliff, Scree and Rock Vegetation; and (3) North American Warm-Desert Xeric-Riparian Scrub.

Within these macrogroups there are at least seven alliances: (1) *Opuntia bigelovii* Cacti Scrub Alliance, (2) *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance, (3) *Larrea tridentata - Fouquieria splendens* Upper Bajada & Rock Outcrop Desert Scrub Alliance, (4) *Ambrosia dumosa* Desert Dwarf Scrub Alliance, (5) *Encelia farinosa* Desert Scrub Alliance, (6) *Atriplex hymenelytra* Scrub Alliance, and (7) *Acacia greggii - Hyptis emoryi - Justicia californica* Desert Wash Scrub Alliance. Within these 7 alliances, we expect at least 15 vegetation associations to be present in the CMAGR. By way of comparison, 25 associations were described from the Barry M. Goldwater Range – West, an area that is about 40% larger than the CMAGR (Malusa and Sundt, 2015).

The flora has proceeded quickly, albeit with marginal rains. By the end of 2018, 287 taxa had been identified, and 1403 herbarium sheets had been catalogued and input into the Consortium of California Herbaria (http://ucjeps.berkeley.edu/consortium/). The complete list of records is in Appendix B.

An important part of the project was providing a properly curated collection for use by MCAS – Yuma. This has proceeded with the cooperation of Arizona Western College, Yuma, under the guidance of Dr. Cecilia Vigil, Professor of Biology, who has taken receipt of 168 specimens prepared by the Herbarium of University of California, Riverside. Dr. Vigil can be reached at Cecilia.vigil@azwestern.edu.

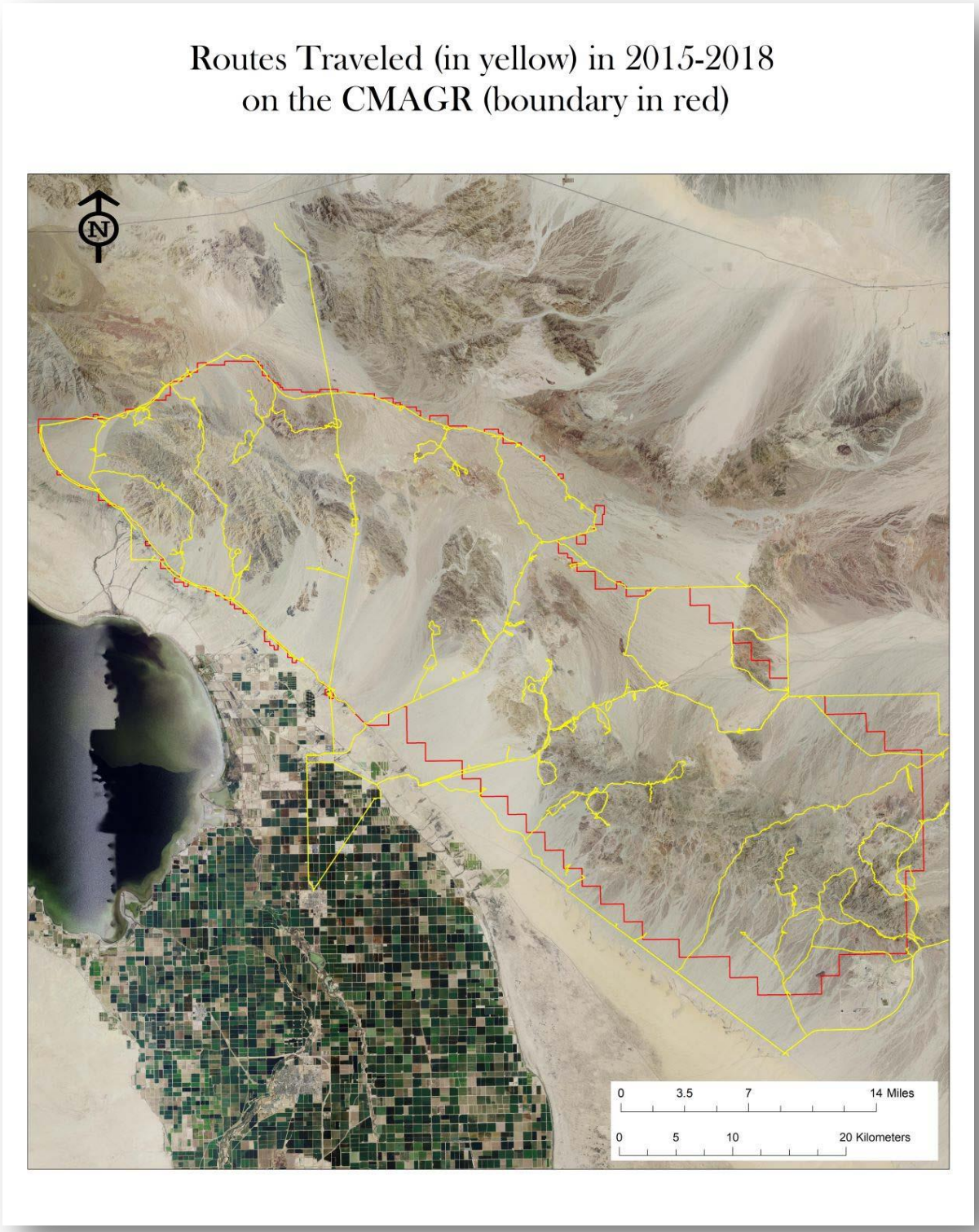

Figure 8 – Routes, shown in yellow, traveled by the authors in 2015-2018.

Invasive species

Finally, we have taken location/abundance data on invasive plant species in the CMAGR. In sum, Sahara mustard, *Brassica tournefortii*, is the only invasive which appears widespread over the range. However, it is common only along roads, particularly near Camp Burt. This is not surprising, as this species, like many invasives, is correlated with disturbance (Brooks and Berry, 2006; Li and Malusa, 2014). The distribution of the mustard, to date, is shown in Figure 9. This map also records several other invasive species: *Tamarix ramosissima, T. aphylla, Sonchus asper* (sow thistle), *Erodium circutarium* (filaree), *Phalaris minor* (Canary grass) and *Sorghum bicolor* (Sudan grass). The latter was found in only one locality.

The locations/abundance are also available online on GISCloud, by going to: https://editor.giscloud.com/

In the 'Search maps' box, type Goldwater. You will be directed to a dynamic map showing the latest localities of invasive plants in both the CMAGR and BMGR-West.

Figure 9. Locations of invasive species found during mapping and flora studies. Red indicates a high abundance, meaning over 100 individuals within 100 feet of the photo plot. For a fuller explanation of abundance and identity of invasive species, go to: https://editor.giscloud.com/ In the web page that comes up, type Goldwater in the Search Maps box, and the dynamic map will appear, with the latest updates on the invasive species.

Acknowledgements

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Appendix A: Protocol for RA/Relevé Database Entry

(The text below was simply copied and pasted from the California Dept. of Fish and Wildlife, at http://www.dfg.ca.gov/biogeodata/vegcamp/veg_publications_protocols.asp)

General guidelines

Keep a journal. List any questions, ideas, problems, etc. in the journal as you enter the data, and reference each journal entry to the **Stand ID**. This protocol includes instructions on how to resolve some common problems (for example, when surface covers do not add up to 100%). Other errors should be corrected with the help of field staff or your team lead.

Default values. An error message box may show up sometimes when entering data, as we have set standards for certain fields (e.g. in the Species list box, you can only enter a **% cover** value that between 0.1 and 101). You cannot proceed until the field has data entered appropriately. Also, once you start a new record ("Enter full plot info" button) you must enter a Stand ID in order to move on to the next field.

If a field was not filled out on the datasheet by the crew person, it should appear as a blank (or null entry) in the database or as an "N/A" (not applicable) if a null entry is not possible. Zero should only be used if the field person intended to indicate a zero (for example, a slash through the field "% Surface Cover H2O" was meant to indicate a value of "zero").

Data flow

Data is collected for Rapid Assessment (RA) and Relevé field surveys in three places: a GPS device is used to capture basic stand information and spatial location data, a paper data sheet is used to collect environmental and plant data, and photos are taken of the stand. The GPS data is uploaded to an ArcGIS database and the physical location of each survey is verified.

Photos are uploaded from the field cameras and the photos for each stand are placed within the project directory in a folder named with the Stand ID. Photos for projected RAs receive special handling, as described below.

After the GPS data has been verified, it is imported from the ArcGIS database into the production RA/Relevé database, and information from the paper data sheets is added to each survey record.

Opening the database and entering data in form view

Make sure you have an up-to-date version of the Access database saved to your desktop. There will be a separate front-end database (a shell which stores the forms but not the data) for each

project, stored in the "SurveyData" folder in the project directory on the V: drive. You must copy the front-end database to your local hard drive and use that copy for your data entry; **do not** use a front-end database from a different project.

When the database is opened, a "Main Menu" will be presented. These instructions apply only to Rapid Assessment and Relevé data entry, so only the "Edit full plot info" and "Enter full plot info" options will be discussed.

Enter vs. Edit.

These instructions assume that skeleton records have been imported into the database from GPS units used to collect data in the field. You will begin your data entry session by selecting **Edit full plot info** from the main menu. If you are entering data from scratch, select **Enter full plot info** from the main menu. Enter the information from the data sheet that would normally be imported from the GPS unit. See the section "Description of Individual Fields – Data Entry" at the end of this document for fields that are treated differently when data are not imported from GPS units.

Starting data entry in the "RAFPlots-edit" Form

When you press the **Edit full plot info** button from the main menu, the RAFPlots-edit form will be presented. The cursor will be placed in the "Select Stand ID" field, which will be blank, even though there is information in the rest of the form. Type in the Stand ID of the record you want to enter or select the Stand ID from the drop-down list. The information that has been imported for that survey will be presented and you can continue to enter information from the data sheet as specified in the "Description of Individual Fields" below.

The entire entry form will not fit on the computer screen; use the scroll bar on the right to access the fields on the bottom of the form.

When you have finished entering the data for a survey, scroll back to the top of the form and select the Stand ID for the next survey you want to enter.

Starting data entry in the "RAFPlots – Enter new records" Form

When you press the **Enter full plot info** button from the main menu, the "RAFPlots – Enter new records**"** form will be presented. The cursor will be placed in the Stand ID field; when you enter the Stand ID, the Survey ID # will be filled in automatically. Enter all data as specified in the "Description of Individual Fields" below.

Note: If this is a return visit to a plot that has been previously surveyed, you must append a character to the Survey ID # to make it unique. For example, a revisit to CARR1234 would have a Stand ID of "CARR1234" and could have a Survey ID # of "CARR1234a."

The entire entry form will not fit on the computer screen; use the scroll bar on the right to access the fields on the bottom of the form.

When you have finished entering the data for a survey (i.e., when you tab out of the "Other ID or mapping info" field), the current record will be saved and a blank screen will appear with the cursor in the Stand ID field.

To leave the database:

Once you are finished, you may click the X button at the top-right of the Access window to close the database. All data that you have entered will be saved in the form and associated tables.

Description of Individual Fields – Data Edit

*** =** Field is treated differently on the "Enter new records" screen. See **Description of Individual Fields – Data Entry** below.

***Survey ID #:** Automatically entered when the record is created. It will be the same as the Stand ID and will not need to be modified.

***Project code:** Automatically entered when the record is created. This is the 4-character code for the project, such as "PYGM" for Pygmy Forest or "SSNF" for Southern Sierra Nevada Foothills.

***Update name:** Enter your name here. If your name does not appear on the drop-down menu, you may enter it using the "User Settings" button on the main menu.

***Update date:** Enter today's date. Access will fill this in automatically if you press and hold the Ctrl key as you hit the semicolon key.

***Survey type:** Automatically entered when the record is created. This should be Relevé or Rapid Assessment; verify against the datasheet.

Location: Enter the physical location where the survey was taken. This may be the name of a public property, such as a state park, or the name of a private landowner.

Information restrictions?: Leave this blank; it will be updated at the end of the project.

***Select Stand ID:** Automatically entered when the record is created. This field cannot be changed. Enter a Stand ID to select a survey to edit.

Alternative ID: Enter if provided on the datasheet. This field is project-specific and may be used for an allocation point UID, air photo number or other information. Before entering data, check to see which information from the datasheet should be entered into this field.

***Date:** Automatically entered when the record is created. Verify against the datasheet.

Names of surveyors: Enter the initials of all the people that participated in the survey. The recorder should be denoted with an asterisk (*) or tilde (~) (e.g., DEH*, ANK). If a person that is not a regular member of the surveying crew participates in a survey, his/her name should be entered here using the first initial and full last name (e.g. D. Hillyard).

GPS Waypoint #: Enter if provided on the datasheet. If this is a projected RA (i.e., GPS in stand = No), enter the ID of the base point in this format: "Base point: ZOE1506111205."

***GPS name:** Automatically entered when the record is created. Verify against the datasheet.

***GPS datum:** Automatically entered when the record is created. Verify against the datasheet.

Bearing, left axis at SW pt (degrees) of <u>Long or Short</u> side: (for Relevé only)
For square or rectangular plots: from the SW corner (= GPS point location), looking towards the plot, record the bearing of the axis to your left in degrees. If the plot is a rectangle, indicate whether the left side of the plot is the long or short side of the rectangle (no need to enter a side for circular or square plots).

***UTM Field reading: UTME, UTMN:** Automatically entered when the record is created. Verify against the datasheet. For a Rapid Assessment where the GPS point is not in the stand (a projected survey), these are the UTMs of the point where the surveyors are standing (the base point), not the UTMs of the projected point within the stand.

***Zone:** Automatically entered when the record is created. Verify against the datasheet. Either 10 or 11 for California.

GPS Error, ft, m, or PDOP: Type in the error (accuracy) value, and select the appropriate unit from the drop-down menu.

Is GPS in stand? If No, cite distance-m___bearing-deg____inclination-deg : If No is entered, type in the distance (in meters), bearing (in degrees, between 1 and 360), and inclination (in degrees) as recorded. These will be used to calculate the UTM values for the projected point within the stand (UTME final and UTMN final).

***UTM final (Button):** Click this button if values for UTME final and UTMN final are not already filled in. Final UTMs will be calculated from the field readings, including the distance, bearing and inclination for projected RAs.

***UTME final and UTMN final:** Automatically entered when the record is created or when the UTM final button is clicked.

Elevation, ft or m: Type in elevation, and select the appropriate units.

Cardinal photos: Enter the camera name first, the range of photo numbers, and then the direction of the photos (e.g., A12: 123-126 > N-W). If this is a projected RA, the cardinal photos will be stored in a folder named for the base point, so a comment should be added to make that clear (e.g., A12: 123-126 > N-W at base point).

Other photos: Enter the numbers of any additional photos, with a description of the photo subject (e.g., 127 stand looking NW, 128 ground vegetation, 129 unknown Aster)

Size of stand: Select a size from the drop-down menu.

Plot Area: For a Relevé, select an area from the drop-down menu. A value may be typed into this field if the drop-down menu does not list the plot area for this stand.

Relevé length x width or RA radius: For a Relevé, select from the drop-down menu or type in the dimensions of the plot in meters. For an RA, type in the radius in meters for which the survey applies.

Actual exposure, General exposure, Actual steepness, General steepness: First enter the actual value (e.g. 345, in degrees, for exposure), then use the drop-down menu to record the general value (e.g. NW, for exposure). Steepness is also recorded in degrees. If the actual exposure or steepness was not measured in the field, leave the field blank. If both general and actual exposure and steepness were recorded, please confirm that the general and actual values are consistent.

Macro Topography: Use the pick-list to select the macro-topography, which contains the variety of topographic features that may have been checked on the field form (e.g., upper, mid, lower, or bottom).

Micro Topography: Use the drop-down menu and select one of the following: flat, convex, concave, or undulating.

Geologic substrate: Select a code from the drop-down menu. If this is consistently left blank, check with your team lead to see if you should use a geology layer for the project to determine this and fill in.

Soil Texture: Select a soil texture code from the drop-down menu.

Upland or Wetland: Select one from the pick-list (select 1 for Upland and 2 for Wetland or Riparian). If the field form is lacking this, look at the site history and species list to figure out which it is (or write in your journal that this is missing).

% Surface cover:

% H2O, % BasalStem, % Litter, %Bedrock, % Boulder, % Stone, % Cobble, % Gravel, % Bare/Fines: Enter the percentages as recorded on the datasheet. Enter 0.2 for <1%; otherwise, enter the specific value from the datasheet (e.g., 70, 0, etc). Note that basal stems should not be more than 2-5% in most situations. All these numbers should add up to approximately 100%. If the numbers do not add up correctly, you may alter them by adjusting the value of

the largest cover category if it appears obvious that the crew made a simple subtraction error. If the cover values are evenly distributed, then the error should be distributed among them proportionally.

Check sum (button): Press this for a pop-up window that shows the total of the surface cover values entered above. This total should be between 98% and 102%.

% current year bioturbation: Enter the percent cover of this year's bioturbation, as seen on the datasheet. Enter 0.2 for <1%; otherwise, enter the specific value from the datasheet (e.g. 3, 0, etc.).

Past bioturbation present: Enter yes or no as recorded on the datasheet.

% hoof punch: Enter the percent cover of sample or stand surface that has been punched down by hooves (cattle or native grazers) in wet soil. Enter 0.2 for <1%; otherwise, enter the specific value from the datasheet (e.g., 2, 0, etc.).

Site history and comments (may contain notes from the GPS unit – incorporate as appropriate): If notes were taken on the GPS unit, they will have been automatically entered here when the record was created. These should be added to the information on the datasheet if not already addressed there. Enter what is seen on the datasheet. However, edit to make as readable as possible. If the meaning is unclear, check with the writer of the form. If the writer is not available, check with someone else to see if they can understand what is being said. Use standard rules of punctuation and capitalization (capitalize genus names and not species epithets). Do not leave abbreviations. All plant acronyms must be expanded to avoid confusion in the future. For instance, if QULO is written on the datasheet, Quercus lobata must be typed into the database.

Type and level of disturbance (sub-form):

This is a sub-form, in which you should skip over (using tab) the Final db # field and go directly to the CodeImpact field. The Final db # will be automatically filled once you enter a CodeImpact value.

CodeImpact: Use the drop-down menu to select the type of disturbance (e.g. 1, for development).

Intensity: Select an intensity code (e.g. 1, for Low level of disturbance). If an intensity level is missing on the field form, enter an intensity of "1" for that impact.

For an impact that is not listed in the CodeImpact column, enter a code of 13 and use the **Other** field to give a description of the disturbance (e.g., grading/disking).

Skip over this subform box if no disturbance impacts are listed on the datasheet.

Tree DBH: Enter tree size class when the tree canopy closure exceeds 10 percent of the total cover (except in desert types), or if young tree density indicates imminent tree dominance. Select a DBH code from the drop-down menu as indicated on the datasheet. This may be left blank if the stand is not a tree type.

Shrub and Herbaceous: Enter if circled on datasheet by using the drop-down menu, or skip over these fields if none are circled.

% non-vascular cover: Enter the total cover of all lichens and bryophytes (mosses, liverworts, hornworts) on substrate surfaces including downed logs, rocks and soil, but not on standing or inclined trees, as seen on datasheet. For <1%, enter a value of 0.2.

Total % vascular veg cover: Enter the numeric value as recorded on the datasheet.

Conifer tree cover, Hdwd tree cover, Regen. tree cover, Shrub cover, Herb cover: Enter a numeric value if recorded on datasheet (e.g. 25). Make sure to enter "0" for fields without representative cover values. For <1%, enter a value of 0.2. Fields should remain null for distance surveys when you are unable to assess cover values for a particular layer (e.g., the herbaceous layer from a distance of 300 meters).

Conifer height, Hdwd height, Regen. tree height, Shrub height, Herb height: Use the drop-down menu to select the appropriate code. Make sure to enter "0" in fields without representative height values. Fields should remain null for distance surveys when you are unable to assess height for a particular layer (e.g., the herbaceous layer from a distance of 300 meters).

Species, Stratum, and Approximate % cover:

This is a sub-form, in which you should skip over (using tab) the Database # field, which will be automatically filled.

Stratum: Use the drop-down menu. Enter Herb (H on the datasheet), Shrub (S), Tree (T), Sapling (A), Seedling (E), Non-vasc (N). Please correct the stratum if the field personnel assigned it incorrectly (and try to adjust the total percent cover estimates for the correct strata). In some cases, the stratum of a particular species might not be obvious. For example, in the desert Juniperus californica has the size and growth habit of a shrub, but it is considered a tree. It is useful to have a list of ambiguous strata for each project.

Only data that is known to be as accurate as possible should be entered. If the full species name is listed on the datasheet but the identification is not definite (recorded with a "?" or in parentheses), record only the genus or family name into the "CodeSpecies" field. Whatever level of taxonomy is confidently known should appear in the species field (e.g., forb). Any indefinite or uncertain notations should be recorded in the comments field. For example, if

the datasheet says "*Bromus (rubens*)", the plant should be recorded as *Bromus*, with "(*rubens*)" in the Notes field.

CodeSpecies and **Species name:**

After the stratum is entered, go to *either* the **CodeSpecies** *or* the **Species name** field to select a species name from the drop-down menu, as described below.

If you start typing in a **CodeSpecies**, make sure to type in the first two letters of the genus and then the first two letters of the specific epithet (with no spaces) for that species (e.g., METO for *Melica torreyana*). The drop-down menu will search for all the matching codes with that spelling. Select the appropriate species code. Once a species code is selected, tab over to the **Species_name** field and the correct name will automatically be filled in. Use this field carefully as many very different plants have codes that are very similar.

You may skip over the CodeSpecies field and type directly into the **Species name** field instead. Start typing in the genus name and the drop-down menu will start searching for that name. Continue typing until the species name appears, or you can use the drop-down menu to find the appropriate name. Then tab over to the **% Cover** field, and the CodeSpecies field will be automatically filled in.

Additional notes for these fields:

If a plant has only been determined to the genus level, start typing in the genus name in either the "CodeSpecies" or "Species_name" field. Select the appropriate genus from the drop-down menu, and tab over to the next field.

If a plant has only been determined to the family level, start typing in the family name in the "CodeSpecies" field or "unknown" then family name in the "Species_name" field. Select the appropriate family from the drop-down menu, and tab over to the next field.

Please be accurate and consistent with use of scientific names, and use the latest Jepson Manual nomenclature. Sometimes collectors of the field data will use nomenclature inconsistent with Jepson, and these "old" names may be found in the drop-down menu. For instance, both *Chrysothamnus albidus* and *Ericameria albida* can be found in the menu, but you should use *Ericameria albida*. Enter "*Chrysothamnus albidus"* in the Notes field to indicate what was entered on the datasheet.

If the lookup list does not contain the species you want, please tell your supervisor, who will need to add a new species code and name to the drop-down menus.

% Cover: Type in a numeric value between 1 and 100 as recorded on the datasheet. If the cover value was recorded as "<1" or "+," enter 0.2. If the cover was recorded as "r," enter 0.11.

If percent cover was not recorded for a species on the datasheet, leave this field null and enter "% cover not recorded" in the Notes field. If the species is named in the Field Alliance or Association, or is prominent in the stand photos, then check with the field crew to determine a reasonable cover value.

Collection: If a species collection has been made and is PRESSED use this data entry column. All plants with a pressed collection should have something entered in this field. Enter **unconfirmed** (a plant was collected and pressed, but the identification is uncertain or not known from this area), **confirmed** (a plant was collected and pressed; it was identified to the extent possible and range issues have been dealt with), **deposited** (a plant was collected and pressed; a label or database info was produced for this specimen and it was given (or is en route) to an herbarium, or **thrown out after confirmation** (a plant was collected and pressed; it was identified to the extent possible and was discarded). The following codes on the datasheet correspond to these entries in the Collection field:

C or CU: unconfirmed
CC: confirmed
CD: deposited
CT: thrown out after confirmation

If a specimen has not been collected, leave the field blank (null).

Notes: Enter any notes from the datasheet or clarifications to the species made during data entry. Expand any abbreviations to make the meaning of the notes clear.

txtCurrPlant: This field should not be changed during data entry. It is automatically filled in from the PLANTS table with the most current code for this plant.

Changed: This is a check box that will not be used during data entry. This will be checked if a species name has changed as a result of a redetermination or update from an herbarium review. The new name will be recorded in the CodeSpecies and Species Name fields, and the old name will be recorded in the Notes field along with any other notes on the name change.

Note: If you make an error and create more records than needed, you can remove these records by doing the following: Move your mouse to the left-hand edge of the row that you want to remove, right click to highlight the row, and then choose Delete Record.

Unusual species: Type in any species recorded as unusual. However, make sure the species are also entered in the species list sub-form.

Field alliance, Field association: Use scientific nomenclature for names listed in both the alliance and association. Leave blank if nothing was recorded.

When more than one species is named in the alliance or association, use a dash if the species are in the same stratum (e.g., both are shrub species) and a slash when they are in different strata (e.g., tree and shrub, shrub and herb). Leave a space between the dash or slash and the species names. (See *A Manual of California Vegetation* for more explanation.)

For example: *Arctostaphylos patula – Ceanothus cordulatus*
Pinus ponderosa / Arctostaphylos viscida

Pay special attention to the spelling of plant names. To avoid misspellings, you can look up the scientific name in the drop-down menu of the **Species name** field (the lookup list found in the Species, Stratum, and Approximate % Cover sub-form), then cut and paste the name into the alliance or association field.

AdjAll 1, AdjAll 2, AdjAll 3: Enter the adjacent alliances, as seen on the datasheet, and the direction of the stand relative to the stand being surveyed. For example, "JUCA 50m / S" on the datasheet would be entered as "*Juniperus californica* 50 m, south" in the database. If there are more than three adjacent alliances listed on the datasheet, you can put more than one in each field. Do not leave abbreviations. All plant acronyms must be expanded to avoid confusion in the future. For instance, if QULO is written on the datasheet, Quercus lobata must be typed into the database.

Confidence in identification: Type in L for Low, M for Moderate, or H for High confidence (with respect to the naming of the Alliance).

Explain: Enter the explanation as recorded on the datasheet.

Phenology: Herbaceous, Shrub, Tree: Enter as recorded on the datasheet; if not applicable, chose N/A.

Other ID or mapping info: Enter if recorded on datasheet, or skip over the field if not.

***Entry name:** Automatically entered when the record is created.

***Data entry date:** Automatically entered when the record is created.

***Data entry time:** Automatically entered when the record is created .

Quality Control date: This field will not be used during data entry. Enter today's date if you are quality-controlling the full plot info. Access will fill this in automatically if you press and hold the Ctrl key as you hit the semicolon key.

QC: This is a check box that will not be used during data entry. Check this box if this record has been quality-checked.

Description of Individual Fields – Data Entry

Stand ID: Enter the Stand ID. The format should be the 4-character project code followed by 4 digits. For example, a stand in the Pygmy Forest project might be "PYGM0123."

Survey ID #: This will be the same as the Stand ID. If this is a return visit to a plot that has been previously surveyed, you must append a character to the Survey ID # to make it unique. For example, a revisit to CARR1234 would have a Stand ID of "CARR1234" and could have a Survey ID # of "CARR1234a."

Project code: Select the 4-character code for the project from the drop-down menu. If your project does not appear on the list, an entry must be made for it in the RAProjects table (you may use the "Edit Projects" button from the main menu).

Entry name: Enter your name, or select it from the drop-down menu. If your name does not appear on the list, you may go back to the main menu and add your name using the "User Settings" button.

Data entry date: Automatically entered when the record is created.

Data entry time: Automatically entered when the record is created.

Survey type: Choose Relevé or Rapid Assessment from the drop-down menu.

Date: Enter the date of the survey.

GPS name: Enter the name of the GPS unit from the datasheet.

GPS datum: Enter the GPS datum from the datasheet.

UTM Field reading: UTME, UTMN: Enter values from the datasheet. For a Rapid Assessment where the GPS point is not in the stand (a projected survey), these are the UTMs of the point where the surveyors are standing (the base point), not the UTMs of the projected point within the stand.

Zone: Enter 10 or 11 for California.

UTM final (Button): Click this button to calculate final UTMs from the field readings, including the distance, bearing and inclination for projected RAs.

UTME final and UTMN final: Automatically entered when the UTM final button is clicked.

Appendix B. Plant species from Chocolate Mountains Aerial Gunnery Range, California

PTER	Cheilanthes parryi (D.C. Eat.) Domin	perennial	N	C+ (>1 coll.)	Locations: S,
PTER	Notholaena californica D. C. Eat.	perennial	N	C (=1 coll.)	
EPHE	Ephedra aspera Engelm. ex S. Wats.	shrub	N	C+	Locations: S, Tabaseca, G,
EPHE	Ephedra californica S. Wats.	shrub	N	C+	Locations: N, OP, G
ACAN	Justicia californica (Benth.) D. Gibson	shrub	N	C+	Mt. Barrow
AIZO	Mesembryanthemum nodiflorum L.	annual	I	C+	Camp Billy Machen
AMAR	Amaranthus fimbriatus (Torr.) Benth. ex S. Wats.	annual	N	C+	Locations: S, N, OP, G,
AMAR	Tidestromia suffruticosa (Torr.) Standl. var. oblongifolia (S. Watson) Sánch. Pino & Flores Olv.	perennial	N	C+	NE edge along road
APOC	Amsonia tomentosa Torr. & Frem.	perennial	N	C+	above Tabaseca
APOC	Asclepias albicans S. Wats.	shrub	N	C+	Locations: S, Tabaseca, G,
APOC	Asclepias erosa Torr.	perennial	N	C+	Skyline Rd. near Camp Burt
APOC	Asclepias subulata Dcne.	perennial	N	C+	Locations: S, N, Iris Pass
APOC	Funastrum cynanchoides (Decne.) Schltr.	perennial vine	N	C+	(= Sarcostemma c.) Locations: S, N, Bradshaw
APOC	Funastrum hirtellum (A. Gray) Schltr.	perennial vine	N	C+	(= Sarcostemma h.) Locs: S, Tabaseca, G,
APOC	Funastrum utahense (Engelm.) Liede & Meve	perennial vine	N	Hypothetical	Closest: Chuckwalla Bench, 3 mi. E of range, 2013
APOC	Matelea parvifolia (Torr.) Woodson	perennial vine	N	C	Tabaseca, Bradshaw Tr.
ASTE	Acamptopappus sphaerocephalus (Harv. & Gray) Gray	shrub	N	C+	N, OP,
ASTE	Adenophyllum porophylloides (Gray) Strother	woody perennial	N	C+	(= Dyssodia p.) S, N
ASTE	Ambrosia dumosa (Gray) Payne	shrub	N	C+	S (Salvation Pass), N (north), T (Tabaseca), OP (OP Slats), G (gasline camp),
ASTE	Ambrosia ilicifolia (Gray) Payne	shrub	N	C+	Salvation Pass
ASTE	Ambrosia salsola (T & G) Strother & Baldwin var. salsola	shrub	N	C+	(= Hymenoclea s.) S, N, Tabaseca, OP, G,
ASTE	Atrichoseris platyphylla (Gray) Gray	annual	N	C+	S, Tabaseca

ASTE	Baccharis brachyphylla A. Gray	shrub	N	C+	S, N, Tabaseca, G, Bradshaw
ASTE	Baccharis sarothroides Gray	shrub	N	C+	Tabaseca, Mammoth Wash
ASTE	Baccharis sergiloides Gray	shrub	N	C	W of Beal Well
ASTE	Bahiopsis parishii (Greene) E.E. Schill. & Panero	shrub	N	C+	(= Viguiera p.) S, N, Tabaseca, G,
ASTE	Baileya pauciradiata Harvey & Gray ex Gray	annual	N	Hypothetical	Closest: Amos, 1 mi. W of range boundary, 1978
ASTE	Baileya pleniradiata Harvey & Gray ex Gray	annual/biennial	N	C+	
ASTE	Bebbia juncea (Benth.) Greene var. aspera Greene	shrub	N	C+	S, N, Tabaseca, OP, G,
ASTE	Brickellia desertorum Coville	shrub	N	C+	
ASTE	Brickellia incana Gray	shrub	N	C+	
ASTE	Calycoseris wrightii A. Gray	annual	N	C+	Hayden Well, Dietz Rd., Camp Burt,
ASTE	Chaenactis carphoclinia A. Gray var. carphoclinia	annual	N	C+	S, N, Tabaseca,
ASTE	Chaenactis stevioides Hook. & Arn.	annual	N	C+	
ASTE	Conyza canadensis (L.) Cronq.	annual	I	C	wash W of Camp Burt
ASTE	Encelia farinosa Gray ex Torr.	shrub	N	C+	S, N, Tabaseca, OP,
ASTE	Encelia farinosa var. phenicodonta (Blake) Jtn.	shrub	N	C+	Beal
ASTE	Encelia frutescens (Gray) Gray	shrub	N	C+	S, N,
ASTE	Ericameria paniculata (Gray) Rydb.	shrub	N	C+	Salt Creek
ASTE	Eriophyllum lanosum (Gray) Gray	annual	N	C+	S,
ASTE	Geraea canescens Torr. & Gray	annual	N	C+	Hayden Well, near Burt
ASTE	Isocoma acradenia (Greene) Greene	shrub	N	C+	Coachella Canal
ASTE	Lactuca serriola L.	annual	I	C+	Waifs (?) along washes.
ASTE	Malacothrix coulteri A. Gray	annual	N	C+	
ASTE	Malacothrix glabrata A. Gray	annual	N	C+	N boundary; Chuck. Bench, 2013; Coach. Canal 2005

ASTE	Monoptilon bellioides (Gray) H.M. Hall	annual	N	C+	"confluence"/Salvation
ASTE	Palafoxia arida B.L. Turner & M. Morris var. arida	annual	N	C+	G, Ted Kipf Rd./edge of range
ASTE	Pectis papposa Harvey & A. Gray var. papposa	annual	N	C+	S, N, G
ASTE	Perityle emoryi Torr.	annual	N	C+	S, N, Tabaseca, G,
ASTE	Peucephyllum schottii A. Gray	shrub	N	C+	S, Gable Wash
ASTE	Pleurocoronis pluriseta (Gray) King & H.E. Robins.	shrub	N	C+	S, Tabaseca, Iris Pass
ASTE	Pluchea odorata (L.) Cass. var. odorata	perennial	N	C	Specimen 1989 at SW edge
ASTE	Pluchea sericea (Nutt.) Cov.	shrub	N	C+	W of Burt, Coachella Canal, Mt. Barrow
ASTE	Porophyllum gracile Benth.	subshrub	N	C+	S, N, Tabaseca, OP,
ASTE	Prenanthella exigua (Gray) Rydb.	annual	N	C+	S, confluence, Beal
ASTE	Psathyrotes ramosissima (Torr.) Gray	annual to subshrub	N	C+	Hayden, Rock Quarry, Cyn. Spr
ASTE	Psilostrophe cooperi (Gray) Greene	subshrub	N	C+	N, Bradshaw
ASTE	Rafinesquia neomexicana Gray	annual	N	C+	S, Tabaseca
ASTE	Senecio mohavensis Gray	annual	N	C+	S,
ASTE	Sonchus asper (L.) Hill	annual	I	C+	
ASTE	Sonchus oleraceus L.	annual	I	C+	S,
ASTE	Stephanomeria pauciflora (Torr.) Nutt.	shrub	N	C+	S, N,
ASTE	Stylocline micropoides A. Gray	annual	N	C	Beal,
ASTE	Trichoptilium incisum A. Gray	annual/perennial	N	C+	Tabaseca
ASTE	Trixis californica Kellogg	shrub	N	C+	S, G,
ASTE	Xylorhiza tortifolia (T. & G) Greene	perennial	N	C+	S, = Machaeranthera t.
BIGN	Chilopsis linearis (Cav.) Sweet ssp. arcuata (Fosberg) Henrickson	shrub/tree	N	C+	N, Salt CR., Bradshaw
BORA	Amsinckia intermedia Fisch. & C.A. Mey.	annual	N	C+	Burt,

BORA	Amsinckia tessellata Gray var. tessellata	annual	N	C+	S, N, u Niland-Blythe Rd.
BORA	Cryptantha angustifolia (Torr.) Greene	annual	N	C+	Lg. fld. white form
BORA	Cryptantha angustifolia (Torr.) Greene	annual	N	C+	Small-fld green form
BORA	Cryptantha barbigera (Gray) Greene var. barbigera	annual	N	C+	S,
BORA	Cryptantha decipiens (Jones) Heller	annual	N	C+	
BORA	Cryptantha dumetorum (Greene ex Gray) Greene	annual	N	C+	
BORA	Cryptantha maritima (Greene) Greene var. maritima	annual	N	C+	S,
BORA	Cryptantha maritima var. pilosa I.M. Johnston	annual	N	C+	
BORA	Cryptantha micrantha (Torr.) Jtn. var. micrantha	annual	N	C+	
BORA	Cryptantha nevadensis A. Nels. & Kennedy var. nevadensis	annual	N	C+	
BORA	Cryptantha pterocarya var. cycloptera (Greene) Macbr.	annual	N	C+	S?, Cyn. above Billy M.,
BORA	Cryptantha racemosa (S. Wats.) Greene	perennial	N	Historical	Old record (Alexander & Kellogg, in 1941) at UC from near Beals Well
BORA	Cryptantha utahensis (A. Gray) Greene	annual	N	C+	
BORA	Pectocarya anisocarpa Veno	annual	N	C+	
BORA	Pectocarya heterocarpa (Jtn.) Jtn.	annual	N	C+	Surveyors Pass
BORA	Pectocarya platycarpa (Munz & Jtn.) Munz & Jtn.	annual	N	C+	
BORA	Pectocarya recurvata Jtn.	annual	N	C+	S,
BORA	Plagiobothrys jonesii A. Gray	annual	N	C+	Beal, u N-B,
BORA	Tiquilia canescens var. pulchella (I.M. Johnston) A. Richards.	perennial	N	C+	Mary Lode Mine;'78 at Ninemile Wash (all flowering plant 2017 = this)
BORA	Tiquilia plicata (Torr.) A. Richardson	perennial	N	C+	Ted Kipf.
BRAS	Brassica tournefortii Gouan	annual	I	C+	S, N, Tabaseca
BRAS	Caulanthus cooperi (S. Wats.) Payson	annual	N	C	N boundary, Bradshaw Tr., ACS in 1986; not seen 2015-2017
BRAS	Caulanthus lasiophyllus (Hook. & Arn.) Payson	annual	N	C+	S,

BRAS	Descurainia pinnata (Walt.) Britt.	annual	N	C+	S, Tabaseca
BRAS	Dithyrea californica Harv. var. californica	annual	N	C+	Ted Kipf.
BRAS	Draba cuneifolia Nutt. ex T. & G.	annual	N	C+	S, Tabaseca
BRAS	Lepidium fremontii S. Wats.	shrub	N	C+	S, N, OP,
BRAS	Lepidium lasiocarpum Nutt. ssp. lasiocarpum	annual	N	C+	S, N, Tabaseca
BRAS	Physaria tenella (A. Nelson) O'Kane & Al-Shehbaz	annual	N	C+	(= Lesquerella t.) S, N, OP,
BRAS	Sisymbrium irio L.	annual	I	C+	N, Tabaseca
CACT	Carnegiea gigantea (Engelm.) Britton & Rose	succulent tree	N	Hypothetical/ h istorical	obs. by JM years ago, near Camp Burt; also outside range at Midway Well 2018; photo
CACT	Cylindropuntia acanthocarpa (Engelm. & J. M. Bigelow) F. M. Knuth var. coloradensis? (L. D. Benson) Pinkava	succulent shrub	N	C+	Imperial Gables
CACT	Cylindropuntia bigelovii (Engelm.) F.M. Knuth	succulent perennial	N	C+	S, N,
CACT	Cylindropuntia chuckwallensis M.A. Baker & M.A. Cloud-Hughes	succulent shrub	N	C+	S, Chuck. Bench,
CACT	Cylindropuntia echinocarpa (Engelm. & J. M. Bigelow) F. M. Knuth	succulent shrub	N	C+	S, N, OP,
CACT	Cylindropuntia munzii (C.B. Wolf) Backeb.	succulent shrub	N	C+	S,
CACT	Cylindropuntia ramosissima (Engelm.) F.M. Knuth	succulent shrub	N	C+	S, N, OP,
CACT	Echinocactus polycephalus Engelm. & Bigelow	succulent	N	C+	S, N, Tabaseca
CACT	Echinocereus engelmannii (Parry ex Engelm.) Lem. var. engelmannii	succulent	N	C+	S, N, OP,
CACT	Ferocactus cylindraceus (Engelm.) Orcutt	succulent	N	C+	S, Bradshaw
CACT	Mammillaria tetrancistra Engelm.	succulent perennial	N	C+	S, Gables Wash, Beal, u N-B,
CACT	Opuntia basilaris Engelm. & Bigel.	succulent subshrub	N	C+	S, N, Tabaseca, OP
CAMP	Nemacladus	annual	N	C+	
CAMP	Nemacladus orientalis (McVaugh) Morin	annual	N	C	ACS 42331, Surveyors Pass; 42745 Imperial Gables

CAMP	Nemacladus tenuis (McVaugh) Morin var. aliformis Morin	annual	N	C+	Haden
CAPP	Isomeris arborea Nutt.	shrub	N	C+	S, Bradshaw Tr., cyn above Billy M., Salt Cr. (= Peritoma a., Cleomella a., Cleome isomeris)
CAPP	Koeberlinia spinosa ssp. tenuispina (K. & P.) E. Murray	shrub	N	C+	
CARY	Achyronychia cooperi T. & G.	annual	N	C+	Niland-Blythe Rd., mouth of Salt Cr., Kipf
CARY	Spergularia marina (L.) Griseb. ?	annual	N	C	Tabaseca,
CHEN	Atriplex canescens (Pursh) Nutt. ssp. canescens	shrub	N	C+	
CHEN	Atriplex canescens var. macilenta Jepson	shrub	N	C (poor)	canal road N of Camp Billy Machen
CHEN	Atriplex hymenelytra (Torr.) S. Wats.	shrub	N	C+	
CHEN	Atriplex polycarpa (Torr.) S. Wats.	shrub	N	C+	Bradshaw, Salvation cutoff, Clemons Well, Siphon 22
CHEN	Chenopodium murale L.	perennial	I	C+	
CHEN	Salsola tragus L.	annual	I	C	Iris Pass; 3000' peak near Tabaseca
CHEN	Suaeda nigra (Raf.) J.F. Macbr.	subshrub	N	C+	Coachella Canal
CUCU	Brandegea bigelovii (S. Wats.) Cogn.	vine	N	C+	
CUCU	Cucurbita palmata S. Wats.	perennial vine	N	Historical	1978 record at RSA from western edge of range near Melson Well, coll. by R.F. Thorne
EUPH	Ditaxis lanceolata (Benth.) Pax & Hoffm.	subshrub	N	C+	
EUPH	Ditaxis neomexicana (Muell.-Arg.) Heller	annual	N	C+	Bradshaw Tr., Salt Crk,
EUPH	Ditaxis serrata (Torrey) Muell.-Arg.	annual/perennial	N	Historical	edge of range near Melsons Well, 1978, R.F. Thorne (RSA)
EUPH	Euphorbia abramsiana L.C. Wheeler	annual	N	C	Bradshaw Trail, 2013
EUPH	Euphorbia eriantha Benth.	annual	N	C+	
EUPH	Euphorbia micromera Boiss. ex Engelm.	annual	N	C+	Salt Crk, Bradshaw
EUPH	Euphorbia pediculifera Engelm.	annual	N	Hypothetical	An old record (1932) from Midway Well which is outside the range, but near
EUPH	Euphorbia polycarpa Benth. var. hirtella Boiss.	perennial	N	C+	
EUPH	Euphorbia setiloba Engelm. ex Torr.	annual	N	C+	

EUPH	Stillingia linearifolia S. Wats.	perennial	N	C+	N, OP,
EUPH	Stillingia spinulosa Torr.	annual	N	C	I N-B,
EUPH	Tetracoccus hallii Brandegee	shrub	N	C+	
FAB+	Acacia greggii Gray	shrub	N	C+	=Senegalia g.
FAB+	Caesalpinia virgata Fisher	subshrub	N	(C+)	= Hoffmannseggia microphylla; J. Malusa, Mt. Barrow area
FAB+	Calliandra eriophylla Benth.	shrub	N	C+	W of Camp Burt
FAB+	Dalea mollis Benth.	annual	N	Historical	Specimens at UCR: W edge of range at Siphon 16, 2006 & Siphon 11, 2005 both by J. Green; near Melson Well, 1978 R.F. Thorne, RSA
FAB+	Dalea mollissima (Rydb.) Munz	annual	N	C+	OP,
FAB+	Hoffmannseggia peninsularis Wiggins	perernnial	N	C+	
FAB+	Leucaena leucocephala (Lam.) DeWit	shrub/tree	I	Hypothetical	Closest: outside W edge, along canal at Flowing Wells. Hypothetical inside
FAB+	Lotus salsuginosus Greene var. brevivexillus Ottley	annual	N	C+	= Acmispon maritimus var. brevivexillus. Hayden
FAB+	Lotus strigosus var. tomentellus (Greene) Isely	annual	N	C+	= Acmispon s.
FAB+	Lupinus arizonicus (S. Wats.) S. Wats.	annual	N	C+	
FAB+	Lupinus sparsiflorus Benth.	annual	N	C+	S, N,
FAB+	Marina parryi (T. & G.) Barneby	perennial	N	C+	Bradshaw
FAB+	Olneya tesota A. Gray	tree	N	C+	
FAB+	Parkinsonia florida (Benth. ex Gray) S. Wats.	tree	N	C+	
FAB+	Prosopis glandulosa Torr. ssp. torreyana (L. Benson) E. Murray	shrub/tree	N	C+	Tabaseca, Salt Creek,
FAB+	Prosopis juliflora (Sw.) DC. var. juliflora	tree	I	C+	Hayden, Pegleg Well, Salvation Pass Well; planted exotic, large spines
FAB+	Psorothamnus arborescens var. simplicifolius (Parish) Barneby	shrub	N	C	OP, near Tabaseca
FAB+	Psorothamnus emoryi (Gray) Rydb.	shrub	N	C	Camp Billy Machen
FAB+	Psorothamnus polydenius (Torr. ex S. Wats.) Rydb.	shrub	N	C+	hills in far north, near T & Bradshaw
FAB+	Psorothamnus schottii (Torr.) Barneby	shrub	N	C+	

FAB+	Psorothamnus spinosus (Gray) Barneby	arborescent shrub	N	C+	Beal, u Niland-Blythe Rd., cyn above Billy M.,
FAB+	Senna armata (S. Wats.) Irwin & Barneby	shrub	N	C+	
FAB+	Senna covesii (Gray) I. & B.	perennial	N	C+	
FOUQ	Fouquieria splendens Engelm. ssp. splendens	shrub	N	C+	
GERA	Erodium cicutarium (L.) L'Her. ex Ait.	annual	I	C+	
GERA	Erodium texanum A. Gray	annual	N	C+	
HYDP	Eucrypta micrantha (Torr.) Heller	annual	N	C+	
HYDP	Nama demissa A. Gray var. demissa	annual	N	C+	N edge/Bradshaw,
HYDP	Nama hispida A. Gray var. spathulata (Torr.) C. Hitchc.	annual	N	C+	
HYDP	Phacelia crenulata Torr. ex. S. Wats. var. ambigua (Jones) Macbr.	annual	N	C+	
HYDP	Phacelia distans Benth.	annual	N	C+	
HYDP	Phacelia minutiflora J. Voss	annual	N	C+	= P. crenulata var. m.
HYDP	Phacelia neglecta M.E. Jones	annual	N	C+	
HYDP	Phacelia pedicellata Gray	annual	N	X	
KRAM	Krameria bicolor S. Watson	shrub	N	C+	= K. grayi
KRAM	Krameria erecta Willd. ex Schult.	shrub	N	C+	
LAMI	Hyptis emoryi Torr.	shrub	N	C+	
LAMI	Salazaria mexicana Torr.	shrub	N	C+	(= Scutellaria m.)
LAMI	Salvia columbariae Benth.	annual	N	C+	S, N, G, Beal, u Niland-Blythe Rd.
LAMI	Salvia greatae Brandeg.	shrub	N	C+	NW edge of range
LOAS	Mentzelia involucrata S. Wats. var. involucrata	annual	N	C+	
LOAS	Mentzelia involucrata var. megalantha I.M. Johnston	annual	N	C+	Beal, u Niland-Blythe Rd., cyn above Billy M.
LOAS	Mentzelia longiloba Darl.	perennial	N	C+	

LOAS	Mentzelia obscura H.J. Thompson & Roberts ?	annual	N	C+	S,
LOAS	Mentzelia puberula J. Darl.	perennial	N	Hypothetical	Historical records from Imperial Gables, just outside SE corner of range
LOAS	Petalonyx thurberi Gray	subshrub	N	C+	
MALV	Eremalche rotundifolia (Gray) Greene	annual	N	C+	
MALV	Hibiscus denudatus Benth.	shrub	N	C+	
MALV	Horsfordia newberryi (S. Wats.) Gray	annual	N	Historical	Chocolate Mts., N of Pope, J.C. Roos in 1949 (UCR)
MALV	Sphaeralcea ambigua A. Gray	perennial	N	C+	
MALV	Sphaeralcea coulteri (S. Wats.) Gray	annual	N	C+	Mammoth Wash; old SPRR barrow pit
MALV	Sphaeralcea emoryi Torr. ex Gray	perennial	N	Hypothetical	Closest: c. 1 mile west of range boundary vicinity of Amos Siding; c. 1.5 mi. SW of boundary, c. 4 mi. N of Glamis;
MART	Proboscidea althaeifolia (Benth.) Dcne.	perennial	N	C+	
MOLL	Mollugo cerviana (L.) Ser.	annual	N	Hypothetical	Closest: c. 1.5 miles E of boundary on Chuckwalla Bench, on Arroyo Seco E of Surveyors Pass
NYCT	Abronia villosa S. Wats.	annual	N	C+	Ted Kipf Rd.
NYCT	Allionia incarnata L.	annual	N	C+	
NYCT	Boerhavia coccinea P. Mill.	perennial	N	Historical	Tabaseca (ACS, in 1989, UCR)
NYCT	Boerhavia intermedia M.E. Jones ?	annual	N	C+	
NYCT	Boerhavia triquetra S. Wats	annual	N	C+	
NYCT	Boerhavia wrightii Gray	annual	N	C+	
NYCT	Mirabilis laevis (Benth.) Curran var. retrorsa (Heller) Jepson	perennial	N	C+	
NYCT	Mirabilis laevis (Benth.) Curran var. villosa (Kell.) Spellenb.	perennial	N	C+	
ONAG	Camissonia arenaria (A. Nels.) Raven	annual	N	C	= Chylismia arenaria
ONAG	Camissonia boothii (Dougl. ex Lehm.) Raven	annual	N	C+	= Eremothera b.
ONAG	Camissonia cardiophylla (Torr.) Raven	annual/perennial	N	C+	= Chylismia cardiophylla. Cyn above Billy M.
ONAG	Camissonia chamaenerioides (Gray) Raven	annual	N	C+	= Eremothera c.

ONAG	Camissonia claviformis (Torr. & Frem.) Raven	annual	N	C+	= Chylismia c.
ONAG	Camissonia refracta (S. Wats.) Raven	annual	N	C+	= Eremothera r.
ONAG	Chylismia brevipes (A. Gray) Small ssp. arizonica (P.H. Raven) W.L. Wagner & Hoch	annual	N	C	= Camissonia b. ssp. a. Need for AWC
ONAG	Chylismia brevipes (A. Gray) Small ssp. brevipes	annual	N	C+	= Camissonia b. ssp. b.
OROB	Orobanche cooperi (Gray) Heller	parasite	N	X	
PAPA	Argemone munita Dur. & Hilg.	perennial	N	C+	
PAPA	Eschscholzia glyptosperma Greene	annual	N	C+	
PAPA	Eschscholzia minutiflora S. Wats.	annual	N	C+	
PAPA	Eschscholzia papastillii Shannon Still	annual	N	Historical	North of Lion Head Mountain, near Beal Well, Gross et al, in 2004, specimen at RSA
PAPA	Eschscholzia parishii Greene	annual	N	C+	
PLAN	Plantago ovata Forsskal	annual	N	C+	
POLE	Aliciella latifolia (S. Wats.) J.M. Porter ssp. latifolia	annual	N	C+	= Gilia latifolia
POLE	Eriastrum eremicum (Jeps.) Mason	annual	N	C+	Beal, u Niland-Blythe Rd., cyn above Billy M.
POLE	Gilia stellata A. Heller	annual	N	C+	
POLE	Langloisia setosissima (T. & G.) Greene ssp. setosissima	annual	N	C+	
POLE	Linanthus bigelovii (A. Gray) Greene	annual	N	Historical	Beal Well; old specimen (1941) at UC by Ira Wiggins
POLE	Linanthus jonesii (Gray) Greene	annual	N	C+	
POLG	Chorizanthe brevicornu Torr. var. brevicornu	annual	N	C+	
POLG	Chorizanthe corrugata (Torr.) Torr. & Gray	annual	N	C+	
POLG	Chorizanthe rigida (Torr.) Torr. & Gray	annual	N	C+	lower Niland-Blythe Rd.
POLG	Eriogonum deflexum Torr.	annual	N	C+	
POLG	Eriogonum inflatum var. deflatum I.M. Johnston	perennial	N	C+	Doubtful taxon, probably = inflatum inflatum
POLG	Eriogonum inflatum Torr. & Frem. var. inflatum	annual	N	C+	

POLG	Eriogonum nidularium Cov.	annual	N	C	
POLG	Eriogonum reniforme Torr. & Frem.	annual	N	Historical	Gas Line Road in major wash W of Iris Wash, Boyd at RSA, (UCR, RSA, UC, etc.)
POLG	Eriogonum thomasii Torr.	annual	N	C+	widespread
POLG	Eriogonum trichopes Torr. var. trichopes	annual	N	C+	Beal, u Niland-Blythe Rd.
POLG	Eriogonum viridescens Heller	annual	N	Historical	Tabaseca (Pitzer in 1989, UCR)
POLG	Eriogonum wrightii Torr. ex Benth. var. nodosum (Small) Reveal	subshrub	N	C+	
POLG	Pterostegia drymarioides F. & M.	annual	N	C+	S, “confluence”
PORT	Calandrinia ambigua (S. Wats.) T.J. Howell	annual	N	C+	
RESE	Oligomeris linifolia (Vahl) J.F. Macbr.	annual	N	C+	
RHAM	Condalia globosa var. pubescens I.M. Johnston	shrub	N	C+	
RHAM	Ziziphus obtusifolia (T. & G.) Gray	shrub	N	C+	
ROS+	Prunus fasciculata (Torr.) A. Gray	shrub	N	C+	N,
RUBI	Galium stellatum ssp. eremicum (Hilend & Howell) Ehrend.	shrub	N	C+	
RUT+	Thamnosma montana Torr. & Frem.	shrub	N	C+	Mt. Barrow
SCRO	Antirrhinum filipes Gray	annual	N	C+	
SCRO	Mimulus bigelovii (Gray) Gray var. bigelovii	annual	N	C+	= Diplacus b.
SCRO	Mohavea confertiflora (Benth.) Heller	annual	N	C+	
SCRO	Stemodia durantifolia (L.) Sw.	perennial	N	C+	Mt. Barrow
SIMA	Castela emoryi (Gray) Moran & Felger	shrub	N	C	
SIMM	Simmondsia chinensis (Link) C. Schneider	shrub	N	C+	
SOLA	Datura discolor Bernh.	annual	N	C+	Salt Crk
SOLA	Datura wrightii Regel	perennial	N	C+	
SOLA	Lycium andersonii A. Gray	shrub	N	C+	

SOLA	Lycium brevipes Benth.	shrub	N	C+	Coachella Canal, Bradshaw, Hayden
SOLA	Nicotiana obtusifolia Mart. & Gal.	perennial	N	C+	
SOLA	Physalis crassifolia Benth.	perennial	N	C+	
TAMA	Tamarix aphylla (L.) Karsten	tree	I	C+	Coachella Canal, wash near Gasline Rd
TAMA	Tamarix ramosissima Ledeb.	shrub	I	C+	Coachella Canal; Billy Machen
URTI	Parietaria hespera Hinton var. hespera	annual	N	C+	
VISC	Phoradendron californicum Nutt.	parasite	N	C+	
ZYGO	Fagonia laevis Standl.	subshrub	N	C+	
ZYGO	Fagonia pachyacantha Rydb.	subshrub	N	C+	
ZYGO	Kallstroemia californica (S. Wats.) Vail	annual	N	Hypothetical	Closest: Chuckwalla Bench c. 7 miles E of Surveyors Pass
ZYGO	Larrea tridentata (Sesse & Moc. ex DC.) Cov.	shrub	N	C+	
AGAV	Nolina bigelovii (Torr.) S. Wats.	perennial	N	C+	S, Bradshaw
AGAV	Yucca schidigera Roezl ex Ortega	succulent shrub	N	C+	
AREC	Phoenix dactylifera L.	tree	I	C+	Camp Billy Machen; Photograph by J. Malusa; Mt. Barrow area
LILI	Calochortus flexuosus S. Wats.	perennial	N	C+	
LILI	Hesperocallis undulata A. Gray	perennial	N	C+	Ted Kipf. Rd.
PO++	Aristida adscensionis L.	annual	N	C+	
PO++	Aristida purpurea Nutt.	perennial	N	C+	var. nealleyi, var. wrightii, & var. parishii?
PO++	Bouteloua aristidoides (HBK) Griseb.	annual	N	C+	
PO++	Bouteloua barbata Lag. var. barbata	annual	N	C+	S, N,
PO++	Bromus berteroanus Colla	annual	N	X	campsite near Tabaseca (dead)
PO++	Bromus rubens L.	annual	I	X	Bradshaw Tr., near Tabaseca (dead)
PO++	Cynodon dactylon (L.) Pers.	perennial	I	C+	

PO++	Dasyochloa pulchella (Kunth) Willd. ex Rydb.	annual/perennial	N	C+	(= Erioneuron p.) S, OP,
PO++	Festuca octoflora Walt.	annual	N	C+	S, Tabaseca
PO++	Hilaria rigida (Thurb.) Scribn.	perennial	N	C+	(= Pleuraphis r.) S, N, Tabaseca
PO++	Muhlenbergia microsperma (DC.) Kunth.	annual	N	C+	N, OP, G,
PO++	Muhlenbergia porteri Scribn. ex Beal	perennial	N	C+	Bradshaw
PO++	Phalaris minor Retz.	annual	I	C+	Surveyors Pass, Tabaseca
PO++	Phragmites australis (Cav.) Steud.	perennial	N	X	Dead plants on W edge, dredge spoil above ex dirt canal
PO++	Polypogon monspeliensis (L.) Desf.	annual	I	X	at Tabaseca (dead)
PO++	Saccharum ravennae (L.) Murr.	perennial	I	Hypothetical	Closest: outside W edge, along canal
PO++	Schismus arabicus Nees	annual	I	C+	Widespread; cyn above Billy M.
PO++	Sorghum sudanense (Piper) Stapf	annual	I	X	wash W of Burt (dead)
PO++	Sporobolus airoides (Torr.) Torr.	perennial	N	X	Bradshaw Tr.
PO++	Stipa speciosa Trin. & Rupr.	perennial	N	C+	Tabaseca, cyn above Tabaseca
PO++	Tridens muticus (Torr.) Nash	perennial	N	C	Mt. Barrow