

Willowy Monardella Census

-2009 Survey Update-

Marine Corps Air Station Miramar
San Diego, California



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Executive Summary

This report presents the results of the 2009 census for the federally endangered and state of California endangered willow monardella (*Monardella viminea*) throughout the Marine Corps Air Station (MCAS) Miramar (Station).

The purpose of the census is to provide fundamental information on the current condition of the willow monardella population across the station as a whole. Such information is used in the continued management of willow monardella on the Station, and to support MCAS Miramar's stewardship commitments regarding the species population health as well as its management. Through these surveys, the Station's willow monardella population was evaluated using an established plant estimation and health assessment protocol, as requested by the Environmental Management Department at MCAS Miramar. The protocol was developed, in part, as a standard approach for approximating individual plants. Given the species' clumpy appearance and lack of a central stem, it is difficult, if not impossible without creating disturbance and possible damage, for independent observers to differentiate each individual plant consistently.

The primary objective of this effort was to identify the current population of willow monardella at the Station, to recognize patterns of occurrence, and develop a better understanding of the species' life history to support management efforts. The 2009 census showed that recorded individuals at the Station decreased by approximately 45 percent since the baseline assessment which estimated the population size in 2002. Various explanations for this trend are considered in this report. Possible habitat reasons for this phenomenon include negative effects of drought, fire, and severe flooding, intensified by competition from exotic annual grasses and herbs. While no one of these reasons seems to be the total cause, the combined effects of multiple stresses may be the cause of this decline. However, given the differences in population measurement between survey efforts, recent results are likely somewhat inconclusive in terms of the species' overall condition.

While the majority of plants observed during this survey were in good health, it was apparent that some plants that had been previously recorded were no longer present. Temporary fluctuations in population may be a natural occurrence for this species; however, this concept has yet to be documented. Given the limited information on this species, it is clear that further research would be valuable in understanding the natural history of willow monardella. This report presents recent findings on the Station's willow monardella population and identifies potential management implications. Federal and state laws concerning the treatment of endangered species were followed at all times during the course of this survey effort.

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Table of Contents

I. Introduction	1
II. Background	2
A. Willowy Monardella Life History and Survey History at MCAS Miramar	2
B. Project Location.....	3
III. Methods.....	5
IV. Results.....	8
A. Site Specific Information.....	8
V. Discussion	13
VI. Conclusion.....	25
VII. Works Cited	34
Appendix A: Dates of Project Work	A-1
Appendix B: Names of Persons Working on the Project	B-1
Appendix C: Detailed Site Photographs	C-1
Appendix D: Datasheets.....	D-1

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I. Introduction

Willow monardella (*Monardella viminea*) is endemic to Southern California and the species is limited primarily to ephemeral drainage habitats within 50-225 meters (m) in elevation. Currently, the species naturally occurs only within the United States in San Diego County. It has been listed as state endangered in California since November 1979 and became federally listed as endangered on 13 October 1998 (Federal Register 63:5937). The species occurs in and along ephemeral drainages in coastal sage scrub, chaparral, and grassland, historically ranging from southwestern California to northern Baja California, Mexico. Willow monardella is threatened by a variety of factors including urbanization, agricultural development, competition from exotic plant species, off-road vehicle use, mining, grazing, recreational activities, and water diversion (California Native Plant Society [CNPS] 2009).

Most of the remaining willow monardella populations are located on Marine Corps Air Station (MCAS) Miramar (Station), the majority of which occur within the canyons of the undeveloped eastern portion of the Station. In 2002, a census using estimating procedures of the Station's population was conducted and a long-term monitoring program was developed. Since then, various studies have been performed with results that indicate the species is in decline for reasons not yet completely understood. Given that such a high percentage of the species occurs on the Station, willow monardella is inevitably a focus of research efforts and management activities for the Station's Environmental Management Department (EMD).

This 2009 census was a Station-wide survey for willow monardella conducted throughout all suitable (present and historical) habitat, rather than evaluating only established monitoring plots. The data collected and observations recorded are intended for comparison between the current status and the original estimates of the species in 2002. As evident from recent willow monardella surveys on the Station, the population appears to be in decline (Tierra Data Inc. [TDI] 2005; San Diego Natural History Museum [SDNHM] 2006).

The data collected during these surveys were analyzed and compared with data collected in prior years. The purpose of this survey was to support stewardship decisions. The Station continuously works with agencies to provide up-to-date information regarding endangered species and strives to ensure that both sound and innovative management practices are being employed, as evident from this and other efforts. The comparisons made here are intended to report on the status of the willow monardella populations and the reproductive health of the species at the Station.

II. Background

A. Willowy Monardella Life History and Survey History at MCAS Miramar

Willowy monardella is a member of the mint family, with a sweet aroma. The perennial herb was found reaching dimensions up to 400 centimeters (cm) in diameter and 75cm in height during the recent survey effort. The semi-woody species typically flowers in spring and summer months (Hickman 1993); however, during this effort robust plants were observed flowering as late as November and nursery plants were flowering through December. The population at the Station was recently separated from a population in the Otay Mesa area and has been elevated to the species status of *Monardella viminea*. This resulted from the consistent identification of morphological differences between the two populations. A new species was proposed for the Otay Mesa population as well (Elvin and Sanders 2003). Given the species' federal and state status, it has been the target of research endeavors over the past few years. Recent research has been conducted in order to contribute to the establishment of a stable phylogeny of the genus. Preliminary genetic information on the rare plant species suggests that a species level classification of willowy monardella is reasonable (Prince 2009).

Population status research for willowy monardella at the Station began in 2002 with the Station-wide census survey and the establishment of long-term monitoring protocol. From this effort, it was estimated that 3,379 individuals occurred throughout the areas considered as potential habitat at the Station (SDNHM 2006). Periodic follow-up studies have been employed since this census to analyze the trend in numbers, record various site factors associated with occurrences, and noting reproductive characteristics. The recent survey effort applied a technique that differs in that it is aimed at distinguishing individuals precisely rather than estimating individuals based on canopy dimensions. This discrepancy, which makes trend assessment and data comparisons difficult, is explained in further detail in the discussion section of the report.

The following questions were the focus of the 2002 study and continue to be central to data collection, analysis, and discussion on this species.

1. Are populations of willowy monardella at MCAS Miramar declining, increasing, or remaining stable?
2. Is recruitment (establishment of new individuals) occurring for this species and in what form?
3. Is the life stage structure of the species stable or unstable?
4. What potential threats to the species exist?
5. What management directives could prove beneficial for the species?
6. What is the natural history and ecology of the species?

In 2003, using the previously established protocol, monitoring was conducted at 15 test sites, all located in the eastern half of MCAS Miramar. The purpose of the effort was primarily to initiate the long-term collection of ecological data as well as to evaluate the proposed monitoring plan (SDNHM 2006).

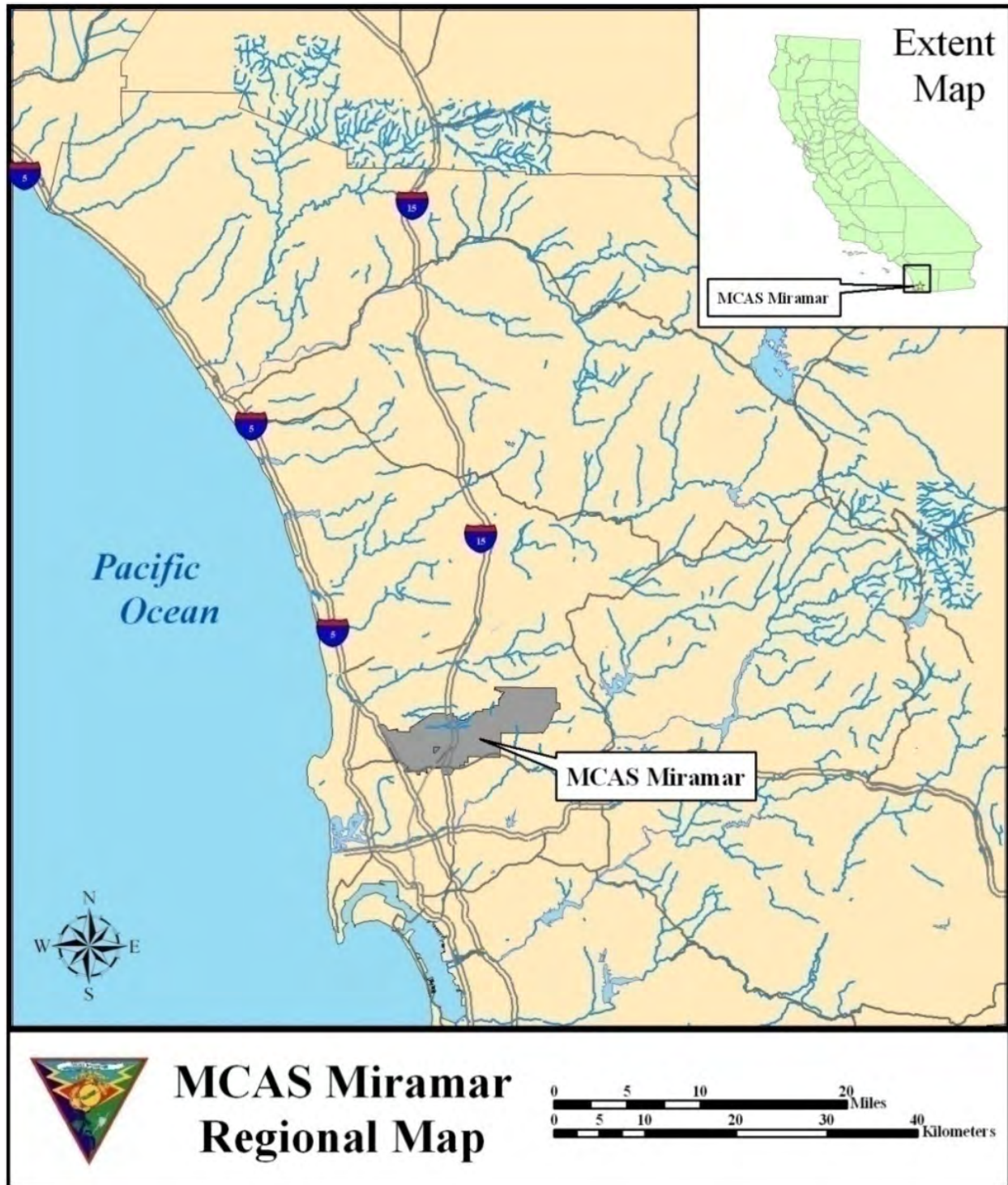
A wildfire, known as “the Cedar Fire”, swept through much of the eastern half of the Station in the fall of 2003. Approximately 17,600 acres of the Station’s 23,000 acres were affected, and approximately 98 percent of willow monardella habitat was burned during this event (MCAS Miramar 2006). Consequently, in 2004, the Station set forth to re-assess the test sites. Prior to the fire, individuals within clusters were estimated by measuring the longest and widest portions of the cluster (in meters), multiplying these two values, and dividing the product by 0.785 square meters (m²). After the fire, abundant large clusters of plants were no longer present so a new method to account for individuals was developed. In order to prevent over-counting willow monardella plants, the “six-inch rule” was designed to recognize the plant’s ability to re-sprout and the difficulty of distinguishing individual plants from the resprouts. This became the standard method for distinguishing individual willow monardella plants at the Station. It was reasonable primarily because willow monardella grows from a taproot, not from rhizomes, as is the case for other California native species on monardella (Hickman 1993). The technique called for measuring the distance between the stems of nearby plants. If the separation between two stems was less than six inches, they were counted as only one individual because they were deemed likely to have originated from the same root structure. If the distance of separation was greater than six inches, plants were recorded as multiple individuals.

In 2005 and 2006, the fifteen (15) established willow monardella monitoring sites were surveyed to assess the status of all individuals within test plots (SDNHM 2006, TDI 2005). In 2007, survey efforts focusing on the San Clemente drainage were performed to determine whether construction of a new rifle range had any impact on local plant occurrences downstream. The conclusion of this effort was that there was no evidence of direct or indirect negative impacts on the local populations.

B. Project Location

MCAS Miramar is located nearly 13 miles north of downtown San Diego, four miles inland from the Pacific coast, and encompasses approximately 23,000 acres (see Map 1). The Station ranges in elevation from approximately 250 feet (ft) to nearly 1,200 ft (approximately 75 m to 365 m). The terrain primarily consists of steep canyons, ephemeral washes, and undulating flatlands which often contain vernal pools.

The Station property contains developed areas with various structures including housing and office buildings, as well as a flight line, shooting ranges, and training areas. The property also includes a large public landfill and a cement plant. Nevertheless, the majority of the property is undeveloped and consists of great expanses of natural habitats, many of which contain rare species (MCAS Miramar 2006).



Map 1. Regional location of Marine Corps Air Station Miramar.

All fieldwork was conducted within the undeveloped areas of the Station boundary north of State Route 52; west of Sycamore Canyon; south of the northern Station boundary; and east of Interstate 805.

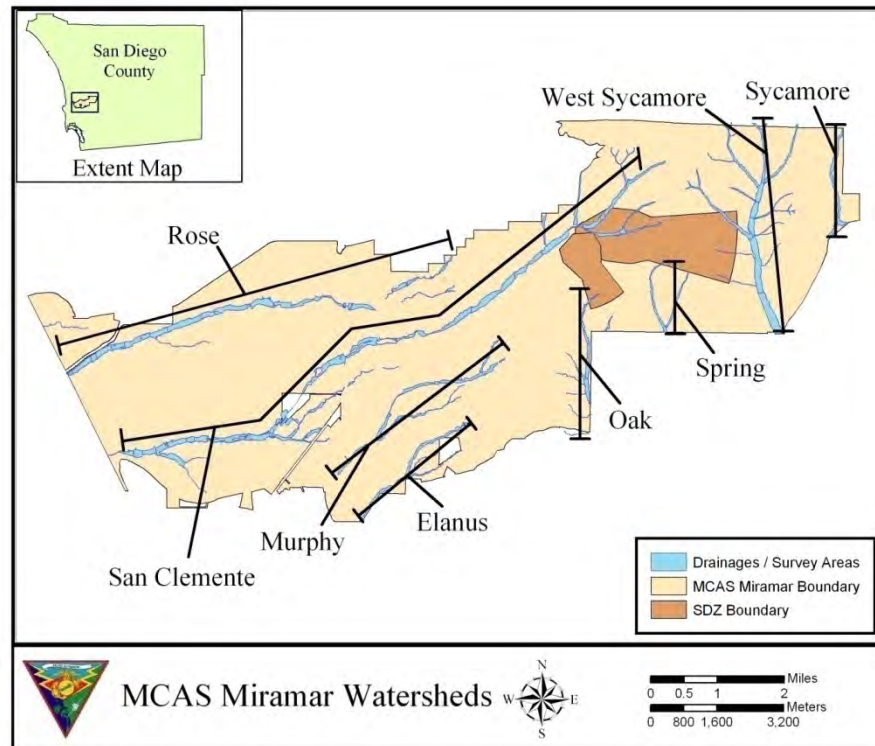
III. Methods

A Trimble ProXR and Trimble GeoXT 2005 Series Global Positioning System (GPS) units were used to map the observed stands of willow monardella with sub-meter accuracy and geographic data was provided in State Plane U.S. Survey Feet. Obtainable 2005 Station imagery and data layers, such as roads, watersheds, and survey locations, including historic species locations, were provided by the Geographic Information Systems (GIS) Point of Contact at MCAS Miramar.

Arc GIS software by Environmental Systems Research Institute, Inc. (ESRI) was used to produce maps for this report as well as for all field mapping efforts. GIS products and GPS products supported geo-referencing, electronic mapping, and field results. GIS metadata conformed to existing standards and formats used by MCAS Miramar and were integrated with the Station's existing GIS data.

The willow monardella survey was a Station-wide census, covering all potential habitats (Map 2). The effort duplicated the original census including visiting each established monitoring site, and searching for new occurrences of the species in all potential habitat. The census data collection included the total number of individual plants/clumps, their locations recorded by GPS, health of individuals, and any special observation of relevance to key questions about viability as identified in previous reports for the Station. Data collected documented life stage, phenology, habitat, and natural history of each individual encountered. Photographic documentation was performed when appropriate. Field survey protocols for monitoring plots followed the original census report that established the monitoring procedures and datasheets (SDNHM 2006). All factors that may be impacting the species were documented. Any species competition compromising the plant, general habitat quality, predation, soil erosion, abnormal findings, or other risk factors to the plant were noted when observed.

Prior to the onset of surveys, purchased plants and known occurrences in the field were examined to establish a quality search image. Furthermore, a laminated field resource card, including multiple photographs of the willow monardella, was developed for use by each field observer. Images consisted of various habitats and features of the species at different life stages. After development of the image card, a search distance, the distance between observers, was determined by the terrain to be covered and the vegetation community present at each survey location. This distance was based on target species visibility. Once established, surveyors navigated in parallel rows (typically two to four surveyors). Because the terrain, and thus the search distance, often changed over the course of the survey, surveyors were continuously shifting to account for the differences and ensure efficient and thorough passes.



Map 2. Willowy monardella census surveys in 2009 included all drainages and suitable habitat throughout the Station.

When plants were encountered, survey measurements were taken following a decision-making support system established upon the initiation of field work. This system was applied by all field surveyors so that observations were consistently recorded. The 2009 survey effort was a Station-wide census; however, the following checklist for willowy monardella monitoring plots and relevant definitions were used to ensure compliance with previous survey efforts (SDNHM 2006).

1. Record survey site identification information (e.g. date, name, site number, etc.).
2. Locate the four corners of the monitoring plot provided as GPS points, delineated with square metal bars and currently painted light blue.
3. Survey the entire site, counting each willowy monardella clump. Any clump larger than one meter across, measure in a perpendicular direction, recording the longest widths in meters. For separating small clustered clumps, use the “six-inch” rule (see definitions below).
4. For each monardella clump, document its current life stage and phenology (see definitions). Record this information on the survey data sheets.
5. List all associated plant species found at the monitoring site on the data sheets.
6. Estimate percent cover for each of the species that have at least 5 percent cover. Record on the data sheets.

7. Describe the stream channels (width, depth, relative location of monardella, rockiness, etc.) on each site and record the information on the data sheets.
8. Describe any observations for the monitoring site or monardella plants, for example:
 - a. Pollinators
 - b. Hydrology
 - c. Unusual observations
 - d. Problems
 - e. Positives
 - f. Predators/herbivores, etc.

Definitions

Seedling: A life stage assessment for any willow monardella clump observed lacking multiple stems and less than four inches tall.

Phenology: The annual life cycle stage of each plant at the time of survey, e.g. vegetative, flowering, seeding, etc.

Vegetative: A phenological assessment that the plant lacks any reproductive parts but isn't dried out/dormant.

Mature: A life stage assessment for any willow monardella clump observed more than four inches tall and having less than 20 stems.

Adult: A life stage assessment for any willow monardella clump having more than 20 stems and more than four inches tall.

Juvenile: Any monardella plant that is lacking multiple stems and more than four inches tall.

Flowering: A phenological assessment that the monardella has one or more flowers.

Dead/Dormant: A phenological and life stage assessment for individuals that are dried out and lack any obvious living tissue (This classification was grouped during the original effort and no methods to distinguish dormant plants from dead plants were employed during previous work or this survey. However, given the timing of the recent census effort and the generally robust plants found, the term "presumed dead" is used to describe individuals that appeared outwardly dry and lacking any above ground living tissue).

N: A scientific short hand for the number of individuals.

Seeding: A phenological assessment that a plant finished flowering, but is still producing seeds.

Budding: A phenological assessment that plants have flower buds, but the flowers have not yet expanded to open.

Between Flowering and Seeding: A phenological assessment that there is no evidence of flowering or seeding, but all parts of the clump are clearly between those two stages.

Clump: A group of one or more willowy monardella plants growing sufficiently intertwined that distinguishing individuals is difficult or impossible.

Channel: The low point in the flood plain where water obviously flows as indicated by scour marks in the vicinity.

When counting individual willowy monardella plants, the “six-inch rule” was employed. This rule was used when considering an individual plant versus what could be “clumps” from the same root system. The aim of this method was to ensure that individual plants with multiple stems sprouting from a single root system were not recorded as more than one plant. When measuring a group of stems, all stems within six inches of each other were considered components of the same plant. As mentioned, this approach differs from previous census efforts in that it is an attempt to precisely identify individuals whereas prior protocol made estimations based on a calculation of canopy dimensions. The consequence of this variation is that a plant that may have been estimated as multiple individuals in previous surveys is recorded as one single individual when applying the current field techniques.

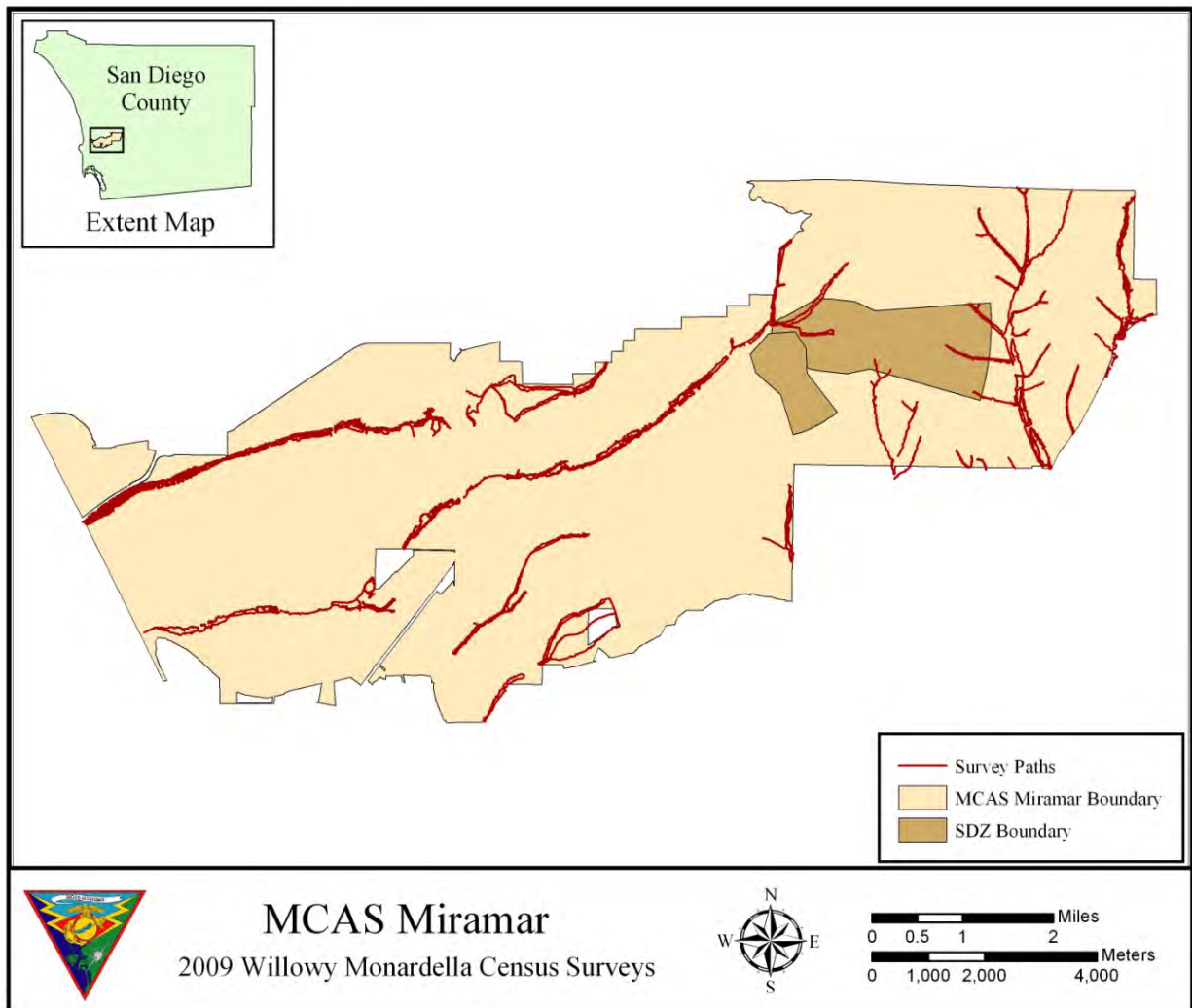
Surveys were performed while the species was most easily recognized. This is when the herb is flowering and a vibrant rose or purple inflorescence is observable. The plant is typically in bloom during the summer months between June and August; however, the species can retain flowers into late fall.

The data collected during this census (2009) were compared to that from previous Station studies. Population trends from 2002 to 2009 were evaluated; however, technique differences between survey efforts limited the statistical power of analyzing current datasets.

IV. Results

A. Site Specific Information

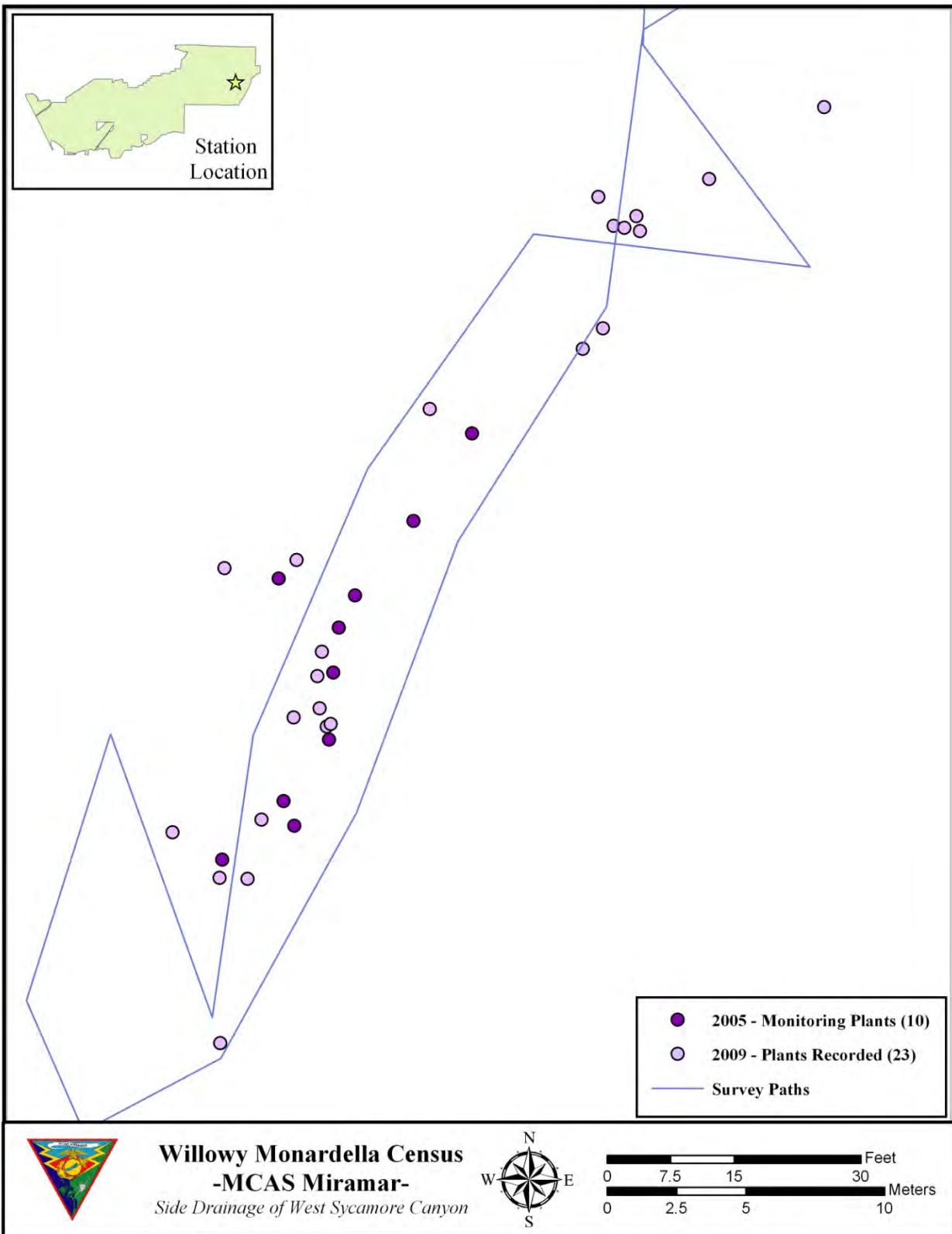
The census covered all suitable habitats throughout the entire Station. The combined survey team covered well over 200 linear miles within drainages in search of willowy monardella plants. In general, the search distance between observers averaged approximately 25 ft; consequently, the approximate habitat surveyed was more than 1,200 acres (nearly two square miles). Map 3 presents the tracklog collected by the field crew during the performance of this survey effort.



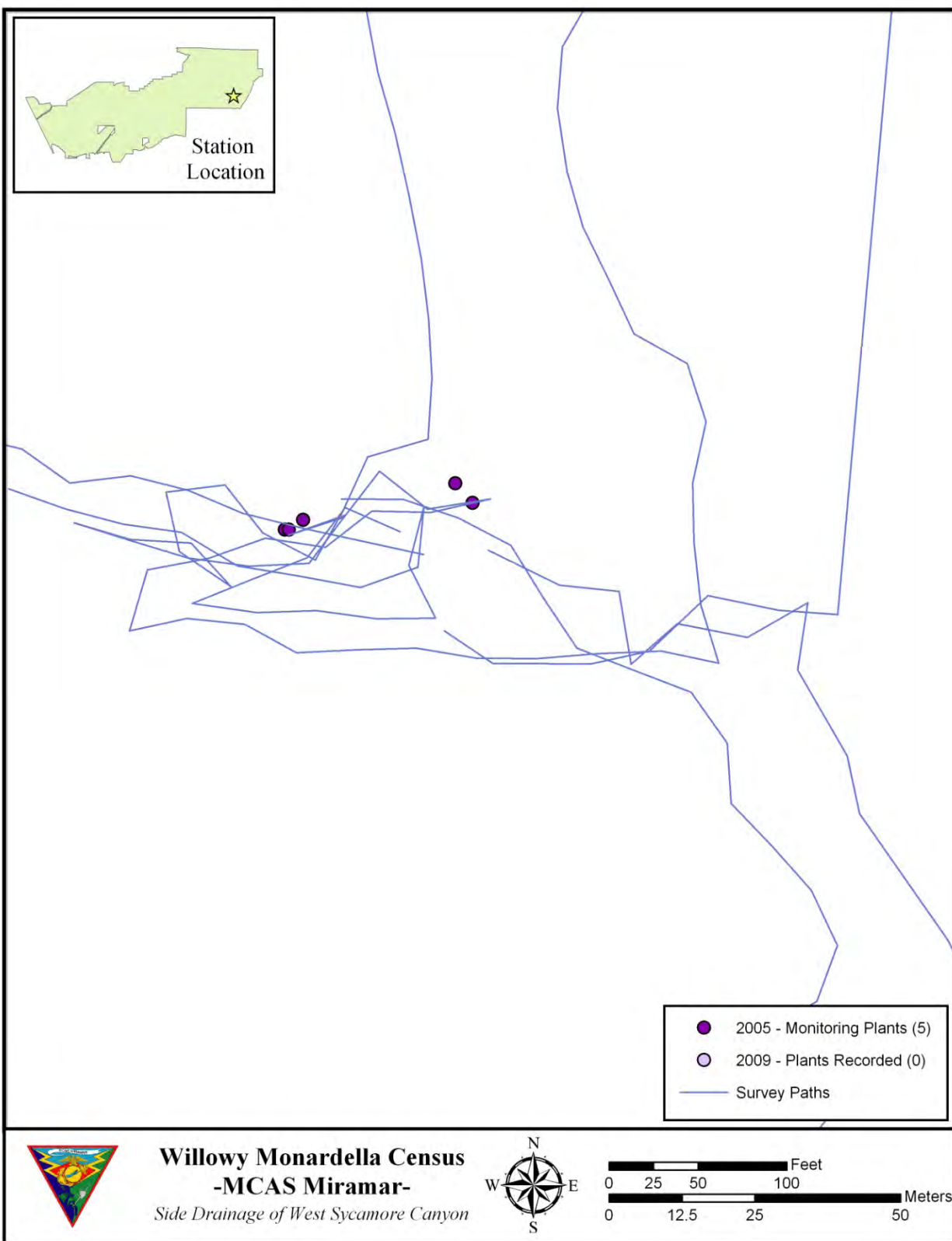
Map 3. Survey paths recorded by field crew using handheld GPS units.

Some previously mapped plants were not found; however, this effort also documented plants that were not mapped during earlier studies of the species. Both phenomena were found throughout the Station appearing in no particular trend; examples of these occurrences found within two different side drainages of West Sycamore Canyon are presented (Map 4 and 5). Altogether, the 2009 surveys resulted in the mapping of 1,809 individual willow monardella plants; the “six-inch rule” for distinguishing individuals was strictly adhered to throughout the census (Table 1). Table 2 shows occurrences of the willow monardella in 2002 and 2009.

See Table 3, Table 4, and Table 5 in the Conclusion section of this report for the location, life stages and phenology, respectively, of the willow monardella found on the Station.



Map 4. Example evidence of plants not previously recorded as individuals.



Map 5. Example evidence of missing plants not found during the recent survey effort.

Table 1. The location (by canyon) of all willowy monardella plants recorded during the 2009 census surveys.

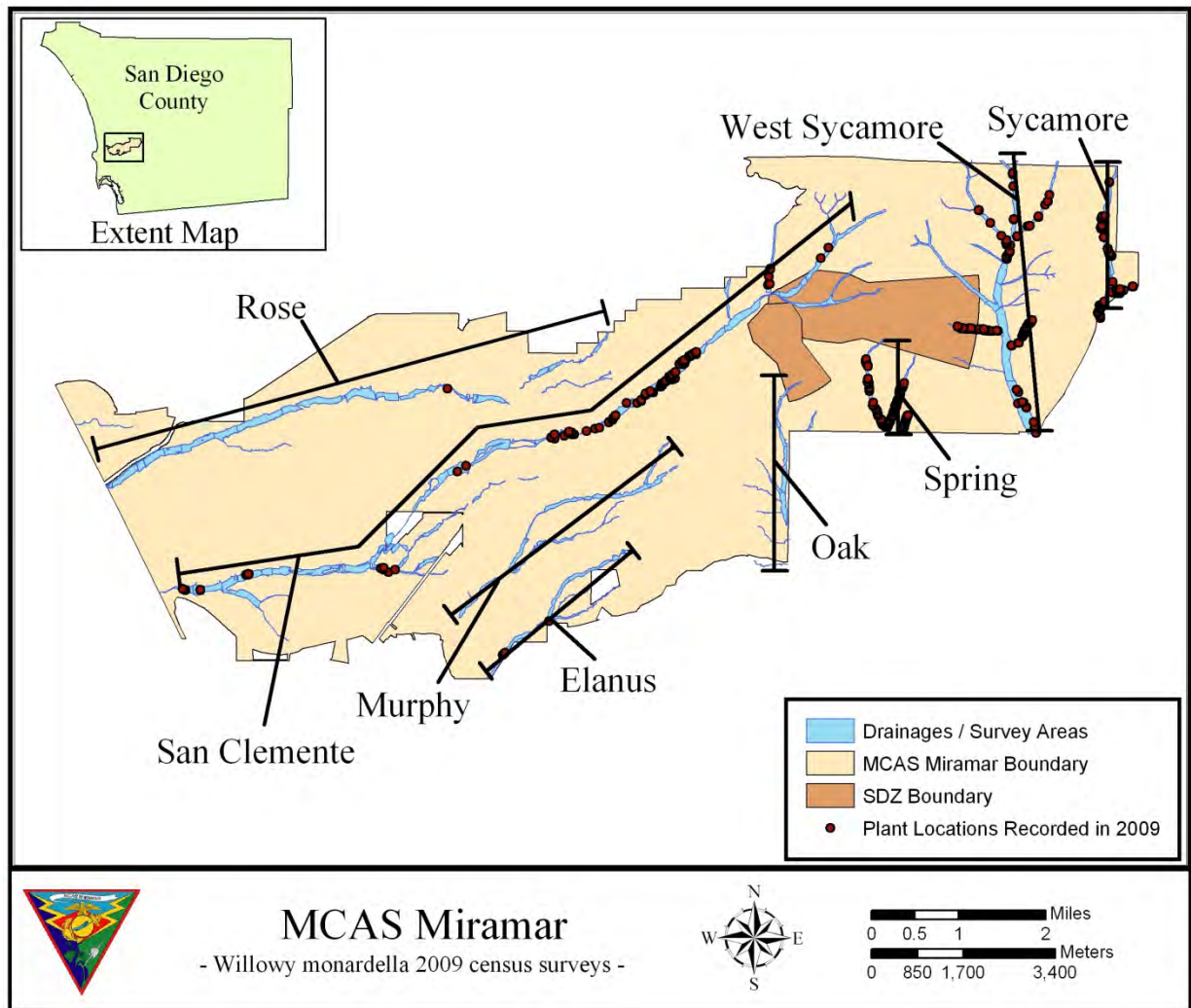
Canyon	Observed Individuals	Approximate Percent of Total
West Sycamore Canyon	580	32
San Clemente Canyon	536	30
Spring Canyon	375	21
Sycamore Canyon	305	17
Elanus Canyon	12	< 1
Rose Canyon	1	< 1
Murphy Canyon	0	0
All Canyons	1809	100

Table 2. Willowy monardella occurrences recorded at MCAS Miramar in 2002 and 2009.

Watershed	Estimated Number of Individuals (2002)	Observed Individuals (2009)	Approximate Percentage of Population Remaining
All Canyons	3379	1809	54%

Nearly all willowy monardella plants encountered over the course of the surveys were healthy in appearance, with many flowers and pollinators observed frequently. Only a nominal number of dormant plants were found. There were a few instances where possible herbivory was evident; upon two occasions, seed heads were found at the base of the plants without explanation. The likely source of this herbivory is thought to be due to rabbits; they may have chewed on the green part of the stems leaving the dry seed heads behind. A grasshopper was observed on a willowy monardella plant although it was not actively damaging the foliage at the time (Appendix C).

The census data collected over the course of the survey effort was entered into a Microsoft (MS) Excel spreadsheet for comparison to previous data. The baseline census dataset from 2002 was used to assess population trend by watershed, including overall population size (Map 6).



Map 6. Population trend of willow monardella by watershed.

V. Discussion

Many factors have been considered when trying to identify a reason for the seemingly declining populations of willow monardella at the Station. The increased competition for nutrients within the plant's suitable habitat from exotic species has undoubtedly placed stress on the species at some sites. Mature plants are less likely affected by this invasion; however, given the small number of seedlings observed over the years, it is possible that the recruitment rates have been affected by the presence of exotic plant species (SDNHM 2006; JoEllen Kassebaum, *pers. comm.* 2009; census observation 2009).

The competitive effect of abundant exotic grasses has been a focus of numerous studies throughout California over the past decade, with varying results. Competitive interactions between native and exotic plant species ensues given the limited supply of available resources. Competition for light and soil moisture can lead to altered plant

community composition if one species has a considerable advantage over another (Crawley 1997). The level of this conflict and the potential result is dependent on the life history of a species. In the case of willow monardella, many aspects of the species' life history are understudied and unidentified. Usually the difference between annuals and perennials in terms of resource acquisition and propagation is evident through these competitive interactions.

Generally speaking, annuals exploit surface soil moisture early in the season, whereas perennials utilize water at depth by the use of established root systems (Eliason and Allen 1997). It is possible that this initial competition reduces perennial species (including willow monardella) recruitment. Annual species are favored and seedling establishment among long-lived plants likely suffers from competition. Abundant annual grasses throughout nearly all of East Miramar result in direct competition for resources between willow monardella and exotic plant species. Given the healthy nature of mature plants, many of which were large and robust, it appears that willow monardella adults eventually out-compete the exotic annuals as they gain size. Conversely, the low number of seedlings indicates that the recruitment of this species may be negatively influenced by the exotics (Appendix C – Photo 10).

Broad comparisons regarding vegetation composition appearance can often be made using historical and recent aerial imagery. Upon the 2009 evaluation of aerial imagery comparing canopy density between 2003 and 2008 images, the difference in shrub abundance is clearly evident (Photo 1 and Photo 2). Extensive damage from fires, such as the Cedar Fire, can result in community type changes (Keeley 2006). It appears that the composition of drainages on the Station has shifted somewhat to plant communities that consist of less shrub species. During such conversions shrubs are replaced by grasses that would normally be absent due to shade intolerance. While sufficient evidence to document a community type conversion is not offered by this aerial imagery alone, general composition changes, i.e. shrub abundance and maturity, are visible. In the case at the Station, the encroaching grasses are primarily exotic species that can create less than ideal circumstances for native plant recovery.

The importance of shrubs as a component of suitable willow monardella habitat has been identified in previous studies evaluating environments of species' populations to better understand selecting locations for transplanting (Scheid 1987). In this study, of the targeted population, 83% of the individuals were located beneath at least some canopy. Of that 83%, 45% had canopy overlap directly over the center of the plant clusters and 38% had partial canopy overlap. The management implications of this occurrence are implicit and should be considered as part of the adaptive management approach employed by the Station (Table 6 in Conclusion section).



Photo 1. A section of West Sycamore Canyon prior to the Cedar Fire with numerous large shrubs (taken in 2003).

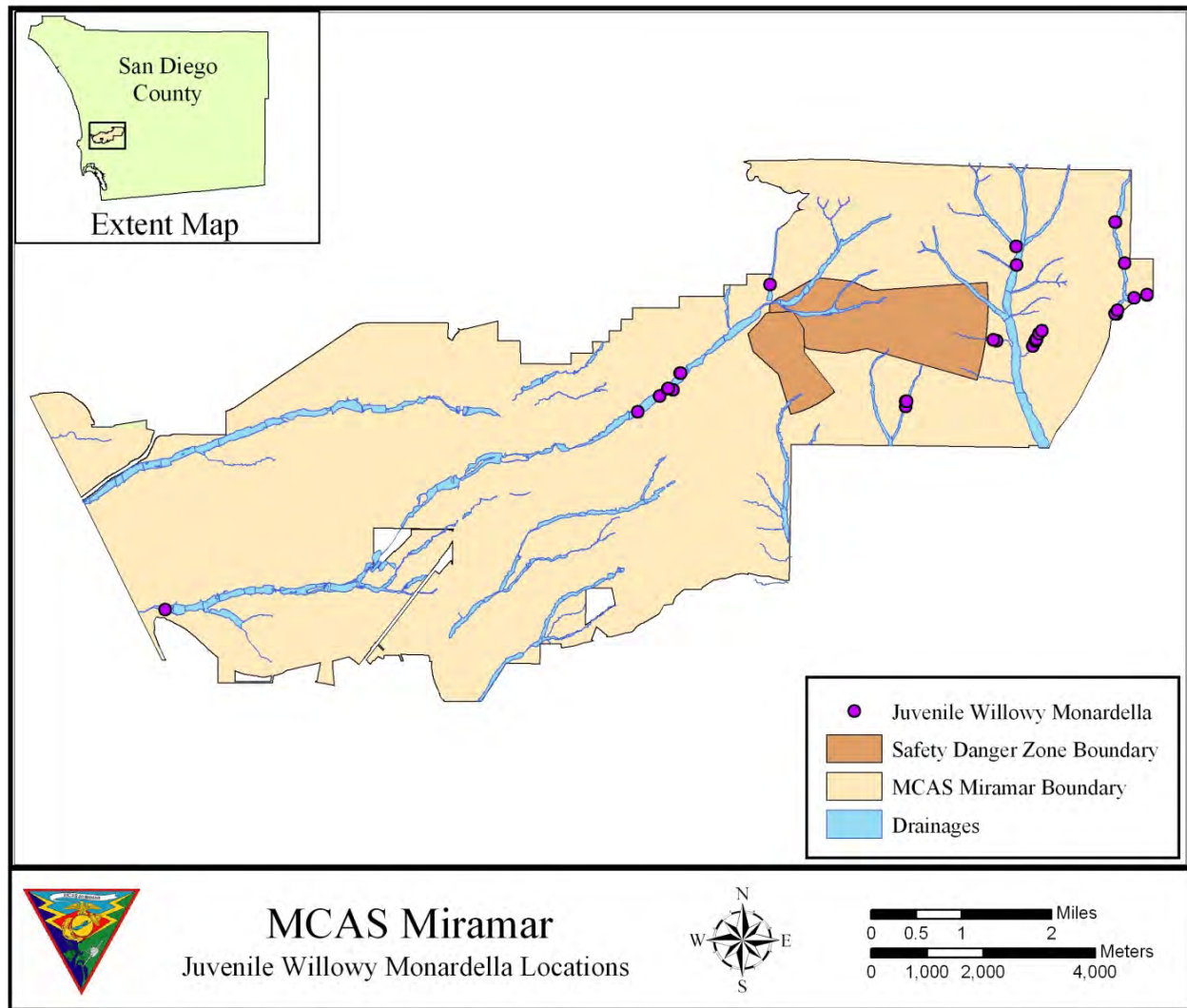


Photo 2. A section of West Sycamore Canyon after the Cedar Fire with very few small shrubs (taken in 2008).

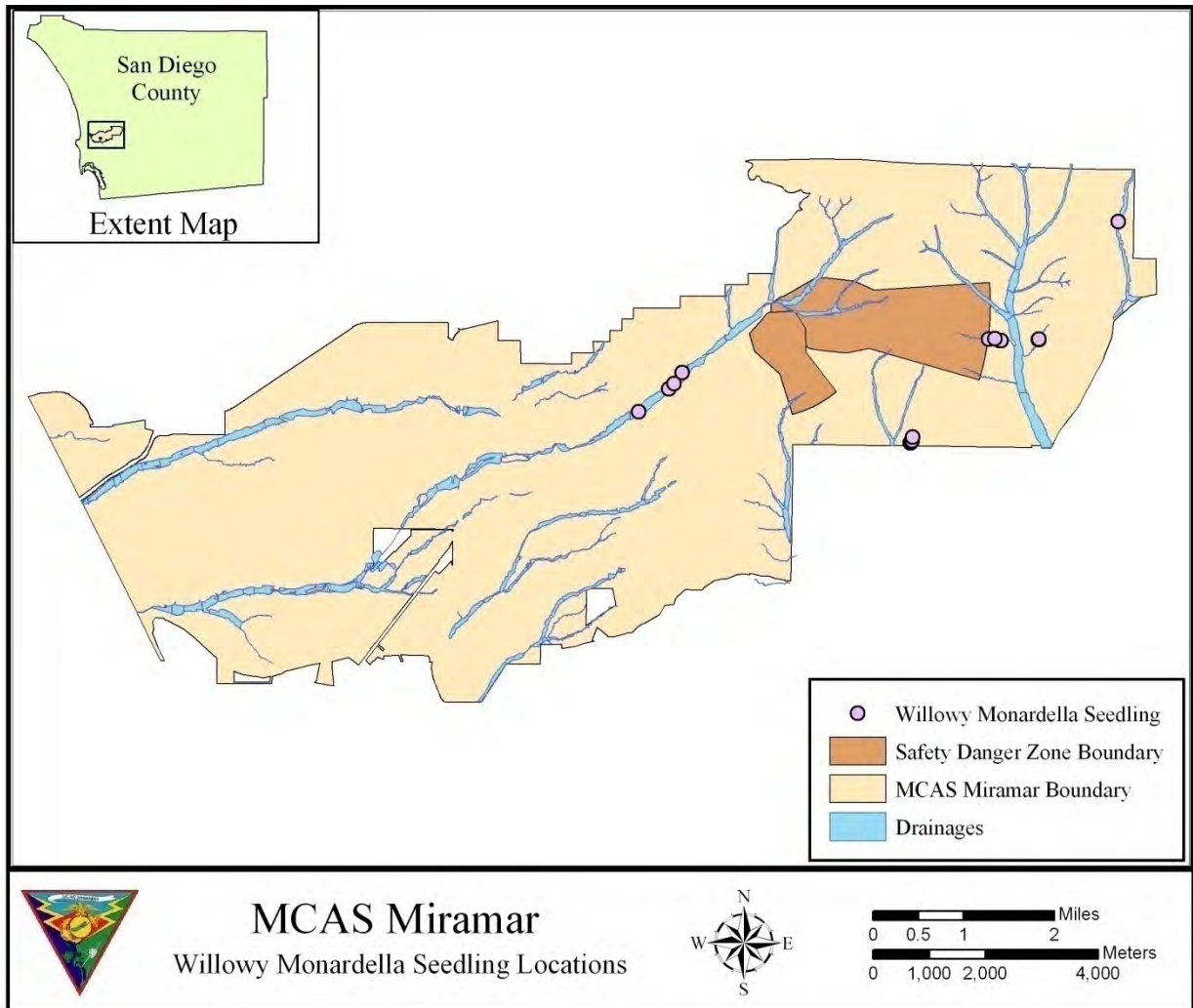
On many occasions during this census, entire drainages nearly devoid of any shrubs were observed (Appendix C – Photo 12). These canyons were dominated by exotic grass species that often created up to six inches of litter. Occasionally, willowy monardella plants were found within the grass on the relatively open banks of drainages. Plants were rarely observed completely surrounded by thick grass. Some of the previously recorded occurrences were no longer traceable when located within such vegetation. This could be the result of plants being out-competed and no longer present; however, observer error is certainly possible when locating presumed dead individuals that are buried in abundant grass mulch.

The effect of the Cedar Fire directly on willowy monardella based on burning alone is currently unknown. Nevertheless, approximately 98 percent of the willowy monardella occurrences at the Station were completely burned in 2003 (MCAS Miramar 2006). While the plant is capable of re-sprouting, it is unclear whether the long-term effect of the fire is harmful or beneficial. As a result of this survey effort, the locations of juveniles and seedlings were identified (Map 7 and Map 8, respectively). They are primarily located on East Miramar in areas that were burned during the Cedar Fire. This implies that the fire has not been detrimental to the willowy monardella population on the Station and may actually have facilitated recruitment. This is still indistinct given the limited data available and is something long-term data collection may potentially clarify. Management directives may arise if ecological commonality between these drainages is identified. Both juveniles and seedlings were observed co-occurring within the same washes which strongly indicates that there is something unique about these habitats that allows for willowy monardella recruitment. A focused study aimed at recognizing the characteristics of these locations may prove valuable (Table 6).

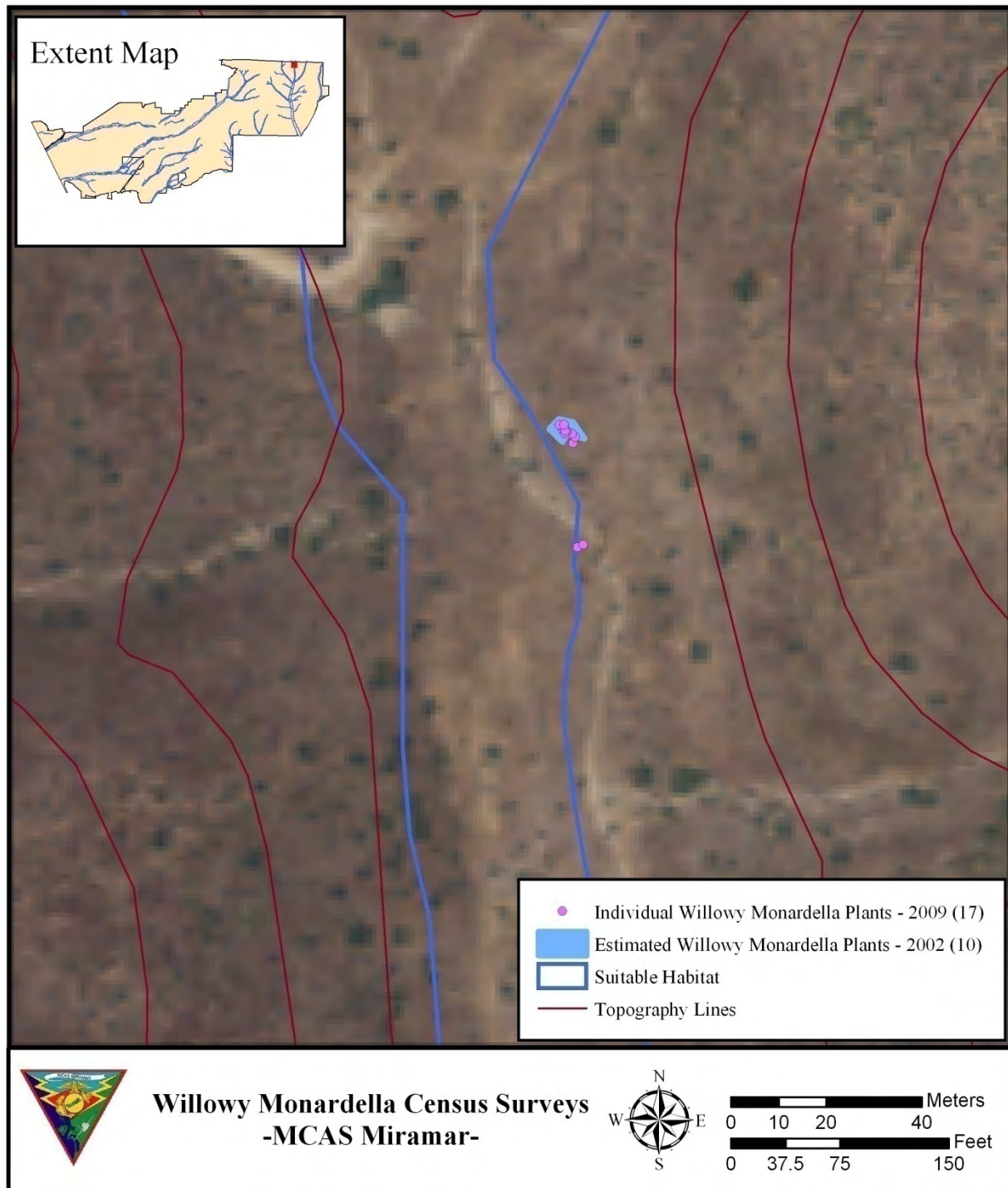
Another possible explanation that has been considered is damage resulting from infrequent flooding. Directly, these events could have displaced individuals vulnerable to being washed away by rushing waters. If this were to occur, it is possible that the plant could be deposited in a streambed and would have the potential to survive given the location is suitable. The possibility of plants being displaced by rushing water has been a subject mentioned before and may be an explanation of the apparent population trend. Higher than average rainfall after the 2003 Cedar Fire could have resulted in severe erosion at the Station. A potential example of this phenomenon was observed during the recent survey effort (Map 9).



Map 7. Juvenile willowy monardella locations recorded during the 2009 Station-wide census surveys.



Map 8. Willowy monardella seedling locations recorded during the 2009 Station-wide census surveys.



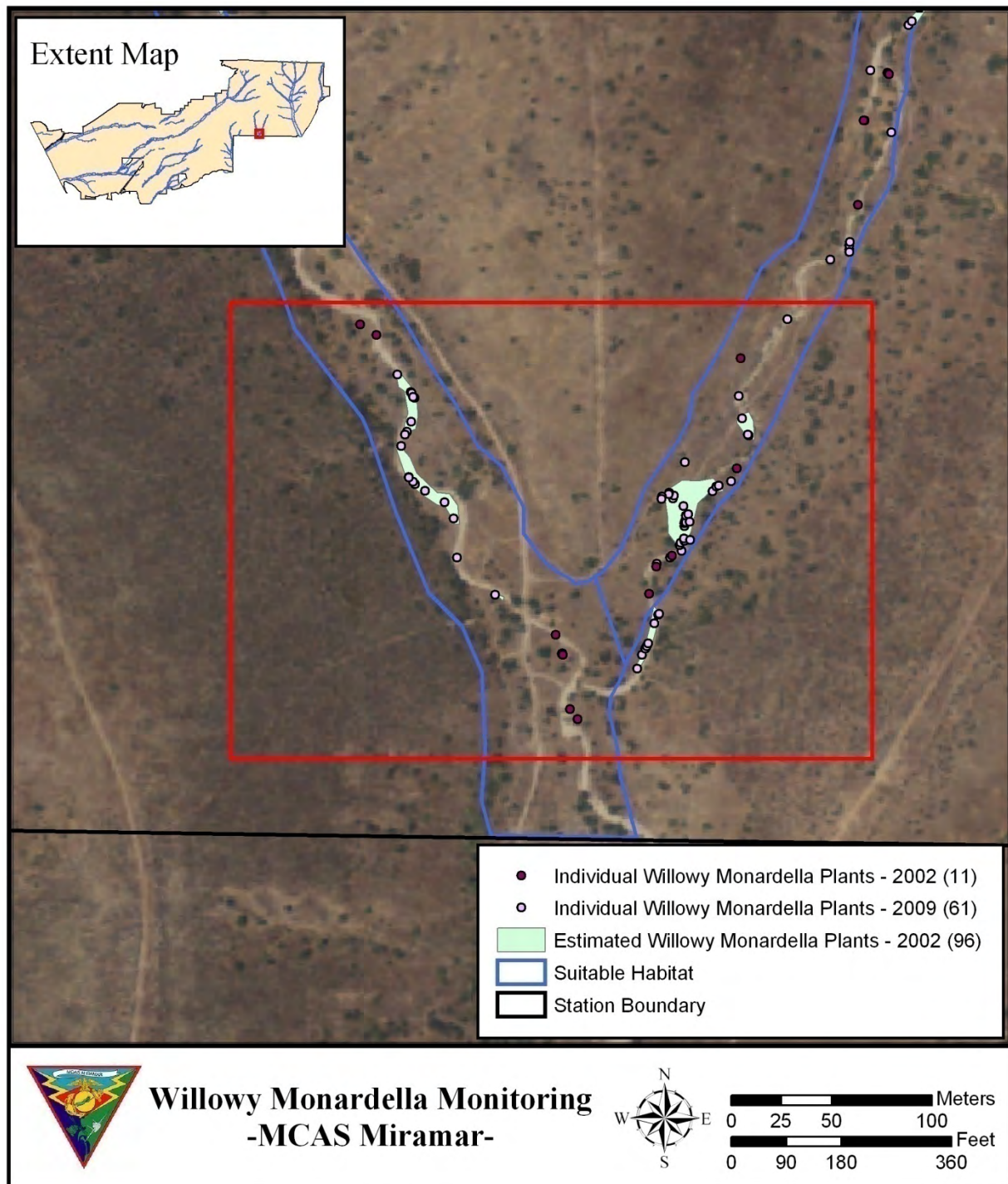
Map 9. New adult willowy monardella locations recorded during 2009 Station-wide census surveys in West Sycamore Canyon.

A population of plants previously estimated to contain ten individuals within a small area was recorded as having fourteen plants during the recent survey effort, two of which were nearly 100 ft downstream on the bank of the floodplain. The two plants that were located downstream were fruiting adults with dimensions of 106 cm x 104 cm and 89 cm x 87cm. It appears possible that the upstream population was the source of adult plants, or pieces of plants, that have since established themselves at the downstream location. It is difficult to claim that a displacement of living plants is exactly what is being seen. Perhaps recruitment is the reason this willowy monardella stand changed in size and location; however, given the size of the plants at the distant location that seems unlikely. Currently, it is unknown precisely how long it takes willowy monardella plants to reach these sizes. It is unlikely that these plants were overlooked in previous survey efforts given that work had been conducted in the vicinity of these newly found plants. If nothing else, this observation indicates that the species is increasing in distribution at this location.

Sedimentation could also result from such floods and bury plants to the point of loss. These floods can sometimes result in entirely new stream beds. This was recorded in 2005 where entire streambed realignment was observed throughout much of West Sycamore Canyon (TDI 2005). Over time this may have caused some plants to die off due to loss of soil moisture. The Cedar Fire may have been a catalyst for any one, or all, of these flooding pulses, becoming more harmful than they would have been without the loss of vegetation in watersheds of drainages containing willowy monardella.

Based on the observations recorded during this census, the decline in willowy monardella populations appears to be a result of a combination of fire, flood, reduced shrub numbers as well as exotic species encroachment.

Field techniques alone may differ between survey crews and result in dataset discrepancies; it is important to identify problematic tendencies and address them prior to conducting a census. In the case at hand, entirely different survey techniques were applied between survey efforts and the apparent magnitude of decline was likely influenced. For example, Map 10 shows polygons created from previous survey efforts (2002) as well as individual points mapped during the recent (2009) census; the light green areas are the polygons that were recorded in 2002 and the purple dots are the individual plants that were recorded in 2009. While the polygons do not identify individual plants, the areas they encompass were estimated to contain 96 plants. Only 61 plants were mapped within these polygons during the 2009 effort. This could simply be the result of different survey methodology, inaccurate population estimation, or completely different reasons.



Map 10. Comparison of general polygon mapping and individual plant mapping in Spring Canyon.

Beyond the myriad of environmental factors that have influenced this species since the original status assessment in 2002, discrepancies in survey techniques may have also resulted in an apparent decline that is in reality less severe. As mentioned, prior to the fire, individuals within clusters were estimated by measuring the longest and widest portions of the cluster (in meters), multiplying these two values and then dividing the product by 0.785 m. The result was an estimated number of individuals within each clump. After the fire, a new modified method that accounted for individuals was developed in order to prevent over-counting of willowy monardella plants. This inconsistency in survey methods make it impractical to compare the two datasets that resulted from the current and previous survey efforts or at least less authoritative; we are comparing estimates to individuals.

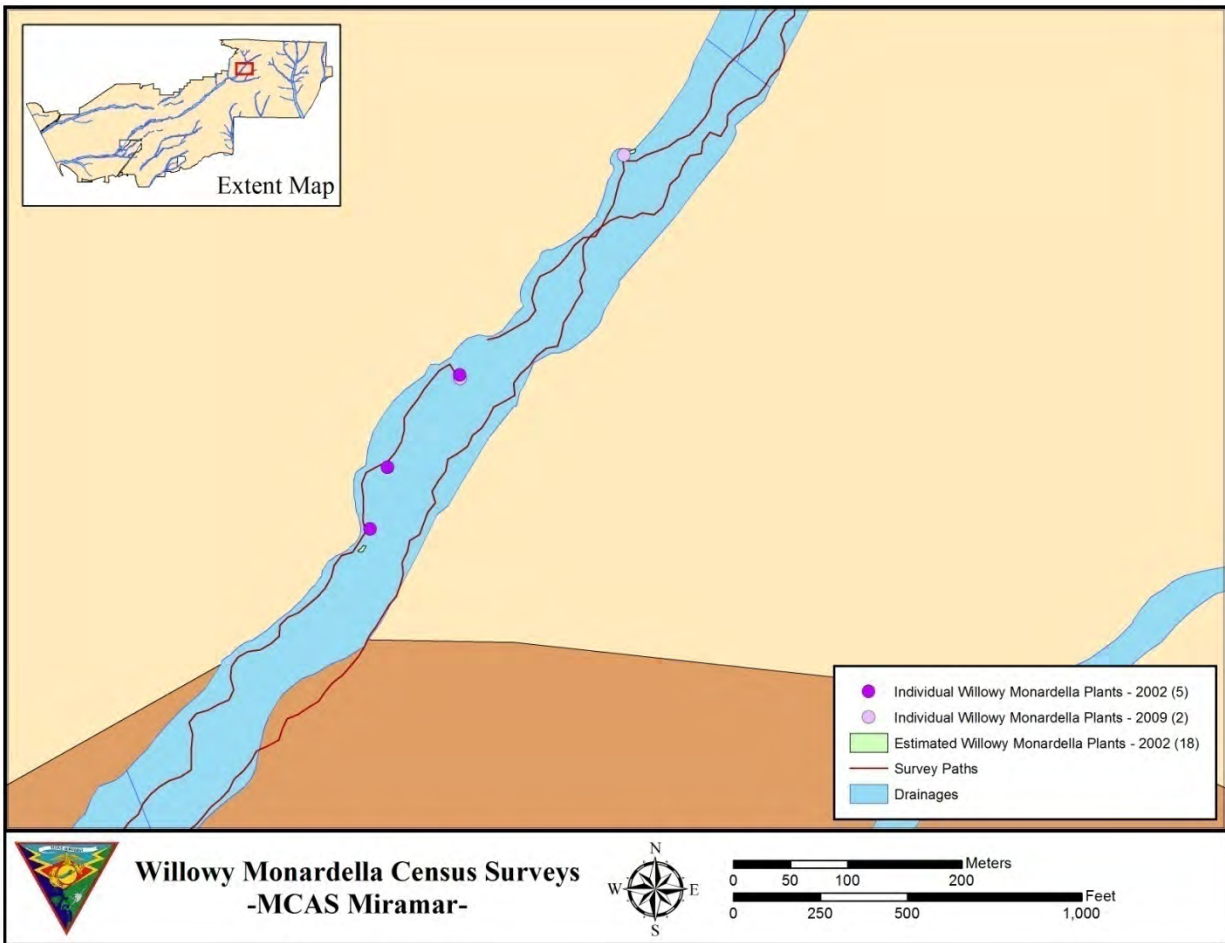
The 2009 census and comparative analysis resulted in inconclusive evidence of population trend; however, various observations and findings may have exposed previously undetected tendencies in relation to habitat change, population status, and species vulnerability.

While recording encountered plants using the six-inch rule, as well as noting their life stage, each plant was also measured at its longest and widest points (excluding individual stems that appeared to be outside of the somewhat defined “clump”). These data proved key for various reasons. To begin with, it simply presented a range of plant sizes that portrayed species variability throughout the Station. Secondly, it made a distinction between survey methods and identified the difference in assessment using different survey protocol.

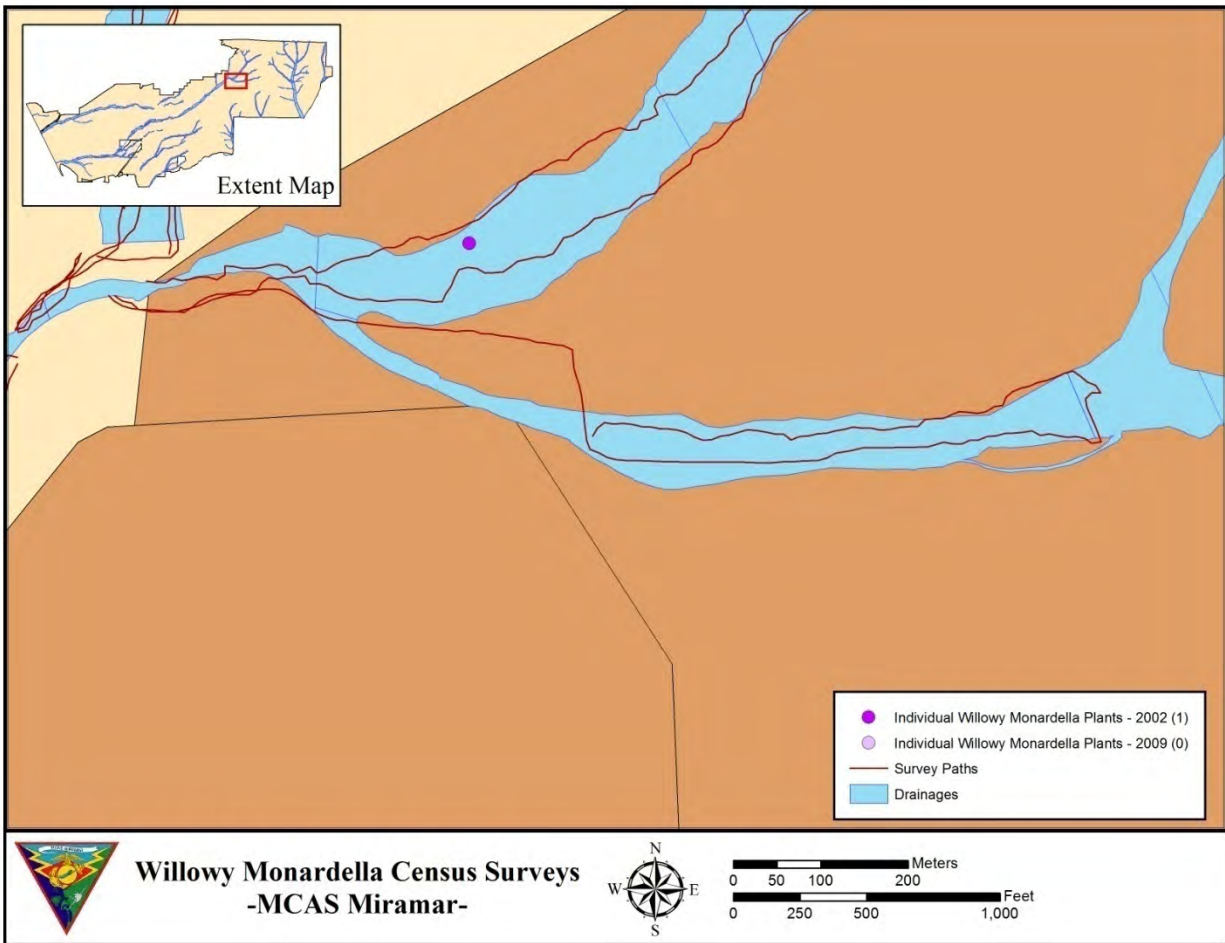
There were a few willowy monardella populations within San Clemente Canyon that appear to have experienced a decline. These locations were specifically evaluated given the recent rifle range work that had potential to influence the local populations. After an assessment of three areas that experienced a decline, it is unlikely that the current status of these populations is a result of rifle range re-construction. Two of the populations are upstream of the rifle range and it is doubtful that activities downstream would have affected the populations. The third decline was found nearly five miles from the range.

The population that appeared to have the most drastic decline in San Clemente Canyon was located north of the rifle range (Map 11). In previous surveys, it was estimated that the area contained a total of 23 plants; however, recent efforts only identified 2 plants remaining at this location.

Another nearby population change was also identified; however, this occurrence was much less severe and whether or not the current finding indicates a decline is questionable (Map 12). There was previously one individual identified in this area during past surveys yet no plant was found during the recent survey effort. This finding was not unexpected given that the previous effort identified the individual as dead/dormant and therefore the plant may not have been in good health historically. Consequently, conclusions regarding this change would be invalid.

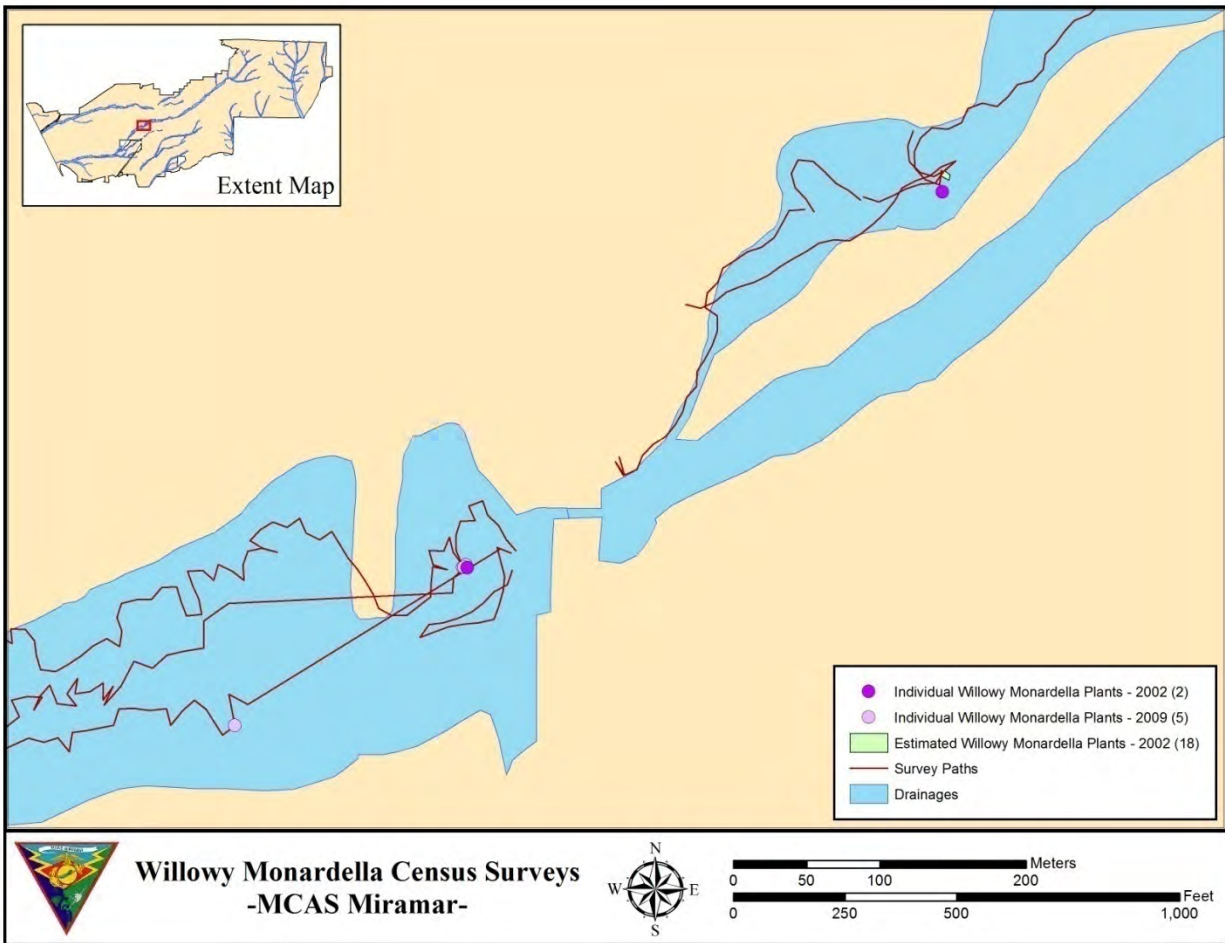


Map 11. Local population trend north of rifle range in San Clemente Canyon.



Map 12. Potentially missing plant location within San Clemente Canyon.

The third population mentioned that appears to have experienced a decline is downstream in San Clemente Canyon nearly five miles away (Map 13). This population was previously recorded as containing an estimated 18 plants at various life stages and two additional individuals, one of which was recorded as being dead/dormant. The recent effort identified five plants in the vicinity, all of which were flowering and fruiting. While a decline at this location is likely to have occurred, the cause of this incidence is unclear. Furthermore, such a change seems strange given the health of the remaining individuals.



Map 13. Population change downstream from the rifle range within San Clemente Canyon.

Given the considerable change in the willow monardella population at the Station between 2002 and 2009, comparisons were attempted between the two datasets. Using the six-inch rule, 1,809 willow monardella plants were identified at the Station, which is approximately 54 percent of the population estimated from the 2002 efforts. If the same evaluation technique employed in 2002 were used during the 2009 effort, based on the recorded dimensions, there would be nearly 200 additional plants. This would result in approximately 10 percent difference in total population remaining at the Station. This difference in total populations recorded, due solely to variations in methodology, indicates that further studies to develop sound methods are critical to the general population assessment of this species (Table 5).

VI. Conclusion

Nearly all plants that were encountered were healthy in appearance, with many flowers visited frequently by pollinators. Only a nominal number of dormant plants were found and very little herbivory was observed. While some plants that were previously mapped were not located, this recent effort did document plants that had not yet been mapped, at least not individually.

The monitoring program that was developed for willowy monardella in 2003 focused on the collection of demographic data in order to answer six questions. These questions were organized with the first question being the center of the monitoring effort. Each consecutive question was considered slightly less important than the previous question (SDNHM 2006). Though these questions were initially developed for the monitoring effort, their importance regarding the trend of the Station-wide population of the species is implicit and therefore they are discussed in this census report.

1. Are populations of willowy monardella at MCAS Miramar declining, increasing or remaining stable?

Because of the differences in data collection methods between the 2002 and the 2009 surveys, it is not possible to give an accurate answer to this question. First of all, the method to census the population used in 2009 more accurately reflects what is known about the growth habit of willowy monardella. It may be that the 2009 data set will better serve as a baseline for future surveys. Secondly, the Cedar Fire clearly altered the landscape and population dynamics of all plant species affected by the fire. Because of the lag time between the fire event and the 2009 survey, it is not possible to estimate mortality caused directly by the fire. However, it appears that the fire opened up at least some habitat for a sufficiently long period to allow for recruitment of new seedlings, addressed in the next set of comments. There is also sufficient evidence that the species was not lost in the fire and subsequent flash flooding. Without immediate post-fire survey data, it cannot be accurately stated that any of the three categories of the question can be answered. Rather, the population having been dealt a double blow in 2003-2004, it appears that the population is rebounding.

2. Is recruitment or the establishment of new individuals occurring for this species and in what form?

There were 20 seedlings recorded during this survey. These were determined to be seedlings based on the definition of seedlings as stated in the original 2002 census report that states a seedling is a plant at a life stage lacking multiple stems and less than four inches tall (SDNHM 2006). While this is an indication of successful recruitment, the small numbers indicate a low rate of reproduction. The recorded phenology of the plants encountered showed that the majority of plants, approximately 97 percent, were either fruiting, or flowering and fruiting (Table 3).

Table 3. The phenology of all willowy monardella plants observed during the 2009 census surveys.

Phenology					
	Vegetative	Presumed Dead	Flowering	Fruiting	Flowering & Fruiting
	17	35	33	1057	667
Approximate Percent of Total	1%	2%	2%	58%	37%

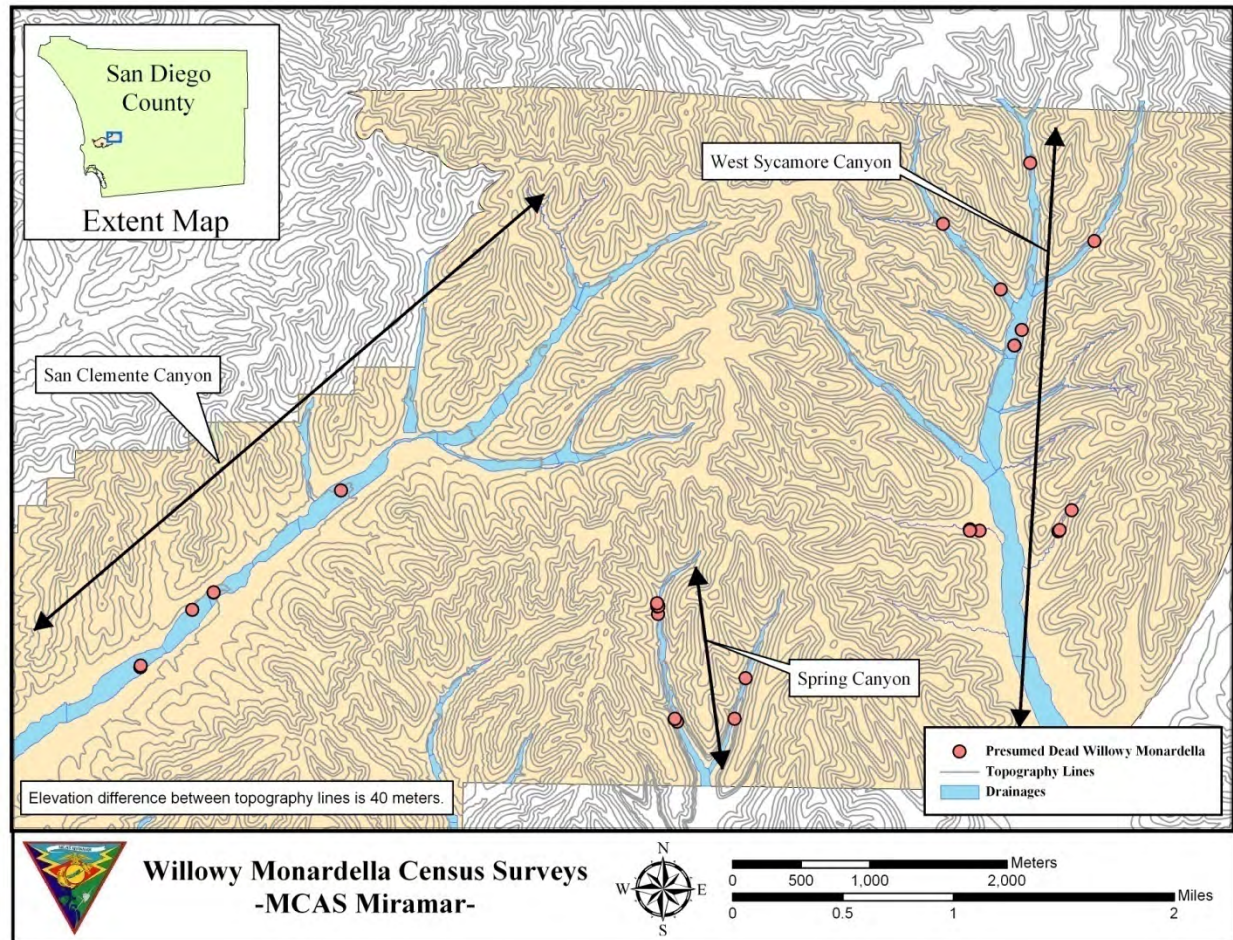
3. Is the life stage structure of the populations stable or unstable?

Previous surveys did not collect life stage structure data for the assessment of population stability and comparison. For life stage structure comparisons, it is necessary for individuals to be tracked over time. The Cedar Fire reset all surviving individuals to the same life stage and trends cannot be identified currently. Therefore, it is unfeasible to draw conclusions regarding the stability of the willow monardella population on the Station at this time. Nevertheless, the relevant data were collected during this census (Table 4), and it may be used as a baseline for future studies. All previous GPS locations were double-checked during this effort and new coordinates of all occurrences encountered were recorded.

Table 4. The life stages of all willow monardella plants encountered during the 2009 census surveys.

Life Stage	Seedling	Presumed Dead	Juvenile	Mature	Adult
	20	35	44	224	1486
Approximate Percent of Total	1%	2%	2%	12%	82%

During the course of this census survey only 35 plants (2%) were recorded as presumed dead; which is also insignificant in terms of identifying the stability of the life stage structure of the population at the Station. Nevertheless, when evaluating the records of these occurrences a potential connection between location and condition became evident. It appears that the majority of the presumed dead individuals are located within comparatively steeper canyons (Map 14). The elevation differences within Spring Canyon and West Sycamore Canyon are greater than those found in San Clemente Canyon. Furthermore, the change is more gradual in San Clemente Canyon than either of the two other canyons. The topography lines indicate a sudden shift in elevation as well as generally narrower streambeds in both West Sycamore and Spring Canyon. In the southern portion of West Sycamore Canyon, it is interesting that the presumed dead individuals are located within side drainages and not the primary streambed. The fact that they too are located in areas that are steeper and narrower also implies that there may be a connection between these individuals' condition and streambed location.



Map 14. Locations of presumed dead plants found throughout the Station.

Spring Canyon and West Sycamore Canyon together contain approximately 75% of the total presumed dead individuals recorded during this survey effort; both of which have a presumed dead percentage of their total population that is over twice as high as that of San Clemente Canyon. This correlation between stream characteristics and presumed dead individuals suggests that there are physical conditions that directly influence the populations found in such areas. The relationship between presumed dead individuals and streambed location is likely a result of the differences in hydrology that arise in these narrower watersheds. The topographic qualities of Spring and West Sycamore Canyon inherently have a higher potential to allow for destructive flashflood events. Given the species' propensity to occur within and/or adjacent to streambeds, such events could have resulted in soil deposition or other damage that may have caused the individuals to perish. Such events likely occurred following the Cedar Fire and may have been the source of these recent observations.

Table 5. Comparison of presumed dead individuals based on watershed location.

Canyon	Observed Individuals	Presumed Dead Individuals	Approximate Percent of Canyon Total	Approximate Percent of Presumed Dead Total
West Sycamore Canyon	580	16	2.75	46
San Clemente Canyon	536	6	1.12	17
Spring Canyon	375	10	2.67	29

4. What potential threats to the species exist?

Over the course of the Station-wide census there were a few observations that appeared to be linked to the decline of this species. The following list was developed based on those observations and is ordered from greatest potential threat to minor potential threat. It is possible that the combination of such events negatively impact the species. On the other hand, temporary fluctuations in population may be a natural occurrence for this species; however, this concept has not been documented to date.

1. Exotic plant species
2. Lack of seed viability
3. Granivory
4. Stochastic events
5. Recreational activities

Exotic invasive plants that seem to have the most influence on willow monardella are co-occurring nonnative grass species, primarily *Bromus* ssp. and *Avena* ssp., that are common throughout all canyons at the Station. Grasses are capable of invading space in which willow monardella might otherwise be capable of colonizing with seedling recruitment. Grasses compete for early season moisture, but are also abundant enough to reduce to zero that open space and exposed mineral soil most likely required for seed germination of the monardella. Many mature monardella plants were observed in areas that were still relatively free of exotic grasses. But in areas invaded by grasses, mature plants were lost from previous counts, and those that were surviving were reduced in size compared to plants growing on open mineral soil. The measurement method employed in the current census will allow for future comparisons of plants in the presence of exotic grasses in terms of the negative impact of competition on existing monardella plants.

Seed viability is easily analyzed using both chemical and germination methods. This effort should be incorporated into future studies.

Granivory by harvester ants (*Pogonomyrmex* spp.) has been documented in a number of southwestern environments (Inouye *et al.* 1980; MacMahon *et al.* 2000; Azcarate and Peco 2003). Harvester ants were observed in all of the drainages in which willow

monardella occurred. Seeds found by harvester ants are sometimes eaten immediately or are removed and cached for food reserves. Since seeds of plants in the mint family (*Lamiaceae*) are generally high in oils and proteins, it may reasonably be assumed that willow monardella seeds are also an attractive food source for the native ant community. Since monardella seeds form relatively late in the season, they potentially could be an important part of the seasonal diet of granivores. This is rich topic for future studies that would directly impact the ability of willow monardella to recruit new plants into the population.

Stochastic events may also have a harmful influence on willow monardella populations at the Station. Such natural events as fire, flood, and drought vary in intensity and recurrence. Furthermore, the combination of these occurrences would likely have synergistic effects. Figure 1 displays the precipitation pattern of the region collected at San Diego Weather Service Office (WSO) Airport, approximately eight miles southwest of the Station.

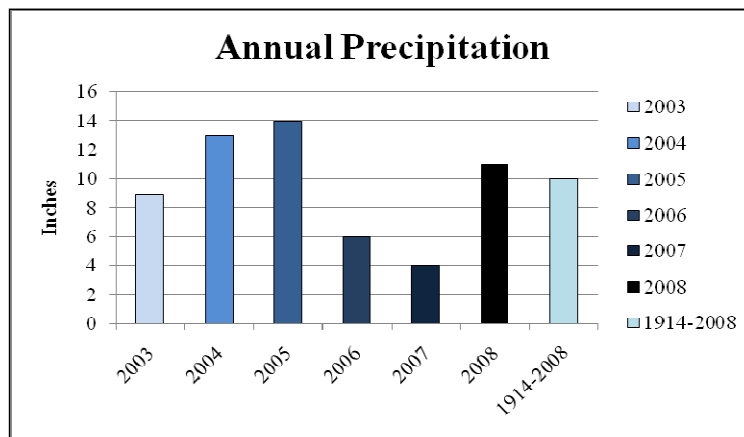


Figure 1. Annual rainfall recordings taken from nearby weather station (San Diego WSO Airport – Western Regional Climate Center-Closest Weather Station with Long-term dataset).

Another threat that willow monardella is facing is damage from human recreation. The resultant damage is far less significant than the previously mentioned threats, but was observed and is worth mentioning. On several occasions throughout the survey effort, bikers were observed; hikers were seen a few times. While they were routinely riding or hiking on well-established paths/trails or in canyons, occasional tracks were found beyond the paths as evident from footprints, tire tracks, and broken vegetation. There was no direct damage to willow monardella from human intruders observed during the surveys, however, the preferred course of trespassers appears to be within or adjacent to willow monardella habitat.

5. What management directives could prove beneficial for the species?

According to the SDNHM Department of Botany, passive management of willow monardella is not effectively protecting the species (SDNHM 2006). Consequently, approaches to improve the status of the species should be considered. According to

the observations made over the course of this survey effort, the following suggestions are offered (Table 6).

Various methods of artificial enhancement (plantings, temporary irrigation, soil enrichment, etc.) should be considered to promote the recovery of willow monardella populations at the Station. Restoration measures including the improvement of suitable habitat and the planting of individuals may prove effective. Enhancement measures are currently being studied and are expected to be insightful. In time, this research will likely uncover successful practices to encourage stabilized willow monardella populations at the Station.

Very little is known about the seed viability of this species. Focused studies on the issues surrounding seed production should be investigated. These and other questions regarding the success of willow monardella seeds should be explored.

A more accurate approach that estimates the number of individuals in large clumps should be considered. The method should take into account the variability in size and appearance of willow monardella individuals. Perhaps a range of techniques specific to the various conditions encountered should be developed. For instance, within two years of a fire event, technique A is applied whereas technique B will be used from the third year forward until another fire event occurs. Regardless, the system of measurements should be adopted by all persons surveying the species in order to ensure that comparable datasets are obtained.

Table 6. Future actions that could be employed to provide further insight on the status of willow monardella.

Research and Management Suggestions*		
Study	Objective	Implication
Seed Viability and Germination	Test seed viability. Identify conditions that promote germination.	The low number of seedlings recently observed could be the result of altered environmental factors. Ecological situations that create suitable seedling habitats could be recognized and exacting soil requirements could occur.
Nursery Plant Survival	Investigate nursery plant endurance when placed in the field under natural environmental conditions.	Nursery plants are generally brought up under conditions that are different than those that occur in the natural environment. It is possible that nursery stock plants could be utilized in the re-establishment of this species; however, consideration should be given to factors assuring successful establishment.
Mulch Enhancement	Experiment with the addition of mineral mulch at the base of study plants.	The addition of dust-free mineral mulch may increase the longevity of soil moisture which may in turn support the healthy development of root structures.

Exotic Plant Removal	Remove all exotic species surrounding willowy monardella plants within a radius that is determined adequate.	Based on the size of individuals or clumps, exotic species should be removed to eradicate any direct competitive relationships for limited resources. This could potentially uncover measures to be taken to increase the likelihood of long-lived willowy monardella as well as the establishment of seedlings.
Granivory	Investigate the role of harvester ants on seed predation and/or distribution.	Harvester ants and other granivores could potentially be consuming a very large proportion of seed produced by willowy monardella, directly impacting the potential for recruitment.
Habitat and Life History	Investigate all plant characteristics and ecological interactions that affect the security of the species. This should include pollinator success studies.	In order to more fully understand the intricacies of this plant's performance, it is fundamental to investigate the general ecological characteristics that this plant endures. Measuring seasonal biomass of populations may be insightful as a means of recognizing population health. Monitoring frequency of occurrence and monitoring habitat development as well as streambed behavior may also uncover commonalities.
Plant Evaluation Protocol	Conduct tests to establish standardized field protocols that accurately identify individual plants among dense clusters of canopy.	Testing methods to establish more defined survey protocols is an important aspect of assessing this plant's status. Methods that were developed over previous years have employed protocols that applied the best attempts to correctly estimate/identify individual willowy monardella plants. Identifying precise and repeatable methods to investigate species populations' trends is essential to understanding the status of this rare species. The performance of replicable methods of field observation that avoid subjective decisions by individual observers is crucial in making valid comparisons over time. Labeling individuals with permanent metal tags may be useful for long-term studies.
Cutting Propagation	Study the success of planting cuttings from naturally occurring willowy monardella plants.	It is possible that using cuttings from natural plants that are capable of withstanding such cuttings could be used to propagate the species.
Canopy Enhancement	Research the addition of shrubs as a source of canopy cover for willowy monardella plants.	Previous studies have indicated that the tendency of willowy monardella to occur underneath the canopy of nearby shrubs is notable. The potential of willowy monardella to occur and survive beneath native shrub canopies is a condition that may be considered worth studying.
Seedling and Juvenile Habitat	Evaluate the environmental conditions that exist where seedlings and juveniles occur.	Potentially be able to better understand what habitat characteristics are conducive to seedling and juvenile

Genetics of Clumps	Perform simple gel electrophoresis tests on large clumps of the species.	Determine whether large clumps are genets ¹ or ramets ¹ .
*It is important to ensure that genetic variability is considered when studying the success of plant propagation, enhancement studies, and general life history evaluations.		
“Genet: a discrete genetic individual plant (in contrast to a ramet, which might be a structurally independent plant derived by lateral growth (vegetative) reproduction, or part of a clonal plant with rhizome or stolon connections between the component ramets) (Crawley 1997).		
<i>This list is not arranged in any particular order; it is not to be implied that the location of the items within this list indicate priority or importance.</i>		

In reality, there is no one management strategy that is clearly going to ensure that willow monardella will rebound successfully. Recurring assessments of intervention technique effectiveness is necessary. Increased knowledge and resultant developments will identify deficiencies that need to be addressed and take advantage of successes that occur. In doing so, an up-to-date and proficient adaptive management approach can be continued.

6. What is the natural history and ecology of the species?

The natural history of willow monardella is a subject that is still being explored. Long-term monitoring efforts as well as census and status surveys have been taking place for less than a decade. As these studies carry on and population assessments continue, discoveries regarding the life history and ecology of the species will transpire. At this time there is still a lot to be learned from the willow monardella populations at the Station.

The willow monardella population at the Station reflects a decline since the initial status surveys conducted in 2002. The severity of this occurrence is unclear at this point. The study of willow monardella is relatively novel so there is a lot that is yet to be understood. While the evidence throughout studies conducted on this species exposes a population decline, it is important to understand that this type of population flux could be typical of this species. Moreover, the majority of the plants found in the recent census were robust with fruits and flowers. Seedlings, though not abundant, were observed this year and their observation had not been recorded in recent years. The primary factor that appears to be limiting the distribution of willow monardella appears to be increased exotic grass. Further assessments of willow monardella will add to population trends and suggest causes of recorded declines.

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Appendix A: Dates of Project Work

Willowy Monardella census surveys conducted in 2009.

DATE
06 June 2009
26 June 2009
30 June 2009
10 July 2009
18 July 2009
19 July 2009
25 July 2009
07 August 2009
09 August 2009
11 August 2009
12 August 2009
25 August 2009
26 August 2009
09 September 2009
11 September 2009
15 September 2009
22 September 2009
25 September 2009
08 October 2009
28 October 2009
27 November 2009
26 August 2010*
02 September 2010*
*Revisits were made to ensure that GPS malfunctions were resolved and missing plants were located and recorded.

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Appendix B: Names of Persons Working on the Project

Personnel	Project Position
Elizabeth Kellogg	Lead Biologist
Melissa Fehling	Contract Manager
Joseph Kean	Biologist/GPS/GIS Technician
Harry Smead	Biologist/GPS/GIS Technician
Scott Snover	Biologist/GIS Technician
Fausto Larios	Biological Technician
Billy Fletcher	Biological Technician
Jason Crandall	Biological Technician
Mark Zegler	Biological Technician
James Lockman	Editor, Sr. Plant Ecologist

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Appendix C: Detailed Site Photographs



Photo 1: Potential habitat with abundant non-native grass species in San Clemente Canyon.



Photo 2: Willowy monardella seedling in West Sycamore Canyon.



Photo 3: Willowy monardella seedling in West Sycamore Canyon.



Photo 4: Willowy monardella seedling in West Sycamore Canyon.



Photo 5: Nearly dormant willowy monardella in Sycamore Canyon.



Photo 6: Potential source of herbivory in Spring Canyon.



Photo 7: Common pollinator attacked by opportunistic predator in Spring Canyon.



Photo 8: Abundant willow monardella individuals prolific within habitat in Spring Canyon.



Photo 9: Tallest willowy monardella observed during census surveys in San Clemente Canyon.



Photo 10: Presumed dead juvenile willowy monardella individual competing with non-native grasses in Sycamore Canyon (these occurrences can be overlooked if one is not paying attention to detail).



Photo 11: Willowy monardella individual with gopher mound disturbance in Spring Canyon.



Photo 12: Survey area that has abundant exotic annual grasses and few shrubs in Elanus Canyon.

Appendix D: Datasheets

The following datasheets were completed during data collection for willowy monardella plants occurring within predefined long-term monitoring plots. The plant specific information for all plants encountered during the Station-wide census are recorded within the associated GIS files.

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Willow Monardella Data Collection Sheet

Date 8/26/09 Start Time 12:05 End Time 12:30

Study Site Label 1-A Detailed or Normal Survey Effort _____

Surveyors J. K., H. S., F. L., B. F.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Phenology

Number of Seedlings _____ Number Vegetative _____

Number of Juveniles _____ Number Budding _____

Number of Mature _____ Number Flowering _____

Number of Adults _____ Number between _____

Number of Dead/Dormant _____ Flower and Fruit _____

Total Number of Individuals _____ Number Dormant/Dead _____

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

BRODIA - 70% BROHOR - 15

AVEBAR - 10%

ERIFAS - 1

Describe the Channel (width, depth, rockiness etc.)

narrow channel (1-2 m) varying depth (.5 - 1.5 m)
3-10 in cobbles

Natural History Observations (pollinators, herbivory, other noticeable features)

There was a wasp nest nearby

Add Clump size dimensions or other notes on back of this survey sheet.
Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 7/25/09 Start Time 9:55 End Time 10:20
 Study Site Label Z-B Detailed or Normal Survey Effort Detailed
 Surveyors Joseph K., Fausto L., Harry S.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings 0
 Number of Juveniles 0
 Number of Mature 1
 Number of Adults 4
 Number of Dead/Dormant 0
Total Number of Individuals 5

Phenology

Number Vegetative 0
 Number Budding 0
 Number Flowering 0
 Number between Flower and Fruit 0
 Number in Seed 5
 Number Dormant/Dead 0

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

BRODIA - 45% TOXDIV - 1% CEATOM - 1%
AVEBAR - 40% BACSAR - 1% SERBER - 1%
QUEBER - 1% ERIFAS - 1%

Describe the Channel (width, depth, rockiness etc.)

littoral + brachypodine w/in wash (a small amount of erodium botry)
2m wide, 1/2 meter deep; very rocky (3-15in cobbles)

Natural History Observations (pollinators, herbivory, other noticeable features)

cell plants located on island
no pollinators → there are no longer flowers

Add Clump size dimensions or other notes on back of this survey sheet.
 Remember to use the 6" rule where applicable.

Willow Monardella Data Collection Sheet

Date 9/25/09 Start Time 8:47 End Time 9:01

Study Site Label 3-C Detailed or Normal Survey Effort _____

Surveyors J.K., H.S., E.L., M.Z.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings _____

Number of Juveniles _____

Number of Mature 1

Number of Adults 4

Number of Dead/Dormant 1

Total Number of Individuals 5

Phenology

Number Vegetative _____

Number Budding _____

Number Flowering _____

Number between _____

Flower and Fruit Number in Seed 4

Number Dormant/Dead 1

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

<u>SALAPI</u>	<u>ERIFAS-2</u>	<u>RHACRO-2</u>
<u>BRODIA-35</u>	<u>EROBOT-35</u>	<u>TOXDIV-3</u>
<u>BROMAD-10</u>	<u>ERICRAS-5</u>	

Describe the Channel (width, depth, rockiness etc.)

2.5m wide, 30 cm deep, overflow - 1m x 10cm
oxbow, cobbles 4in

Natural History Observations (pollinators, herbivory, other noticeable features)

fairly open, good solar radiation
rather steep w 2°

Add Clump size dimensions or other notes on back of this survey sheet.
Remember to use the 6" rule where applicable.

Willow Monardella Data Collection Sheet

Date 9/25/09 Start Time 8:27 End Time 8:35
Study Site Label 4-D Detailed or Normal Survey Effort _____
Surveyors J.K., H.S., F.L., M.Z.

Demographic Data (entire monitoring site, use tic marks):

<u>Life Stage</u>	<u>Phenology</u>
Number of Seedlings _____	Number Vegetative _____
Number of Juveniles _____	Number Budding _____
Number of Mature _____	Number Flowering _____
Number of Adults _____	Number between _____
Number of Dead/Dormant _____	Flower and Fruit _____
	Number in Seed _____
Total Number of Individuals _____	Number Dormant/Dead _____

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

<u>BRONIA - 90%</u>	<u>MALLAU - 1%</u>
<u>PRULI - 3%</u>	<u>POLMON</u>
<u>EROFAS - 1%</u>	

Describe the Channel (width, depth, rockiness etc.)

.5 m wide, 10 cm deep, cobbles 1-4 in

Natural History Observations (pollinators, herbivory, other noticeable features)

no flowers on anything, thick mat of grass up to 6 in
lots of animal trails (noticeable due to grass)

Add Clump size dimensions or other notes on back of this survey sheet.
Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 7/25/09 Start Time 3:00 End Time 5:15

6327820 Study Site Label 5-E Detailed or Normal Survey Effort detailed

1905216 Surveyors Joseph K., Fausto L., Harry S.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings 0
 Number of Juveniles 0
 Number of Mature 1
 Number of Adults 2
 Number of Dead/Dormant 0
 Total Number of Individuals 3

Phenology

Number Vegetative 0
 Number Budding 0
 Number Flowering 2
 Number between Flower and Fruit 0
 Number in Seed 1
 Number Dormant/Dead 0

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

BRODIA-40% QUERER-1% FROBOT-1%
BROMAD-40% TOKDIL-3% HIRING-1%
SERBER-10% PRUILLI-1% BACSER-1%

Describe the Channel (width, depth, rockiness etc.)

3.5 m wide, 1/2 m deep, cobbles (2-10 inch)
spots w/ algae, stream channel is very rocky

Natural History Observations (pollinators, herbivory, other noticeable features)

all three plants are on rocky bank

Add Clump size dimensions or other notes on back of this survey sheet.
 Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 7/25/09 Start Time 9:00 End Time 9:40

Study Site Label 6-F Detailed or Normal Survey Effort Detailed

Surveyors Joseph K., Fausto L., Harry S.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings 0

Number of Juveniles 0

Number of Mature 2

Number of Adults 12✓

Number of Dead/Dormant 2

Total Number of Individuals 14

Phenology

Number Vegetative 0

Number Budding 0

Number Flowering 0

Number between 0

Flower and Fruit
Number in Seed 12

Number Dormant/Dead 2

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

BRODIA - 45% TOXDIV - 1% CEATOM - 1%
AVEBAR - 40% BACSAR - 1% SERBER - 1%
QUEBER - 1% ERIFAS - 1%

Describe the Channel (width, depth, rockiness etc.)

3 m wide, 1/3 meter deep. All plants found in stream channel, medium rockiness (small cobbles - 2.5 in) algae lotum in the channel

Natural History Observations (pollinators, herbivory, other noticeable features)

no pollinator activity (they are on the eriogonum); plants on islands w/in channel and on the sides, robust plants

Add Clump size dimensions or other notes on back of this survey sheet.
Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 7/25/09 Start Time 8:10 End Time 8:40

Study Site Label 7-6 Detailed or Normal Survey Effort detailed

Surveyors Joseph K., Fausto L., Harry S.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings 0
 Number of Juveniles 0
 Number of Mature 0
 Number of Adults 0
 Number of Dead/Dormant 0
 Total Number of Individuals 0

Phenology

Number Vegetative 0
 Number Budding 0
 Number Flowering 0
 Number between Flower and Fruit 0
 Number in Seed 0
 Number Dormant/Dead 0

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

AVEBAR-40 CEATOM-11
BRODIA-30 PRULI-11
BROMAD-20 TOXDIV-11

Describe the Channel (width, depth, rockiness etc.)

1m wide, mostly sandy some cobbles (5-10in)
1/3 m deep

Natural History Observations (pollinators, herbivory, other noticeable features)

1 on the road appears flattened, one right off road
in small depression, road = old channel
2003 fire has influenced entire drainage

Add Clump size dimensions or other notes on back of this survey sheet.
 Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 8/26/09 Start Time 3:15 End Time 3:40

Study Site Label 8-H Detailed or Normal Survey Effort _____

Surveyors J.K., H.S., F.L., B.F.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Phenology

Number of Seedlings _____ Number Vegetative _____

Number of Juveniles _____ Number Budding _____

Number of Mature _____ Number Flowering _____

Number of Adults _____ Number between _____

Number of Dead/Dormant _____ Flower and Fruit _____

Total Number of Individuals _____ Number Dormant/Dead _____

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

AVEBAR - 25 SERDET - 2
BRODIA - 60 BACSAR - 1
QUERER - 5 TOXDIV - 1

Describe the Channel (width, depth, rockiness etc.)

3m x 1m cobbles 2-4 in, lot of sand
steep banks

Natural History Observations (pollinators, herbivory, other noticeable features)

dense grass w/ a few shrubs

Add Clump size dimensions or other notes on back of this survey sheet.
 Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 11/27/09 Start Time 12:50 End Time 2:10
 Study Site Label 9-I Detailed or Normal Survey Effort Normal
 Surveyors Harry Smead + Fausto Larios

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings 1

Number of Juveniles —

Number of Mature |||||

Number of Adults |||||

Number of Dead/Dormant —

Total Number of Individuals 58

Phenology

Number Vegetative —

Number Budding —

Number Flowering —

Number between 58

Flower and Fruit

Number in Seed —

Number Dormant/Dead —

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

<u>MALLAY - 10</u>	<u>RAMCRO - 20</u>	<u>ERICRA - 5</u>
<u>Yerb4 - 15</u>	<u>ERIFAS - 2</u>	<u>NNG - 60</u>
<u>SALAPI - 1</u>	<u>PRUN - 2</u>	<u>barrel cactus</u>

Describe the Channel (width, depth, rockiness etc.)

1.5 meters wide - .4 meter deep
channel is briefly split in center of plot
rocky w/ 3-8 mm cobble

Natural History Observations (pollinators, herbivory, other noticeable features)

Add Clump size dimensions or other notes on back of this survey sheet.
 Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 11/27/09 Start Time 12:00 End Time 12:30
 Study Site Label 10-J Detailed or Normal Survey Effort Normal
 Surveyors Harry Smeab + Fausto Larios

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings —
 Number of Juveniles —
 Number of Mature —
 Number of Adults 13
 Number of Dead/Dormant —
 Total Number of Individuals 13

Phenology

Number Vegetative —
 Number Budding —
 Number Flowering 1
 Number between Flower and Fruit 12
 Number in Seed —
 Number Dormant/Dead —

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

BAC SAR - 3 CERBEL - 1 NNG - 15
ERIFAS - 2 RAMCRO - 1
MALLAU - 1 ARTCAL - 1

Describe the Channel (width, depth, rockiness etc.)

1.5 meters wide and .3 meters deep
rocky rubble approx 2-8 inches

Natural History Observations (pollinators, herbivory, other noticeable features)

Add Clump size dimensions or other notes on back of this survey sheet.
 Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 8/25/08 Start Time 7:45 End Time 8:45

Study Site Label 11-K Detailed or Normal Survey Effort _____

Surveyors Joseph K., Billy F., Harry S., Fausto L.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings _____

Number of Juveniles _____

Number of Mature _____

Number of Adults _____

Number of Dead/Dormant _____

Total Number of Individuals _____

Phenology

Number Vegetative _____

Number Budding _____

Number Flowering _____

Number between _____

Flower and Fruit _____

Number in Seed _____

Number Dormant/Dead _____

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

<u>ERIFAS-4</u>	<u>BAC SAL-1</u>	<u>NAP LUT-1</u>
<u>ARTCAL-1</u>	<u>BAC SAR-8</u>	<u>PLA RAC-1</u>
<u>SAL API-2</u>	<u>PRI CAL-1</u>	<u>QUE AGR-1</u>

Describe the Channel (width, depth, rockiness etc.)

40m (central channel) 20m - 1.5m
* 2m

very rocky, cobbles 1-6 in

Natural History Observations (pollinators, herbivory, other noticeable features)

- plants no longer present, somewhat recent grading
- 2 located S. of plot on the road (possibly where plant was)

Add Clump size dimensions or other notes on back of this survey sheet.
Remember to use the 6" rule where applicable.

Willow Monardella Data Collection Sheet

Date 9/25/09 Start Time 10:03 End Time 10:17

Study Site Label 12-L Detailed or Normal Survey Effort _____

Surveyors J.K., H.S., F.L., M.Z.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings _____

Number of Juveniles _____

Number of Mature _____

Number of Adults 8

Number of Dead/Dormant +

Total Number of Individuals 8

Phenology

Number Vegetative _____

Number Budding _____

Number Flowering _____

Number between _____

Flower and Fruit Number in Seed 8

Number Dormant/Dead _____

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

BRODIA-40% PRULI-1 BROHOR-5
SERBER-1 ERIFAS
QUEBER-8% BROMAD-10

Describe the Channel (width, depth, rockiness etc.)

2.5 m x 30 cm cobbles 4-8 in
winding w/ steep cut bank

Natural History Observations (pollinators, herbivory, other noticeable features)

lots of shrubs, abundant acorns
all plants in middle of stream

Add Clump size dimensions or other notes on back of this survey sheet.
Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 7/25/09 Start Time 10:30 End Time 10:55

Study Site Label 13-M Detailed or Normal Survey Effort detailed

Surveyors Joseph K., Fausto L., Harry S.

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings 0

Number of Juveniles 0

Number of Mature 0

Number of Adults 0

Number of Dead/Dormant 0

Total Number of Individuals 0

Phenology

Number Vegetative 0

Number Budding 0

Number Flowering 0

Number between 0

Flower and Fruit
Number in Seed 0

Number Dormant/Dead 0

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

CEATOM - 3% Pru ILI - 1%
AVEBAR - 30% SERBER - 1%
BrodIA - 60%

Describe the Channel (width, depth, rockiness etc.)

1 1/2 m wide, 1/4 m deep, 3-15 in cobble, a little algae

Natural History Observations (pollinators, herbivory, other noticeable features)

no plants → no pollinators; lots of non-native
grasses along are along banks

Add Clump size dimensions or other notes on back of this survey sheet.
Remember to use the 6" rule where applicable.

there were no plants found
the fire may have eliminated populations

Willow Monardella Data Collection Sheet

Date 11/27/09 Start Time 10:57 End Time 11:42
 Study Site Label 14 N Detailed or Normal Survey Effort _____
 Surveyors J.K., H.S., F.L., M.Z.

Demographic Data (entire monitoring site, use tic marks):

Life Stage	Phenology
Number of Seedlings <u>2</u>	Number Vegetative <u>—</u>
Number of Juveniles <u>1</u>	Number Budding <u>—</u>
Number of Mature <u>III III</u>	Number Flowering <u>—</u>
Number of Adults <u>III III I</u>	Number between <u>25</u>
Number of Dead/Dormant <u>2</u>	Flower and Fruit <u>—</u>
	Number in Seed <u>—</u>
Total Number of Individuals <u>27</u>	Number Dormant/Dead <u>2</u>

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

<u>BRODIA-50</u>	<u>PRULLI-1</u>	<u>TOXDIV-1</u>
<u>AVEBAR-10</u>	<u>SERBET-5</u>	
<u>QUEBER-3</u>	<u>ERLEAS-1</u>	

Describe the Channel (width, depth, rockiness etc.)

1.5m x 25cm cobles 4-8 in

Natural History Observations (pollinators, herbivory, other noticeable features)

channel w/ varying depth and appears
to have more than one water course?

Add Clump size dimensions or other notes on back of this survey sheet.
 Remember to use the 6" rule where applicable.

Willowy Monardella Data Collection Sheet

Date 7/25/09 Start Time 4:00 End Time 4:35

Study Site Label 15-0 Detailed or Normal Survey Effort census

Surveyors Harry Smead, Joseph Kean, Fausto Larias

Demographic Data (entire monitoring site, use tic marks):

Life Stage

Number of Seedlings Number Vegetative

Number of Juveniles Number Budding

Number of Mature Number Flowering

Number of Adults |||| Number between ||

Number of Dead/Dormant Flower and Fruit |||

Total Number of Individuals 5 Number Dormant/Dead

Phenology

Habitat Data:

Surrounding Species Observed (Use the plant list sheet with codes. Add percent cover next to species names.)

List any new species below using the botanical name and the estimated percent cover next to the species name.

AVEBAR - 30% CEATOM - 3%
BRODIA - 40% CERMIN - 7%
PRUILL - 5%

Describe the Channel (width, depth, rockiness etc.)

well established island within channel
medium → large cobbles, varying depth

Natural History Observations (pollinators, herbivory, other noticeable features)

Add Clump size dimensions or other notes on back of this survey sheet.
 Remember to use the 6" rule where applicable.

