2016 ANNUAL REPORT
BIOLOGICAL MONITORING
for Units 09, 23N, and 28, and Units 11 and 12 Containment Lines; Units 01 East, 06, 07, 10, Watkins Gate Burned Area, and MOUT Buffer; Unit 04 and Units 11 and 12 Interior; Units 18 and 22
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ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
BO	Biological Opinion

BLM	United States Bureau of Land Management
Burleson	Burleson Consulting, Inc.
dm	Decimeter(s)
EcoSystems West	EcoSystems West Consulting Group, Inc.
ft	Feet
GPS	Global Positioning System
HMP	Habitat Management Plan
HMP Shrub	Shrub Species of Concern
MEC	Munitions of Explosive Concern
m	Meter(s)
mg/L	Milligram(s) per Liter
MOUT	Military Operations Urban Terrain
NMDS	Non-metric Multidimensional Scaling
Tetra Tech	Tetra Tech, Inc.
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UXO	Unexploded Ordnance
WGBA	Watkins Gate Burn Area

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1 INTRODUCTION

The USACE (United States USACE Corps of Engineers) contracted Burleson Consulting, Inc. (Burleson) to manage biological monitoring at the former Fort Ord, Monterey County, California (see Figure 1). Burleson sub-contracted Tetra Tech, Inc. (Tetra Tech) and EcoSystems West Consulting Group (EcoSystems West) to support monitoring and analysis. The monitoring is centered on biological impacts associated with environmental cleanup activities employed for munitions of explosive concern (MEC). Biological monitoring includes three types of sampling: annual plant species density, shrub transects, and annual plant macroplots.

This report presents the results of biological monitoring conducted in Units 09, 23N, and 28, and Units 11 and 12 containment lines (Year 1 monitoring), Units 01 East, 06, 07, 10, Watkins Gate Burned Area (WGBA), and Military Operations Urban Terrain (MOUT) Buffer (Year 3 monitoring), Unit 04 and Units 11 and 12 interior (Year 5 monitoring), and Units 18 and 22 (Year 8 monitoring). Monitoring occurred during spring and summer of 2016. The 2016 biological monitoring program was conducted to satisfy the monitoring requirements of the *Installation-wide Multispecies Habitat Management Plan for Former Fort Ord* (HMP) and the *Biological Opinion* (BO) issued by the United States Fish and Wildlife Service (USFWS) (USACE, 1997; USFWS, 2015). This annual monitoring report presents the results of monitoring for HMP annuals, shrubs, grasses, and invasive plants. Before the completion of vegetation clearance, MEC removal, and other related environmental cleanup operations, biological baseline monitoring is conducted to establish whether protected species are present prior to work operations, including their location and abundance. Prior to cleanup activities, the vegetation is burned and/or masticated to remove standing vegetation and allow access to the soil surface.

Monitoring of protected species and habitat after completion of cleanup activities is conducted to determine whether the species and habitat recovery are meeting success criteria; as established in the *Revisions of Protocol for Conducting Vegetation Monitoring for Compliance with the Installation-Wide Multispecies Habitat Management Plan, Former Fort Ord, Monterey, California* (Tetra Tech and EcoSystems West, 2015b). As part of the development of the Revised Protocol, a series of three major shrub associations were identified based on the dominant species present in the Baseline surveys and their successional patterns described. These associations included: Association A - shaggy barked manzanita (*Arctostaphylos tomentosa*) dominated with chamise (*Adenostoma fasciculatum*) sub-dominant; Association B – chamise dominated with shaggy barked manzanita and sandmat manzanita (*Arctostaphylos pumila*) subdominant; Association C/D – sandmat manzanita dominated.

Densities of the annual HMP plants have been monitored at 1, 3, 5, and 8 years after completion of vegetation clearance. Shrub communities have been monitored at 3, 5, 8, and 13 years after completion of vegetation clearance. With the issuance of a programmatic BO in May 2015, USFWS has concurred with the Army's recommendation to reduce the duration of monitoring to a maximum of 5 years for the HMP annuals and a maximum of 8 years for the shrub communities (USFWS, 2015). This change was based on an analysis of vegetation data collected from over 5000 acres over a period of up to 10 years that indicated that recovery could be documented based on a reduced time period (Tetra Tech and EcoSystems West, 2015).

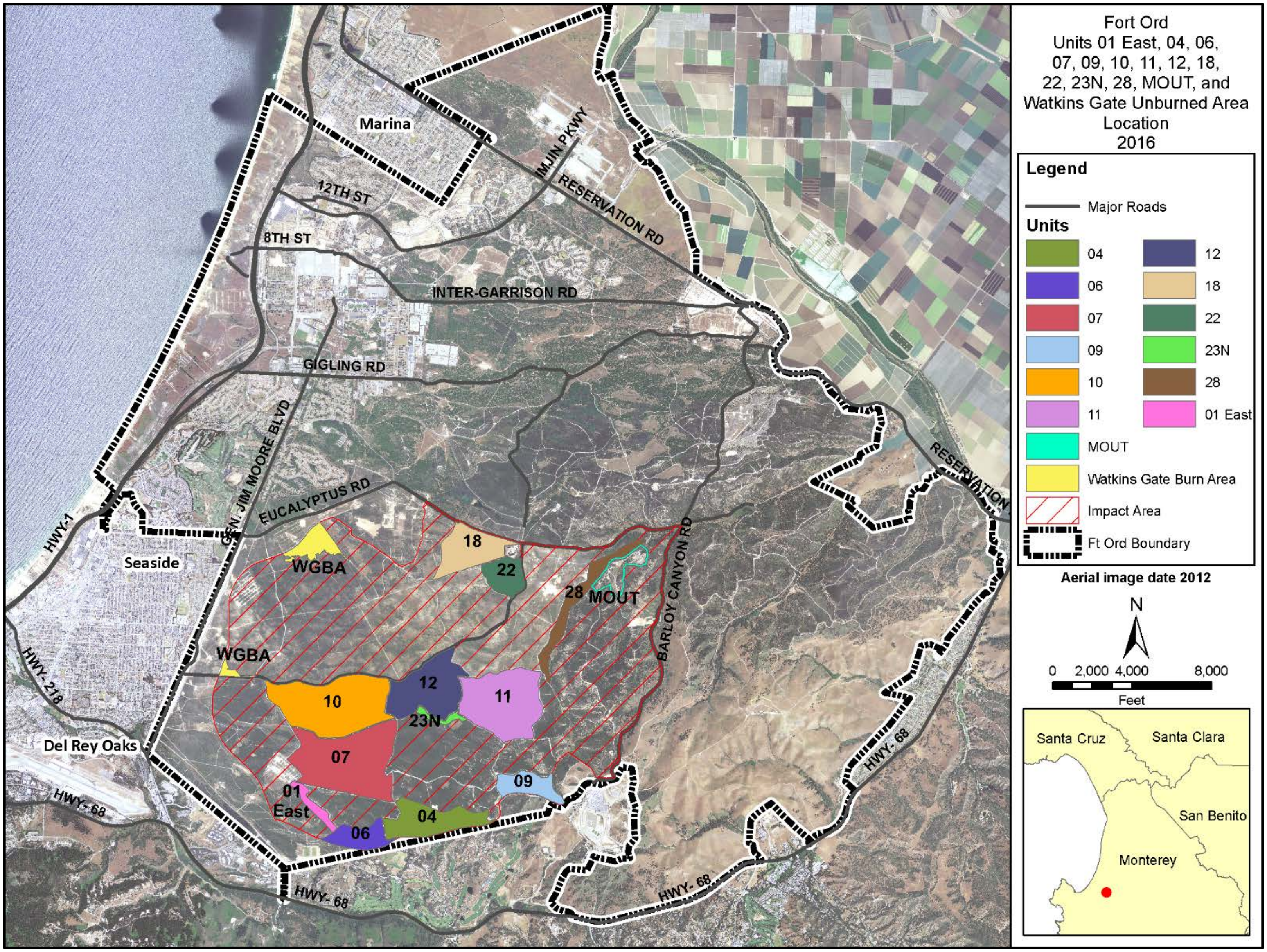

Figure 1-1. Map of Former Fort Ord, Monterey California Showing Locations of Units Sampled in 2016

Terrain over most of the sites consists of rolling hills with elevations ranging from 375 to 550 feet (ft). The vegetation type is primarily central maritime chaparral with patches of annual grasslands and coast live oak (*Quercus agrifolia*) woodlands. Central maritime chaparral is protected under the HMP because of its restricted geographic range and association with significant numbers of rare, threatened, and endangered species. Central maritime chaparral is also adapted to periodic fires. These fires remove the dominant shrub species and create open space that can be colonized by annual plants. Van Dyke *et al.* (2001) suggest that prescribed burning, or mechanical disturbance with smoke treatment, maybe necessary in central maritime chaparral management. This regime may support the establishment of a more diverse chaparral community by creating more open space.

A significant mitigating factor affecting the response of vegetation at the former Fort Ord is the 2012 to 2015 drought. Periodic droughts have occurred in the past in California. The 2012 to 2014 drought is considered to be the most severe drought in the past 1200 years, with 2014 having the highest moisture deficit of any previous span of dry years (Griffin and Anchukatis, 2014). Precipitation was also below normal in the 2014-2015 water-year (14.35 inches), with the majority coming in December 2014 (8.55 inches) (NPS, 2016; NCDC NOAA 2016). The 2015-2016 water-year was above normal (21.21 inches); however, the drought still persisted during this year.

1.1 Species Included in 2016 Habitat and Rare Species Monitoring

The primary habitat type within the USACE's portion of the former Fort Ord is central maritime chaparral. Plant species within central maritime chaparral include a variety of shrub and herbaceous plants (see Appendix A). These include five shrub species and three annual herbaceous species that are special-status species and, as such, are designated by the HMP as species of concern (USACE, 1997). The shrub species of concern (HMP shrubs) include sandmat manzanita, Monterey manzanita (*Arctostaphylos montereyensis*), Hooker's manzanita (*Arctostaphylos hookeri ssp. hookeri*), Monterey ceanothus (*Ceanothus cuneatus var. rigidus*), and Eastwood's goldenbush (*Ericameria fasciculata*). The annual species of concern (HMP annuals) include state threatened and federally endangered sand gilia (*Gilia tenuiflora ssp. Arenaria*), federally threatened Monterey spineflower (*Chorizanthe pungens var. pungens*), and state endangered seaside bird's-beak (*Cordylanthus rigidus ssp. littoralis*). Survey teams also report the locations of federally endangered Yadons's piperia (*Piperia yadonii*) when encountered during monitoring efforts.

Some changes in species taxonomy were made to conform to current taxonomic treatments (Baldwin *et al.*, 2012). Specifically, the acronym for the Monterey ceanothus (*Ceanothus cuneatus var. rigidus*) was changed from CERI to CECUR in 2010 to reflect the sub-specific designation of this plant at that time. However, prior to the 2013 survey, the accepted species designation was changed back to Ceanothus rigidus (Baldwin *et al.*, 2012). Therefore, the code has been changed back to CERI to remain consistent with historical data.

1.2 Previous Surveys Conducted on the Sites

The previous surveys conducted at the specific Fort Ord sites monitored in 2016 are referenced in Table 1-1. The Year 1 units (Units 9, 23N 28, and containment lines of Units 11 and 12) were sampled previously for baseline conditions in 2011. Units 09 and 28 were not masticated for MEC removal until 2015. Unit 23N and the containment lines of Units 11 and 12 were originally masticated in spring 2011. However, due to the presence of highly explosive MEC, these units were not subjected to a prescribed burn as planned and were masticated in entirety the same year. These units were planned to be burned in fall 2016, and the containment lines were re-masticated in fall 2015 to support this action (USFWS, 2015). Baseline sampling in Year 3 Units (Units 06, 07, 10, MOUT Buffer, and WGBA) was conducted in 2011, 2012, and 2013, respectively. These units were treated in 2013 and Year 1 sampling was conducted in 2014. Baseline sampling on the Year 5 Units (Units 04, interior of 11 and 12) was conducted in 2011, with Year 1 and Year 3 sampling in 2012 and 2014. Unit 4 was masticated in 2011 and 2012.

Data from previous surveys for HMP annuals and shrub line transects were obtained from GIS shapefiles and associated metadata provided by the USACE, and from the results of previous surveys in 2011 through 2014 (Tetra Tech and EcoSystems West, 2012, 2013, and 2014).

When appropriate, shrub transect data were transcribed from the electronic versions of previous monitoring reports when available. In addition to the incorporation of past line transect data into the database, adjustments were made to the "density" class field in the HMP vegetation monitoring data table to correspond to the density classes defined by Burleson (2009a) while maintaining the original data. If only count data were provided in previous reports or the database, then an entry was provided in the "density" class field. If the database contained only qualitative estimates of HMP densities (e.g., high, medium, low), then an appropriate density class was determined.

Table 1-1. Previous Monitoring Surveys at 2016 Study Sites on Fort Ord

Survey Year	Survey
1997, 2000	Hardy Lawson Associates performed broadscale baseline surveys on Units 01 East (formerly called the Multirange Area).
2008	Shaw Environmental (2009) performed baseline surveys on Units 18 and 22.
2009	Burleson Consulting (2009) performed Year 1 HMP annual plant density monitoring on Units 18 and 22.
2011	Tetra Tech and EcoSystems West (2012) performed baseline surveys on Units 04, 09, 11, 12, 23, 28, MOUT Buffer, and WGBA, and Year 3 HMP annual plant density and shrub transect monitoring on Units 18 and 22.
2012	Tetra Tech and EcoSystems West (2013) performed baseline surveys on Units 6 and 10, and Year 1 HMP annual plant density monitoring on Units 04, 11, 12, and 23.
2013	Tetra Tech and EcoSystems West (2014) performed baseline surveys on Unit 07, and Year 5 annual plant density and shrub transect monitoring on Units 18 and 22.
2014	Tetra Tech and EcoSystems West (2015) performed Year 1 HMP annual plant density monitoring on Units 07, 10, MOUT Buffer, and WGBA, and Year 3 HMP annual plant density and shrub transect monitoring on Units 04, 11, 12, and 23.

A new data field, "treatment", was added in 2011 to the line transect and Vegetation Monitoring data tables. This field was incorporated to enable a comparison to be conducted between treatment classes. Three treatment classes were identified based on treatments applied:

- Masticated – Vegetation was cut and masticated in place;

- Masticate & Burn – Vegetation was cut and then burned in place, or was cut and accidentally burned; and

- Burn – Vegetation was burned in place without being cut first. This method most closely mimics a natural fire.

In addition, two other treatment classes were identified for grids and transects which could not be assigned to one of the three primary treatment classes:

- Mixed – A portion of the grid cell was masticated and a portion was burned. These grids are generally located on the border between two treatments. A total of 6 HMP grids and no shrub transects were assigned to this class in 2015.

- Unspecified – This class was applied to those grid cells that were cleared prior to 2010 and which could not be assigned a treatment type. No transects or HMP grids were assigned to this class in 2015.

Treatments were identified based on the activities reported in previous reports and using data from the “flora_fire_area” shapefile obtained from the USACE.

2 SURVEY METHODS

This section describes the standard monitoring methods used during the 2016 monitoring program. Monitoring was completed based on methodology presented in the *Protocol for Conducting Vegetation Monitoring in Compliance with the Installation-Wide Multispecies Habitat Management Plan at Former Fort Ord* (HMP) and *Revisions of Protocol for Conducting Vegetation Monitoring for Compliance with the Installation-Wide Multispecies Habitat Management Plan, Former Fort Ord, Monterey, California* (Burleson, 2009a; Tetra Tech and EcoSystems West, 2015b). Unit specific modifications to methods are identified in the introduction to each age class results.

2.1 Soils

The U.S. Department of Agriculture (USDA) maps five soil types as occurring in units monitored in 2016 (USDA, 2016). Arnold-Santa Ynez complex is mapped as occurring in all of Unit 01 East, 04, 06, 07, 09, 12, 18, 22, and 23N. It also covers the majority of Units 09, 10, and 11 as well as small portions of Unit 28, MOUT Buffer, and WGBA. Xerorthents soil type is mapped as occurring throughout the majority of Unit 28 and smaller portions of Units 09, 11 and MOUT Buffer. The majority of the WGBA Unburned Area and the northwest corner of Unit 10 are underlain by Baywood sand and 2 percent (%) to 15% slopes. Arnold loamy sand on 15% to 50% slopes and Aquic Xerofluvents comprise the remaining portions of the MOUT Buffer (see Table 2 1).

It is apparent in the field that at least two distinct types of soil occur in the 2016 monitoring areas where the soil is mapped as Arnold-Santa Ynez complex as well as elsewhere in the portion of the base in which MEC removals were being conducted in 2016. One type of this soil consists primarily of relatively coarse, loose sand, generally without gravel. The other soil type consists of finer, harder-packed sand with finer material, and typically contains large numbers of small, reddish, rounded pebbles. The HMP annual species Monterey spineflower, sand gilia, and seaside bird's-beak occur almost exclusively on the former soil type. In Units 04, 07, 11, and 23N, this soil variant is located almost entirely in and along the margins of or in close proximity to herbaceous meadows and vernal pools of varying levels of seasonal hydrology. In Unit 09, HMP annuals are growing entirely in areas mapped asXerorthents soil type. Several areas, including the MOUT Buffer and WGBA have HPM annuals occurring in soils mapped as Baywood sand and Arnold sandy loam. However, in areas where HMP annual plants are present, these soils share very similar characteristics; Arnold-Santa Ynez complex with loose sandy substrates. These may be incorrectly mapped or reflect co-occurring soil types.

Table 2-1. Distribution of Soil Types in the Fort Ord Biological Monitoring Areas (USDA, 2016)

Soil Type	Description	Units Where Found
Aquic Xerofluvents	Texture variable; somewhat poorly drained; derived from alluvium derived from sedimentary rock	Year 3: MOUT Buffer
Arnold-Santa Ynez complex	Arnold: Loamy fine sand; somewhat excessively drained; derived from residuum weathered from sandstone Santa Ynez: Fine sandy loam; moderately well drained; derived from residuum weathered from sandstone	Year 1: Units 09, 23N, 28, and containment lines of Units 11 and 12 Year 3: Units 01 East, 06, 07, 10, MOUT Buffer, and WGBA Unburned Area Year 5: Unit 04, and interior of Units 11 and 12 Year 8: Units 18 and 22
Arnold loamy sand, 15% to 50% slopes	Loamy fine sand; somewhat excessively drained; derived from residuum weathered from sandstone.	Year 3: MOUT Buffer
Baywood sand, 2% to 15% slopes	Sand; somewhat excessively drained; derived from stabilized sandy eolian sands	Year 3: Unit 10 and WGBA Unburned Area
Xerorthents, dissected	Loam, clay loam; well drained; derived from mixed unconsolidated alluvium	Year 1: Units 09, 28, and containment line of Unit 11 Year 3: MOUT Buffer Year 5: Interior Portion of Unit 11

2.2 Meandering Transects

The following methodology outlines methods used to survey and monitor each Unit prior to vegetation treatment and clearance of MEC. There were no baseline units monitored in 2016. However, the following outlines methodology used to monitor units in baseline (pretreatment) condition.

Species surveyed for in baseline conditions prior to MEC clearance included six HMP herbaceous species: the biennial to perennial species coast wallflower (*Erysimum ammophilum*) and Yadon's piperia (*Piperia yadonii*), as well as the annual species Monterey spineflower, sand gilia, seaside bird's-beak, and Contra Costa goldfields (*Lasthenia conjugens*). The timing of this surveying was optimal for locating and identifying coast wallflower, Monterey spineflower, sand gilia, and Contra Costa goldfields, as the surveying was conducted during the flowering period of these species. Seaside bird's-beak and Yadon's piperia had not yet flowered when the meandering transect survey was conducted. However, seaside bird's-beak was readily identifiable by its vegetative characteristics. While surveyors could be highly certain of the identity of the Yadon's piperia plants, confirmation would require the presence of the flower, which is usually present in June and July.

When an HMP herbaceous species was observed during meandering transect surveying, a recreational-grade Garmin 62S Global Positioning System (GPS) was used to record the location. The HMP species present in the vicinity of each point were also recorded. The base-wide system of 100×100-ft grids was then used for mapping HMP herbaceous species. All GPS coordinates for HMP herbaceous species observed during meandering transect surveying were plotted onto a map of the grids. A list was then compiled of all grids within the baseline areas that contained one or more HMP herbaceous species.

2.3 HMP Annuals Density Monitoring

Density monitoring for three HMP annual species (Monterey spineflower, sand gilia, and seaside bird's-beak) was conducted in all 2016 baseline units. Yadon's piperia is not monitored for density as individual plants are often widely scattered and difficult to locate during meandering surveys. Instead, individuals are mapped using GPS and occurrences are noted for comparison with future monitoring efforts. Coast wallflower has not been observed within the Impact Area currently being cleared of munitions, but nearby occurrences are known to the north and west in aeolian, sandy soils.

The pre-defined 100×100-ft grids were used as sample grids for the density monitoring. In the baseline units, a stratified random sample of 100×100-ft grids consisting of grids identified during meandering transect surveying as occupied by one or more herbaceous HMP species were selected for sampling. The monitoring protocol indicates that 20% of occupied grids or 38 total grids, whichever is greater, be selected for HMP annual density monitoring (Burleson, 2009a). Sampling was stratified by species to ensure adequate representation of both Monterey spineflower and sand gilia (the only HMP annual species mapped in the units), and by containment (mastication) area vs. interior (as proposed). The baseline grids were not marked in any way in the field. A resource grade Trimble GeoXH GPS receiver with the grid boundaries loaded as a map layer was used to determine the boundaries of the sampled grids. Grid corners were temporarily marked in the field using pink flagging tape tied to the tallest point of vegetation to assist with navigation during HMP annual species monitoring.

The methods specified in the monitoring protocols were followed for all units monitored in 2016 in their respective baseline year for the density monitoring (Burleson, 2009a; Tetra Tech and EcoSystems West, 2015b). An exception is that for one or more HMP annual species, a complete census of the entire grid was conducted rather than subsampling for all units monitored in baseline condition in 2011-2014.

Follow-up monitoring for HMP annual species density is conducted at 1, 3, and 5 year intervals following treatment and MEC clearance. For all 2016 HMP annuals density surveys, the surveyors conducted an initial reconnaissance of each 100×100-ft sample grid to determine which HMP annual species were present and how they were distributed within the grid. When feasible given the numbers and distribution of individuals of HMP annual species in the grid, the entire grid was censused by counting all individuals of a given HMP annual species within the grid using a hand counter.

For all HMP annual species in 100×100-ft sample grids, the surveyors estimated the percent suitable habitat within the grid for each HMP annual species present. In practice, “suitable habitat” was essentially treated as equivalent to “occupied habitat”. Since the percent suitable habitat was used to calculate the estimated number of individuals present within a 100×100-ft sample grid when a circular subsample plot was used, including habitat subjectively judged to be “suitable”, but not occupied, in the estimates of suitable habitat would have resulted in upwardly biased estimates of numbers of individuals present in subsampled 100×100-ft grids.

Prior to 2012, when it was determined to be time intensive or infeasible to conduct a complete census of a given species in a given grid, the grid was subsampled using a 2.5-meter (m) radius circular plot. For this technique, an area judged by the surveyors to be representative of the density of the species within the entire grid was selected for subsampling, and the circular plot was sampled using a measuring tape. One surveyor held the end of the measuring tape at the point selected as the center point of the circular plot, while another surveyor scribed the circle. All plants of the species being sampled were then counted within the 2.5-m radius plot.

When circular plots were used for subsampling, estimates of the total number of plants present in the 100×100-ft sample grid were calculated. Since the area of a 2.5 m radius circular plot is approximately 211 ft^2, and since the area of a 100×100-ft grid is 10,000 ft^2, the estimated number of individuals in the 100×100-ft grid was calculated using the following formula:

$$n = \frac{10000\, a\left(\frac{b}{100}\right)}{211.34}$$

where,

n = the estimated number of individuals in the 100×100-ft grid,

a = the number of individuals counted in the circular plot, and

b = the estimated% suitable habitat in the 100×100-ft grid.

For each HMP annual species, each 100×100-ft sample grid was assigned to one of five density classes based on the number of individuals counted or estimated to be present. The density classes are as follows when the entire 100×100-ft sample grid was sampled:

0 = 0 plants,

1 = 1 to 50 plants,

2 = 51 to 100 plants,

3 = 101 to 500 plants,

4 = >500 plants.

When only a portion of the grid was sampled, due to recent disturbance or interception by roads, the density classes were scaled proportional to the percentage of the total grid sampled.

In some cases, where it was evident that a given sample grid should be assigned to density class 4 (i.e., more than 500 plants), the survey team assigned the grid to this density class without attempting to count or estimate numbers of plants. This was done because it is difficult to get accurate counts of HMP species, even within a 2.5-m radius circular plot, when plant densities are very high. In some cases, grids were assigned to density class 4 after a partial census indicated that considerably more than 500 plants were present in a 100×100-ft sample grid, or after it became apparent that the number of plants within a circular plot considerably exceeded the minimum number required for an estimate of greater than 500 plants within the 100×100-ft sample grid.

2.4 Macroplot Sampling

Macroplot sampling was conducted for the first time during the 2016 field season. The purpose of the macroplot sampling was to assess distributional changes in HMP annual species. The rationale for the macroplot sampling is provided in *Revisions of Protocol for Conducting Vegetation Monitoring for Compliance with the Installation-Wide Multispecies Habitat Management Plan, Former Fort Ord, Monterey, California* (Tetra Tech and EcoSystems West, 2015b). Guidance on the implementation of macroplot sampling for 2016 is provided in *Addendum to Revisions of Survey Protocol for HMP Annual Plants: Implementation of Macroplot Sampling at Former Fort Ord* (Tetra Tech and EcoSystems West, 2016).

2.5 Shrub Transect Monitoring

Areas supporting habitat types other than maritime chaparral (e.g. coast live oak woodland, grassland), and extensively disturbed areas (roads, lead remediation sites, abandoned military infrastructure), were mapped but excluded from transect sampling, which focused on the chaparral community. Locations for all newly established transects were then selected by randomly selecting 100×100-ft grids within the areas of maritime chaparral vegetation in each baseline unit.

For previously sampled transects, including follow-up monitoring at 3, 5, and 8 years post-treatment, the surveyors used a resource grade Trimble GeoXH GPS receiver to locate the previously recorded start and end points of each transect sampled. One transect was allocated for approximately 11 acres. Transects were allocated separately within the primary containment lines (areas to be masticated only) and within the interior of the units beyond the containment lines.

Shrub transect sampling was conducted using the line intercept method along transects 50 m in length (Burleson, 2009a). For transects not sampled in any previous year, the surveyors used a resource grade Trimble GeoXH GPS receiver with the grid boundaries loaded as a map layer to locate the grids randomly selected for sampling. The end point of each transect was located on or near one of the boundaries of the 100×100-ft grid selected as the basis for transect placement. Exact transect placement was such that the vegetation along the transect was representative of the surrounding area, and such that most of the transect was in the selected grid.

All transects were established by stretching out a 50-m measuring tape between the start and end points.

For all woody species (shrubs and subshrubs) present along the transect length, cover data was recorded separately. Iceplant (*Carpobrotus edulis*) and pampas grass (*Cortaderia jubata*) were also recorded separately because they are invasive species. Other herbaceous vegetation was recorded as "herb", with no breakdown by species, though the herbaceous species along transects were noted on field datasheets. Bare ground (including dead vegetation known as thatch) was also recorded.

The continuous lengths along the transect (above, below, or touching the measuring tape) occupied by each woody species, herbaceous vegetation, and bare ground were recorded in 1-dm (decimeter) intervals. Lengths less than 1 dm were not recorded. Absolute percent cover of each woody species, herbaceous vegetation, and bare ground along each transect were calculated by summing all the individual lengths along the transect and then calculating this length as a percentage of 50 m.

2.5.1 Analytical Methods

Community structure parameters including total shrub cover, species richness, diversity, and evenness were calculated for each transect. Species richness is defined as the number of species per transect.

Species diversity was measured by the Shannon-Weiner H' metric (Pielou, 1974). This metric expresses diversity as a combination of the number of species present in the association and their relative abundance (or cover) in the sample. Diversity increases with increasing number of species, and with increasing equitability of species abundance. For a given number of species, diversity is highest when all species are present in equal abundance. Diversity index is calculated as:

$$H' = -\sum_{i=1}^{S} p_i \;\; ln\, p_i$$

where,

p_i = proportion of the ith species $= \frac{n_i}{N}$

Evenness is a measure of the equability of the relative contribution of species to the total cover in the association (Pielou, 1974). Evenness is the ratio of the observed diversity to the maximum diversity possible for a sample with the same number of species. Maximum evenness (value = 1) is achieved when all species are present in equal abundance in the sample. Evenness is calculated as:

$$J' = \frac{H'}{\ln S}$$

where,

S = species richness

Multivariate statistics (cluster and ordination analyses) were used to assess whether there is a difference in species composition among transects (Jongman *et al.*, 1995). These techniques are based on measures of dissimilarity between transects. To determine whether time had an effect on community structure analyses were conducted using non-metric multidimensional scaling (NMDS) as implemented in function *metaMDS()* in the vegan package in R statistical software (Oksanen *et al.*, 2016; R Core Team, 2016).

2.6 Annual Grass Monitoring

Non-native annual grass monitoring was conducted within the masticated primary containment lines surrounding units monitored in 2016. Due to the unique geography and orientation, not all monitored units had a primary containment line. Some units were masticated in their entirety or were determined not to require containment fuel breaks prior to a prescribed burn. Only units with discrete containment lines were monitored for non-native annual grass.

Annual grass monitoring included identification and mapping of the following non-native annual grass species: silvery hair-grass (*Aira caryophyllea*), wild oat (*Avena* spp.), rattlesnake grass (*Briza maxima*), little quaking grass (*Briza minor*), ripgut grass (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), red brome (*Bromus madritensis* ssp. *rubens*), nit grass (*Gastridium ventricosum*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), barnyard foxtail (*Hordeum murinum* ssp. *leporinum*), Italian ryegrass (*Festuca perennis*, sometimes a biennial), and rattail fescue (*Festuca myuros*).

The annual grass monitoring was conducted by driving the perimeter roads surrounding units and walking where necessary to obtain a full overview of the containment areas. Areas supporting non-native annual grass species were mapped onto aerial photographs. In each mapped area, non-native annual grass density was visually estimated and mapped in one of three density classes:

1 (low) = 1–5%,

2 (medium) = 6% to 25%,

3 (high) = >25%.

2.7 Invasive Species

Invasive species including iceplant, pampas grass, and French broom (*Genista monspessulana*) may be encountered incidentally during meandering transect surveys, HMP annuals density monitoring or shrub transect monitoring. When invasive species were encountered, the locations were mapped using a recreational-grade GPS. A comprehensive survey for invasive species was not conducted since surveys for these species occur during weed treatment activities through a service agreement with BLM (United States Bureau of Land Management).

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3 YEAR 1 VEGETATION SURVEYS: UNITS 09, 23N, 28, UNITS 11 AND 12 CONTAINMENT LINES

3.1 Introduction

Year 1 units included the entirety of Units 09, 23N, and 28, and the buffer areas of Units 11 and 12 (see Figure 3-1). Units 09, 23N, and 28 were masticated in 2015. Units 11, 12, and 23N were masticated in their entirety in 2011 and allowed to recover, prior to a prescribed burn of their interior portions scheduled for fall 2016. Secondary mastication of the containment lines in Units 11 and 12 occurred in 2015 to prepare their interiors for a prescribed burn as required by the BO (USFWS, 2015). As such, both 2012 and 2016 are considered Year 1. Unit 23N was re-masticated during the larger effort to clear MEC from the remainder of Unit 23 to the south in 2015.

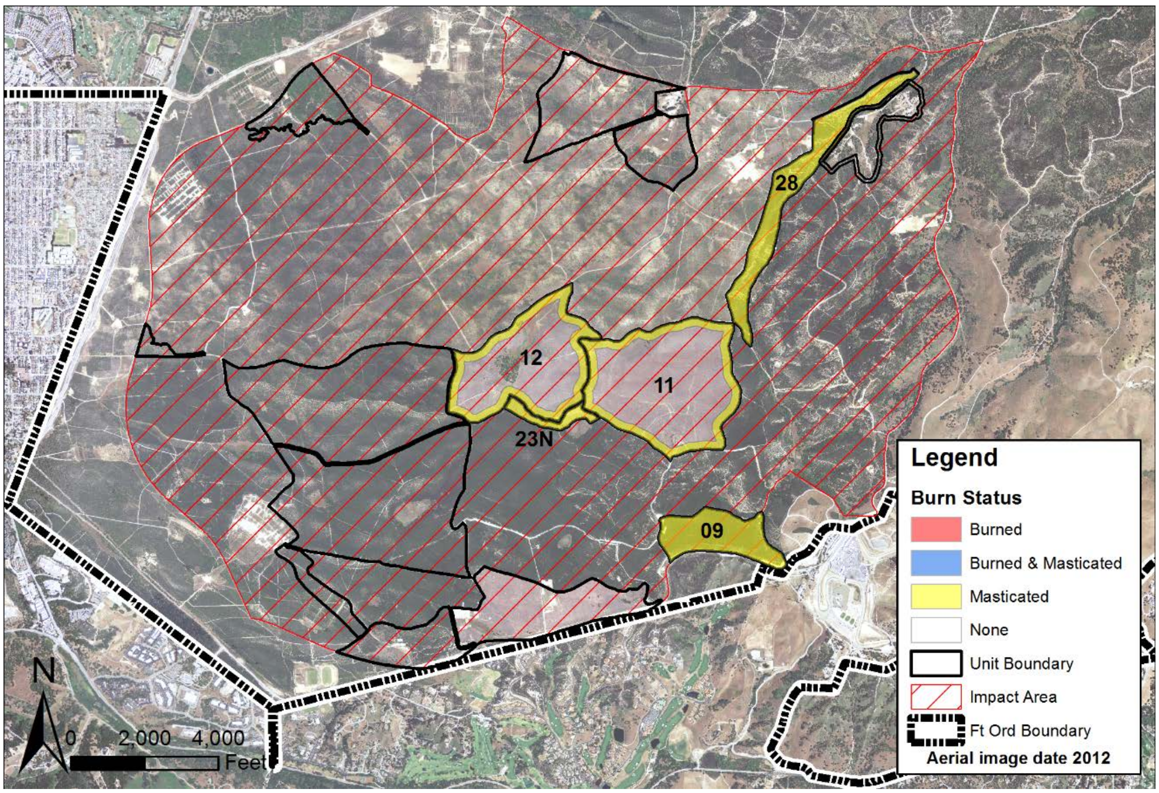

Figure 3-1. Year 1 Units Surveyed in 2016. Treatments are Shown as Colored Fill

In spring 2016, Year 1 vegetation monitoring surveys were conducted in these units. These 2016 monitoring surveys consisted of the following components:

- Density monitoring for three HMP annual species: Monterey spineflower, sand gilia, and seaside bird's-beak.
- Sampling of macroplots.
- Mapping of non-native annual grasses within the primary containment areas.

- Mapping of invasive species including iceplant, pampas grass, and French broom, where encountered.

3.2 Units 09, 23N, and 28, and Units 11 and 12 Containment Lines: Setting

Unit 9 encompasses an area of 75 acres. This Unit is located at the south end of former Fort Ord. The terrain is mostly gently rolling to moderately steep. In pre-treatment condition, this unit was vegetated primarily with mature maritime chaparral largely dominated by shaggy-barked manzanita. Other dominants sometimes include such species as Hooker's manzanita, Monterey manzanita, chamise, and black sage (*Salvia mellifera*). The extreme east end of Unit 9 is principally vegetated with coast live oak woodland, interspersed with smaller patches of maritime chaparral and habitat intermediate between these two habitat types.

The primary containment lines of Unit 11 and Unit 12 encompass an area of 70 acres and 68 acres, respectively (see Figure 3-1). These units are adjacent to each other in the south-central portion of the area of former Fort Ord. A small portion of Unit 23 (23N), adjacent to the southeastern boundary of Unit 12 and encompassing 15.5 acres, was included in the 2016 monitoring (see Figure 3-1). The terrain is gently rolling to locally steep. In pre-treatment condition, these units were vegetated primarily with mature maritime chaparral. A sizable wetland occurs in the north-central portion of Unit 11 and is mostly located within the containment line.

Unit 28 encompasses an area of 102 acres (see Figure 3-1). This long narrow unit encompasses a portion of Impossible Canyon as well as portions of the adjacent southeast-facing slopes of Riso Ridge and Tongue (Dallas) Ridge. The terrain is gently rolling to very steep. In pre-treatment condition, Unit 28 was vegetated primarily with mature maritime chaparral, but also included numerous areas of coast live oak woodland of various sizes. Monterey manzanita is prevalent in this unit and was flagged to be omitted from fall 2015 mastication efforts. Localized areas of disturbance also occurred in this unit. Part of the northern end of this unit was burned in an accidental fire in 2003.

3.3 Units 09, 23N, and 28, and Units 11 and 12 Containment Lines: Results and Discussion

Baseline surveys of Units 09 and 28 were conducted in 2011. These Units were masticated in 2015 as the primary treatment. A total of 47 HMP monitoring grids were sampled in Units 09 and 28 in 2016.

Initial baseline sampling of the Unit 23N, 11 and 12 containment lines were conducted in 2011 prior to mastication. Unit 23N and the containment lines for Units 11 and 12 were re-masticated in 2015 in preparation for a proposed burn of these Units in 2016. Therefore, these containment lines are considered to be Year 1 for the purpose of monitoring. A total of 20 HMP monitoring grids were sampled in the Unit 23N and the containment lines of Units 11 and 12 in 2016.

Line transects for shrub community structure are not conducted in Year 1 Units. Maps of HMP survey grids for the sampled Units are provided in Appendix B.

3.3.1 Sand Gilia

A total of 67 grids were surveyed for HMP plants including sand gilia in the Year 1 Units in 2016 (see Table 3-1; see Figures B-1, B-4, B-7, B-10, and B-13). This species was present in only two of the five Year 1 Units (Units 12 and 28).

Sand gilia was present in 30 grids (45%) and was absent (density class 0) in 55% of the grids sampled. The average density class for sand gilia in sampled grids was 0.72. Densities were higher in 2016 than in previous years, for Unit 28 and the Unit 12 containment line.

3.3.2 Seaside Bird's-Beak

Seaside bird's-beak was not present in any of the 67 grids sampled for Year 1 Units in 2016 (see Figures B-2, B-5, B-8, B-11, and B-14). This species was also absent from all grids in previous years.

3.3.3 Monterey Spineflower

Monterey spineflower was present at moderate to high densities in 65 of the 67 grids sampled in Year 1 Units (see Table 3-2; see Figures B-3, B-6, B-9, B-12, and B-15). Monterey spineflower was present at an average density class of 2.4 in sampled grids. These values are consistent with historic average values (see Section 8.1).

Table 3-1. Sand Gilia – Number of Grids per Density Class in Year 1 Units

Density	Unit 09		Unit 28		Unit 23N				Unit 11 Containment Line				Unit 12 Containment Line			
	2011	2016	2011	2016	2011	2012	2014	2016	2011	2012	2014	2016	2011	2012	2014	2016
0 plants/grid (percent of total grids)	10 (100%)	10 (100%)	24 (65%)	9 (24%)	3 (100%)	3 (100%)	3 (100%)	3 (100%)	7 (100%)	7 (100%)	7 (100%)	7 (100%)	10 (100%)	9 (90%)	9 (90%)	8 (80%)
1–50 plants/grid (percent of total grids)	0 (0%)	0 (0%)	13 (35%)	16 (43%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (10%)	1 (10%)	2 (20%)
51–100 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	6 (16%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
101–500 plants/grid (percent of total	0 (0%)	0 (0%)	0 (0%)	6 (16%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
> 500 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Density Class	**0.0**	**0.0**	**0.35**	**1.24**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.2**
Total Occupied Grids	**0**	**0**	**13**	**28**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**
Total Grids Sampled	**10**	**10**	**37**	**37**	**3**	**3**	**3**	**3**	**7**	**7**	**7**	**7**	**10**	**10**	**10**	**10**

[1] Each grid is 100- x 100- feet, or 10,000 square feet, or 0.23 acre.

Table 3-2. Monterey Spineflower – Number of Grids per Density Class in Year 1 Units

	Unit 09		Unit 28		Unit 23N				Unit 11 Containment Line				Unit 12 Containment Line			
Density	**2011**	**2016**	**2011**	**2016**	**2011**	**2012**	**2014**	**2016**	**2011**	**2012**	**2014**	**2016**	**2011**	**2012**	**2014**	**2016**
0 plants/grid (percent of total grids)	0 (0%)	1 (10%)	0 (0%)	1 (2.7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (20%)	1 (10%)
1–50 plants/grid (percent of total grids)	2 (20%)	2 (20%)	2 (5.4%)	15 (41%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)	3 (43%)	0 (0%)	5 (50%)	5 (50%)	5 (50%)	2 (20%)
51–100 plants/grid (percent of total grids)	0 (0%)	2 (20%)	4 (10%)	6 (16%)	1 (33%)	0 (0%)	0 (0%)	1 (33%)	0 (0%)	0 (0%)	2 (29%)	2 (29%)	0 (0%)	1 (10%)	0 (0%)	1 (10%)
101–500 plants/grid (percent of total	2 (20%)	4 (40%)	15 (41%)	7 (19%)	0 (0%)	1 (33%)	1 (33%)	1 (33%)	1 (14%)	2 (29%)	1 (14%)	1 (14%)	2 (20%)	1 (10%)	3 (30%)	2 (20%)
> 500 plants/grid (percent of total grids)	6 (60%)	1 (10%)	16 (43%)	8 (22%)	2 (66%)	2 (66%)	2 (66%)	1 (33%)	5 (71%)	5 (71%)	1 (14%)	4 (57%)	3 (30%)	3 (30%)	0 (0%)	4 (40%)
Average Density Class	**3.2**	**2.2**	**3.2**	**2.2**	**3.3**	**3.7**	**3.7**	**3**	**3.4**	**3.7**	**2.0**	**3.3**	**2.3**	**2.2**	**1.4**	**2.6**
Total Occupied Grids	**10**	**9**	**37**	**36**	**3**	**3**	**3**	**3**	**7**	**7**	**7**	**7**	**10**	**10**	**8**	**9**
Total Grids Sampled	**10**	**10**	**37**	**37**	**3**	**3**	**3**	**3**	**7**	**7**	**7**	**7**	**10**	**10**	**10**	**10**

[1] Each grid is 100- x 100- feet, or 10,000 square feet, or 0.23 acre.

Temporal patterns in density class for the three species are shown in Figure 3-2. Sand gilia exhibited a substantial increase in average density between baseline (2011) and Year 1 (2016) in Unit 28, but remained relatively constant in all other units. Frequency of occurrence also increased substantially in Unit 28 from 13 of 37 grids in 2011 to 28 of 37 sampled grids in 2016 (see Table 3-1).

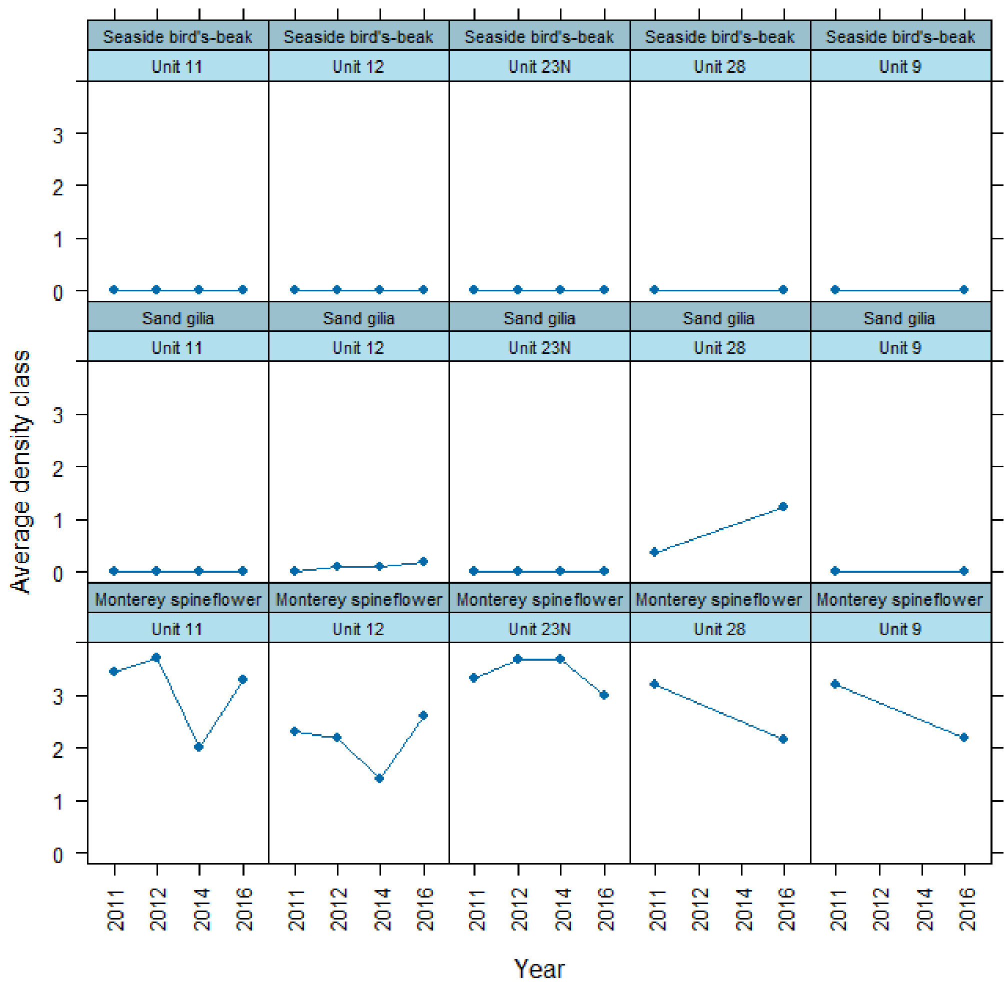

Figure 3-2. Temporal Trends in Density Class of HMP Species in Year 1 Units. Lines Represent Average Values. Baseline Surveys Were Conducted in 2011. Units 11, 12, and 23N Were Masticated in 2011 and Subsequently in 2015; Hence 2012 and 2016 are Both Considered Year 1.

Monterey spineflower exhibited a decrease of about 1 density class (3.2 to 2.2) between 2011 and 2016 in Units 9 and 28. Due to the extent of time between the baseline survey and the Year 1 survey, it is unclear whether this decrease is due to the mastication treatment or to other factors (e.g.,drought). However, this species continued to maintain a high frequency of occurrence in all units. In the Unit 11 and 12 containments lines, there was a decrease in average density class in 2014 (Year 3). However, average Monterey spineflower density subsequently increased in 2016 after the 2015 re-mastication.

A Kruskal-Wallis rank sum test was performed to test for differences in median density in Monterey spineflower between the 2012 (Year 1) and the 2016 (Year 1) surveys. No significant difference was detected between these two years in Units 11, 12, or 23N ($p>0.3$). However, significant differences were detected in median density between 2011 and 2016 in Unit 9 (p=0.05) and Unit 28 (p<0.001), indicating that median densities had decreased.

A Kruskal-Wallis test for differences between 2011 and 2016 in sand gilia densities in Unit 28, indicated a statistically significant increase in median density.

3.3.4 Yadon's Piperia

Yadon's piperia was not observed in any of the Year 1 Units.

3.3.5 Annual Grass Monitoring

Annual grass surveys were conducted along roadsides and within the primary containment lines to assess whether cutting of vegetation affects the distribution and density of annual grasses. Annual grass surveys were limited to the periphery of the Units. Estimated areas occupied by annual grasses are summarized in Table 3-3.

Table 3-3. Estimated Area Occupied (Acres) by Annual Grasses in Year 1 Surveys

	Cover Class			
Unit	**1 (low) = 1–5%**	**2 (medium) = 6–25%**	**3 (high) = >25%**	**Total Acreage Occupied**
Unit 23N (see Figure C-2)	0.6	0.2	2.8	3.5
Unit 11 containment line (see Figure C-3)	18.9	11.1	8.2	40.2
Unit 12 containment line (see Figure C-4)	23.2	14.1	18.8	56.0

3.3.6 Invasive Species Monitoring

Two areas of pampas grass and two areas of iceplant were observed along Impossible Canyon Rd. in Unit 09 (see Figure C-1). No other invasive species were observed in the Year 1 Units.

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4 YEAR 3 VEGETATION SURVEYS: UNITS 01 EAST, 06, 07, 10, WGBA, MOUT BUFFER

4.1 Introduction

In 2013, the entirety of Unit 01 East was masticated (see Figure 4-1). Due to risk of wildfire and smoke impacts to the adjacent communities, the USACE initiated a formal consultation with USFWS to masticate rather than burn this area (USACE, 2013). After a period of approximately 5 years, a controlled burn will be conducted similarly to other baseline units in an effort to benefit maritime chaparral recovery, a fire dependent natural community type (USFWS, 2015).

Baseline data for herbaceous HMP plants was not gathered for Unit 01 East following methods outlined in the Vegetation Monitoring Protocol (Burleson, 2009a). Rather, baseline monitoring was conducted in this unit by Harding Lawson Associates in 1997 and included shrub transect sampling and broad-scale mapping of HMP annuals not associated with survey grids. No HMP annuals were identified in Unit 01 East during baseline monitoring.

All of Units 06, MOUT Buffer, WGBA and the containment lines of Unit 07 were masticated in 2013 (see Figure 4-1). The containment line of Unit 10 was masticated in 2012. Controlled burns were conducted in the interior of Units 07 and 10 in late fall 2013. Baseline monitoring was conducted in spring and early summer 2011 for Unit 06, MOUT buffer and WGBA, in 2012 for Unit 10, and in 2013 for Unit 07 (Tetra Tech and EcoSystems West, 2012, 2013 and 2014). WBGA at this time is unburned. Baseline monitoring included meandering transect surveys to map areas of occurrence of HMP herbaceous species; density monitoring for the HMP annual species Monterey spineflower, sand gilia, and seaside bird's-beak; transect surveys to sample shrub composition in the maritime chaparral; and annual grass monitoring in the primary containment areas around the perimeters of Units 07 and 10.

With the exception of Units 01 East and 06, Year 1 follow-up monitoring was conducted in the spring and early summer of 2013. This is due to the need to assess recovery of the three HMP annual species in these units during the first season after burning, as well as to assess the status of non-native annual grasses in the primary containment areas. Year 3 follow-up monitoring, including HMP annual density, shrub transect, and annual grass monitoring, was conducted in these units in spring 2016.

The 2016 Year 3 follow-up monitoring consisted of the following:

- Repeat density monitoring for three HMP annual species: Monterey spineflower, sand gilia, and seaside bird's-beak.
- Sampling of macroplots.
- Mapping of non-native annual grasses within portions of the units that served as primary containment areas when prescribed burning was conducted.
- Mapping of invasive species, including iceplant, pampas grass, and French broom, where encountered.

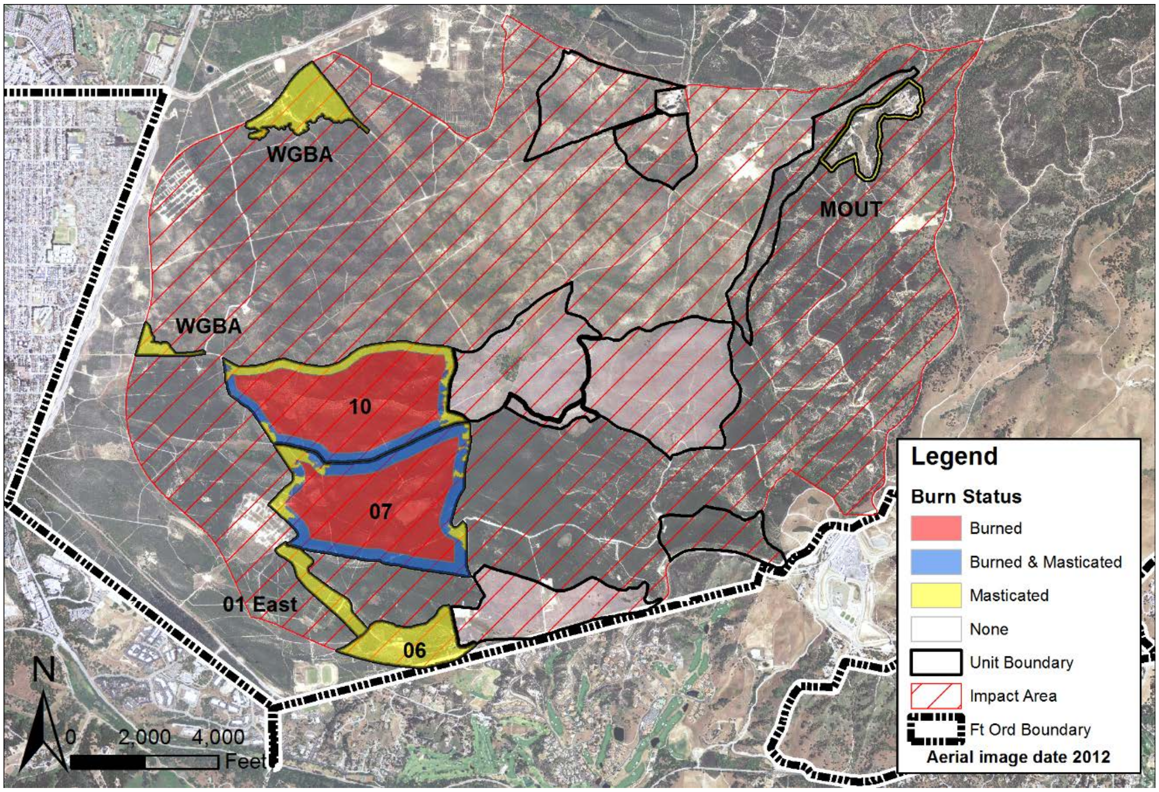

Figure 4-1. Year 3 Units Surveyed in 2016. Treatments are Shown as Colored Fill

4.2 Units 01 East, 06, 07, 10, WGBA, and MOUT Buffer: Setting

Unit 01 East encompasses 32 acres and is situated in the southwest portion of the Fort Ord Impact Area. This unit was not observed in detail in pre-treatment condition but consisted of structurally heterogeneous maritime chaparral reflecting varying levels of disturbance from past military staging activities. No wetlands or oak woodland is located within this unit but maritime chaparral begins to transition to coastal scrub and disturbed grassland with dense infestations of pampas grass and iceplant towards the south and west portions of the unit.

Unit 06 encompasses an area of 70 acres, and is located at the south-central end of the former Fort Ord with the base boundary forming part of the southern boundary of the unit (see Figure 4-1). The topography consists of portions of two parallel east-west-trending ridges along the northern and southern periphery of the unit, with a broad lower-lying area – the upper headwaters of a west-draining canyon – in the central portion. In baseline condition, the vegetation of Unit 06 consisted of a mosaic of mature maritime chaparral and extensive disturbed areas, with limited areas of coast live oak woodland in the southern third of the unit. Mature maritime chaparral occupied much of the eastern half of the unit, and was of lesser extent in the extreme western portion. Shaggy-barked manzanita was the principal dominant in this chaparral. Other dominants included chamise and black sage (Tetra Tech and EcoSystems West, 2014). Much of Unit 06, especially the central and south-central portions, has a history of extensive heavy disturbance. Vegetation of disturbed areas in baseline condition ranged from areas dominated by non-native annual grasses and associated herb species, also largely non-native, to a sizable area near the center of the unit that was largely bare, with only sparse vegetation. A large area in the south-central portion of the unit was heavily infested with large clumps of the invasive, non-native perennial grass pampas grass. The density of pampas grass in the area has been considerably reduced in recent years by eradication efforts. The northwestern portion of the unit was vegetated with maritime chaparral that had been subject to considerable past disturbance, consisting of clumps of chaparral shrubs interspersed with open areas vegetated with mostly non-native grasses and herbs.

Unit 07 encompasses an area of 340 acres, of which 124 acres are within the 300-ft primary containment mastication area. The remaining 216 acres are in the interior of the unit for which prescribed burning only, without mastication, was conducted (see Figure 4-1). The unit is located south of Nowhere Road and north of Phoenix Road in the southwest portion of former Fort Ord. In general, Unit 07 slopes down from east to west with several prominent north-south trending ridges. Abandoned roads with varying amounts of vegetative overgrowth follow these ridgelines providing some degree of unobstructed access to the interior portions of the unit.

Under baseline conditions, Unit 07 was almost entirely vegetated with mature maritime chaparral varying considerably in physiognomy and species composition with the exception of a few meadow grasslands in lowland basins throughout the unit (Tetra Tech and EcoSystems West, 2014). Relatively open chaparral was most extensive in the southeast along ridgelines and south facing slopes in areas that appeared to be more recently disturbed, during active use of the range by the military. As in maritime chaparral throughout Fort Ord, shaggy-barked manzanita was the most characteristic dominant. Other characteristic shrubs that were often dominant or co-dominant included chamise, black sage, sandmat manzanita, Monterey ceanothus, and poison-oak (*Toxicodendron diversilobum*). Three sizable areas of meadow grassland habitat, dominated by native and non-native grasses and forbs, occur in the unit. The largest meadow, located in the east-central portion of Unit 7, is dominated primarily by a mix of upland and wetland herbaceous vegetation. In years of average to above average rainfall, standing water typically forms a contiguous seasonal pond lasting into spring which was present during the 2016 monitoring due to slightly above average seasonal rainfall. Although numerous individual coast live oak trees are scattered throughout the unit and small stands occur surrounding the meadow margins, well developed coast live oak woodland does not occur elsewhere in this unit. Disturbed areas are of limited extent in this unit, and mostly occur along old roads and fuel breaks. However, a large lead remediation area encroaches on the southwest corner of Unit 07 near the intersection of Austin Road and Phoenix Road. This area remains largely denuded of vegetation and topsoil and is currently planned for future restoration and re-vegetation activities.

Unit 10 encompasses a total area of 327 acres, of which 87 acres are within the 239-ft primary containment mastication area and the remaining 240 acres are in the interior of the unit where prescribed burning was conducted. The unit is located south of Watkins Gate Road in the west-central portion of the area of the base (see Figure 4-1). The unit is dominated by a prominent ridge (presumably a fossil dune ridge) running east-west across the center of the unit. Elsewhere in the unit the terrain is gently rolling.

In baseline condition, Unit 10 was almost entirely vegetated with mature maritime chaparral varying considerably in physiognomy and species composition (Tetra Tech and EcoSystems West, 2013). The chaparral shrubs ranged from low (3-4 ft) to tall (12-15 ft), and shrub density ranged from relatively open, with numerous openings of various sizes, to essentially 100% areal cover. Relatively open chaparral was most extensive on the upper parts of the main ridge, where chaparral with this physiognomy was continuous almost all the way across the unit. Similar to Unit 7, shaggy-barked manzanita is the most characteristic dominant where vegetation is tall and dense. Other shrubs such as chamise, black sage, sandmat manzanita, Monterey ceanothus, and poison-oak are dominant or co-dominant elsewhere in the unit. Two sizable areas of meadow habitat, dominated by native and non-native grasses and herbs, occur in the southwestern portion of the unit. One sizable stand of coast live oak woodland occurs in the north-central portion of the unit. Although numerous individual coast live oak trees are scattered throughout the remainder of the unit, and small stands occur in the southwestern portion of the unit, well developed coast live oak woodland does not occur elsewhere in this unit. Disturbed areas are of limited extent in this unit, and mostly occur along old roads and fuel breaks.

The MOUT Buffer Area encompasses an area of 22 acres (see Figure 4-1). This area consists of a zone approximately 99 ft wide encircling the periphery of the MOUT area containing the Impossible City training facility in and east of Impossible Canyon. The terrain within the MOUT Buffer Area ranges from nearly level to steep. In baseline conditions, the area was vegetated with a mosaic of mature maritime chaparral, non-meadow grassland, and coast live oak woodland, with some localized areas of heavy disturbance. A portion of this area was burned in an accidental fire in 2003.

The WGBA encompass 72 acres, divided into two non-contiguous portions (see Figure 4-1; Tetra Tech and EcoSystems West, 2012). The larger northern portion is in the northeast corner of the WGBA, west of the north end of Evolution Road; the smaller southern portion is in the southwest corner of the WGBA, north of Watkins Gate Road. The terrain is level to gently rolling, with mostly low local relief. In baseline condition, the northern area was vegetated primarily with mature maritime chaparral in its western portion, with smaller areas of coast live oak woodland interspersed. The eastern portion was vegetated primarily with dense coast live oak woodland, interspersed with areas of maritime chaparral of varying sizes. Sizable disturbed areas occur in the westernmost area of the northern portion; some areas of maritime chaparral in the eastern portion were also subject to soil remediation activities that removed or reduced the coast live oak canopy. The southern area was vegetated in baseline condition almost entirely with mature maritime chaparral with numerous openings, with the exception of a small seasonal wetland adjacent to Blueline Road.

The U.S. Department of Agriculture maps the Arnold-Santa Ynez complex as occurring in all of Units 01 East, 06, 07, as well as most of Unit 10 and a small portion of the WGBA (USDA, 2016). The soil in the northwest corner of Unit 10 and remaining portions of WGBA is mapped as Baywood sand with 2% to 15% slopes. A more complex mosaic of unique soil types occurs in the MOUT Buffer Area. The distribution of soils in the Year 3 survey areas and characteristics of these soils are presented in Table 2-1.

4.3 Units 01 East, 06, 07, 10, WGBA, and MOUT Buffer: Results and Discussion

A total of 132 grids were surveyed in the Year 3 Units. Unit 01 East and Unit 6 did not support HMP annual species in the baseline survey and therefore were not sampled in the 2016 Year 3 survey. Maps of survey grids for the sampled units are provided in Appendix B.

4.3.1 Sand Gilia

This species was present at low densities in Units 7 and 10, in the MOUT buffer area, and in the WGBA. Overall, sand gilia was present in 46 (35%) of the 132 grids sampled in the 2016 Year 3 Units (see Table 4-1; see Figures B-18, B-22, B-26, and B-30). Average density classes ranged from 0.05 in the WGBA to 1.9 in Unit 10, with an overall average density class of 0.87. Densities tended to remain constant or increase slightly relative to baseline conditions. Sand gilia in Unit 10 increased substantially in Year 1 as compared to the baseline, and continued to remain relatively high in Year 3.

Table 4-1. Sand Gilia – Number of Grids per Density Class in Year 3 Units

Density	Unit 07			Unit 10			MOUT			WGBA		
	2013	2014	2016	2012	2014	2016	2011	2014	2016	2011	2014	2016
0 plants/grid (percent of total grids)	36 (95%)	35 (92%)	35 (92%)	39 (71%)	17 (31%)	16 (29%)	1 (25%)	2 (50%)	1 (25%)	34 (97%)	34 (97%)	17 (49%)
1–50 plants/grid (percent of total grids)	2 (5%)	2 (5%)	3 (8%)	16 (29%)	19 (35%)	13 (24%)	2 (50%)	2 (50%)	2 (50%)	1 (3%)	1 (3%)	0 (0%)
51–100 plants/grid (percent of total grids)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	3 (5%)	3 (5%)	1 (25%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (3%)
101–500 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6 (11%)	9 (16%)	0 (0%)	0 (0%)	1 (25%)	0 (0%)	0 (0%)	0 (0%)
> 500 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	10 (18%)	14 (25%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Density Class	**0.05**	**0.1**	**0.08**	**0.3**	**1.5**	**1.9**	**1.0**	**0.5**	**1.25**	**0.03**	**0.03**	**0.05**
Total Occupied Grids	**2**	**3**	**3**	**16**	**38**	**39**	**3**	**2**	**3**	**1**	**1**	**1**
Total Grids Sampled	**38**	**38**	**38**	**55**	**55**	**55**	**4**	**4**	**4**	**35**	**35**	**35**

[1] Each grid is 100- x 100- feet, or 10,000 square feet, or 0.23 acre.

Table 4-2. Seaside Bird's-Beak – Number of Grids per Density Class in Year 3 Units

Density	Unit 07			Unit 10			MOUT			WGBA		
	2013	2014	2016	2012	2014	2016	2011	2014	2016	2011	2014	2016
0 plants/grid (percent of total grids)	38 (100%)	37 (97%)	34 (89%)	55 (100%)	53 (96%)	54 (98%)	4 (100%)	4 (100%)	4 (100%)	35 (100%)	35 (100%)	35 (100%)
1–50 plants/grid (percent of total grids)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	2 (4%)	1 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
51–100 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
101–500 plants/grid (percent of total grids)	0 (0%)	0 (0%)	2 (5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
> 500 plants/grid (percent of total grids)	0 (0%)	0 (0%)	2 (5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Density Class	**0.0**	**0.03**	**0.4**	**0.0**	**0.04**	**0.02**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Occupied Grids	**0**	**1**	**4**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
Total Grids Sampled	**38**	**38**	**38**	**55**	**55**	**55**	**4**	**4**	**4**	**35**	**35**	**35**

[1] Each grid is 100- x 100- feet, or 10,000 square feet, or 0.23 acre.

Table 4-3. Monterey Spineflower – Number of Grids per Density Class in Year 3 Units

Density	Unit 07			Unit 10			MOUT			WGBA		
	2013	2014	2016	2012	2014	2016	2011	2014	2016	2011	2014	2016
0 plants/grid (percent of total grids)	1 (3%)	2 (5%)	7 (18%)	0 (0%)	4 (7%)	5 (9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (3%)	3 (9%)
1–50 plants/grid (percent of total grids)	4 (11%)	12 (32%)	4 (11%)	18 (33%)	30 (55%)	10 (18%)	2 (50%)	1 (25%)	1 (25%)	8 (23%)	15 (43%)	5 (14%)
51–100 plants/grid (percent of total grids)	0 (0%)	3 (8%)	2 (5%)	8 (15%)	7 (13%)	4 (7%)	0 (0%)	0 (0%)	1 (25%)	2 (6%)	3 (9%)	2 (6%)
101–500 plants/grid (percent of total grids)	3 (8%)	8 (21%)	8 (21%)	17 (31%)	11 (20%)	18 (33%)	2 (50%)	3 (75%)	2 (50%)	8 (23%)	8 (23%)	12 (35%)
> 500 plants/grid (percent of total grids)	30 (79%)	13 (34%)	17 (45%)	12 (22%)	3 (5%)	18 (33%)	0 (0%)	0 (0%)	0 (0%)	17 (49%)	8 (23%)	16 (46%)
Average Density Class	**3.5**	**2.5**	**2.6**	**2.4**	**1.6**	**2.6**	**2.0**	**2.5**	**2.5**	**3.0**	**2.2**	**2.9**
Total Occupied Grids	**37**	**36**	**31**	**55**	**51**	**50**	**4**	**4**	**4**	**35**	**34**	**32**
Total Grids Sampled	**38**	**38**	**38**	**55**	**55**	**55**	**4**	**4**	**4**	**35**	**35**	**35**

[1] Each grid is 100- x 100- feet, or 10,000 square feet, or 0.23 acre.

4.3.2 Seaside Bird's-Beak

Seaside bird's-beak was present only in Units 7 and 10 at very low average densities (see Table 4-2; see Figures B-19, B-23, B-27, and B-31). The species was not observed in the MOUT or WGBA. Overall, seaside bird's-beak was present in only 4% of the 132 potentially suitable grids sampled in 2016. However, seaside bird's-beak was present in four grids in Unit 7 at densities in excess of 100 plants per grid (see Figure B-19). These are very high densities for this species and warrant further monitoring to determine the reason for these high densities.

4.3.3 Monterey Spineflower

The Monterey spineflower is the most frequently occurring and has the highest densities of the three species considered in this monitoring program. In this Year 3 survey, the species was present in 117 (89%) of the 132 grids sampled (see Table 4-3; see Figures B-20, B-24, B-28, and B-32). The average density class ranged from 2.5 in the MOUT to 2.9 in WGBA, with an overall average density class of 2.7. With the exception of Unit 7, average densities remained consistent over time. In Unit 7, average density class decreased from 3.5 to 2.6.

4.3.4 Yadon's Piperia

Yadon's piperia was not observed in any of the Year 3 Units.

4.3.5 Effect of Treatment on HMP Density

Temporal trends in HMP density classes relative to treatment type are shown in Figure 4-2. Although there are differences between units for Monterey spineflower, no clear distinction between treatments can be seen.

Only sand gilia in Unit 10 shows a difference between treatments; burned grids had a stronger positive response than masticated grids.

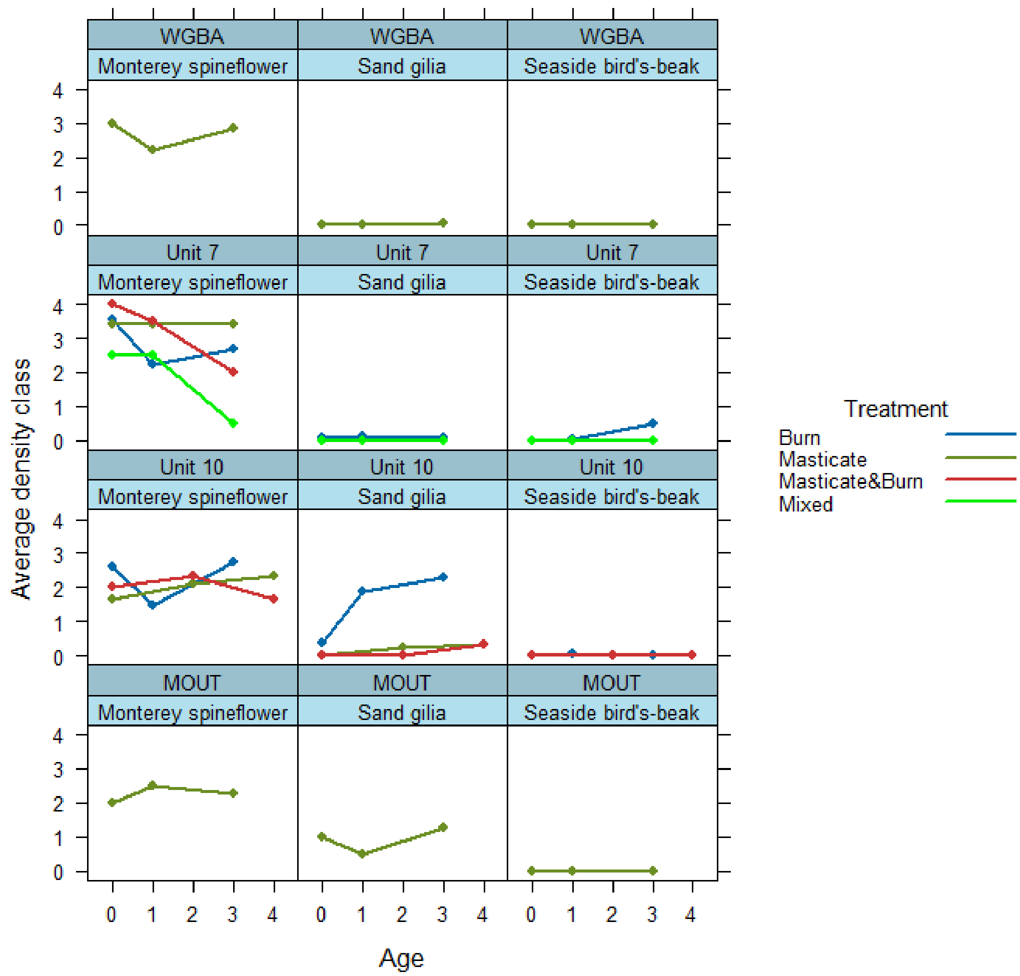

Figure 4-2. Temporal Trends in Density Class of HMP Species in Year 3 Units Relative to Treatment. Lines Represent Average Values.

4.3.6 Shrub Transect Monitoring

A total of 79 transects were sampled in Units 01 East, 06, 07, 10, WGBA, and MOUT (see Figures B-16, B-17, B-21, B-25, B-29, and B-33). Total shrub cover for all units and transects averaged 101.0% and ranged from 34.8% to 165.8% (see Figure 4-3). Herbaceous cover averaged 3.6% and ranged from 0.0% to 17.2% (see Figure 4-3). Bare ground averaged 23.6% and ranged from 0.0% to 58.6% (see Figure 4-3). Total cover decreased slightly compared to baseline cover in Year 3, while herbaceous cover and bare ground increased. Raw data for shrub transects sampled in 2016 are provided in Appendix E.

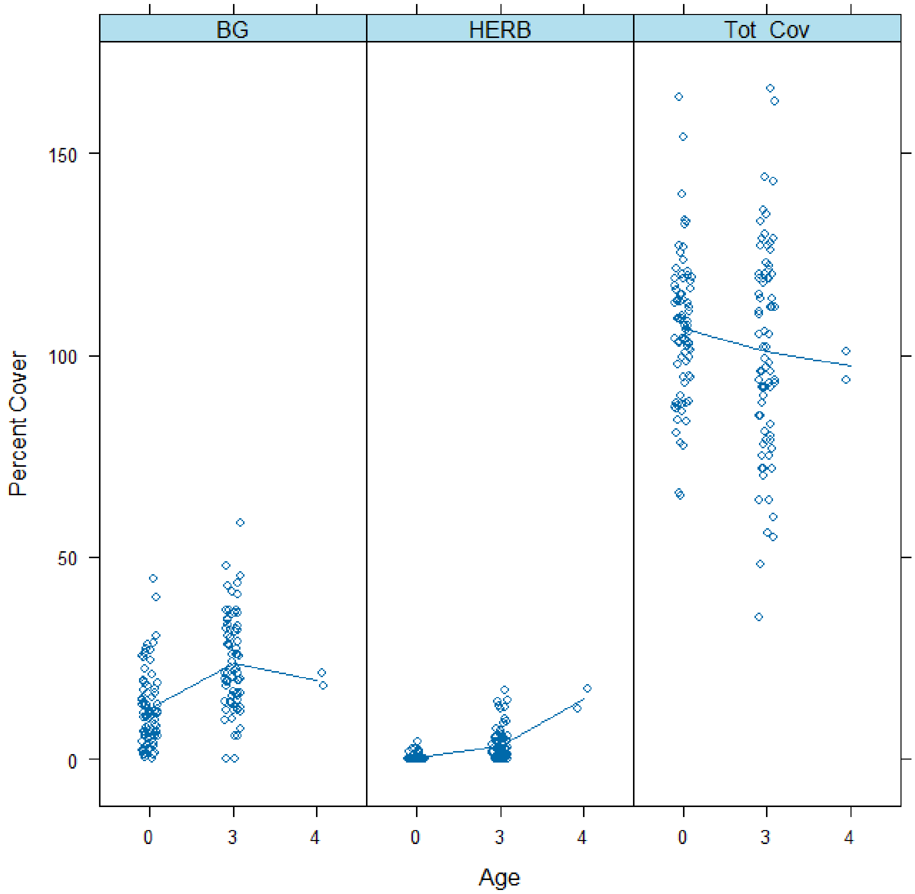

Figure 4-3. Percent Cover in Vegetation Strata in Year 3 Units. Individual Transects are Indicated by Open Circles. The Blue Line Represents the Average Cover in Each Group. Two Age 4 Transects Were Located in the Containment Line of Unit 10 Which Were Masticated in 2012, One Year Earlier Than Unit 7.

The standard community structure parameters (i.e., total% cover, species richness, dominant species, diversity and evenness) were calculated for baseline and Year 3 transects (see Table 4-4). Average % cover decreased slightly relative to baseline in Year 3. The number of species increased as did diversity and evenness, due to colonization of the transects by early successional sub-shrub species (deerweed, dwarf ceanothus, and peak rush rose).

Table 4-4. Community Structure Parameters for Baseline and Year 3 Transects in Units 01 East, 06, 07, 10, WGBA, and MOUT Buffer

	Parameter							
	Total Cover (%)		Species Richness (S)		Diversity (H')		Evenness (J')	
	Year 0	Year 3	Year 0	Year 3	Year 0	Year 3	Year 0	Year 3
Minimum	65.2	34.8	3	5	0.36	0.91	0.26	0.43
25%ile	94.7	82.2	5	8	0.94	1.47	0.56	0.71
Median	107.2	98.6	6	9	1.17	1.65	0.65	0.75
Mean	106.4	101.0	6	8.9	1.14	1.61	0.65	0.75
75%ile	116.4	119.5	7	10	1.32	1.79	0.76	0.81
Maximum	163.9	165.8	10	13	1.87	2.13	0.92	0.90

Temporal patterns of total cover, diversity, and species richness in each unit are shown graphically in Figure 4-4 – 4-6. Analysis of variance (ANOVA) was used to test for the effects of unit, age, and treatment on each of these three parameters. Total cover exhibited differences between units and treatments, and an interaction between age and treatment (see Table 4-5). Mastication tended to result in a decrease in total cover, whereas burned areas in Units 7 and 10 exhibited an increase in total shrub cover. The primary effect of age was not significant due to its interaction with treatment.

Diversity tended to increase with age in all units and treatments (see Figure 4-5). The ANOVA indicated significant effects of unit and age (see Table 4-6). An effect of treatment on diversity is not evident.

Species richness responds similarly to diversity, exhibiting an increase in the number of species after treatment (see Figure 4-6; see Table 4-7).

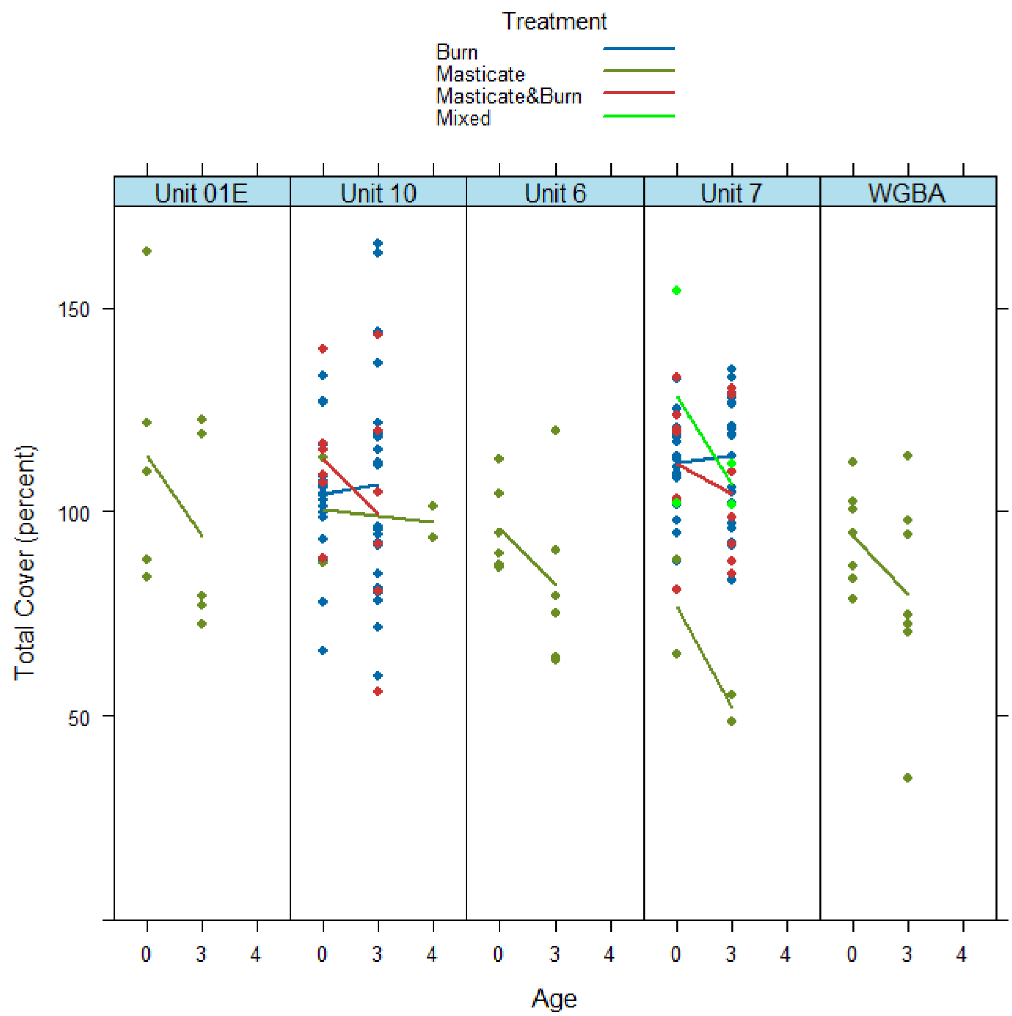

Figure 4-4. Total Percent Cover on Transects in Year 3 Units Between 2012 and 2015. Dots Represent Individual Transects. Lines Represent Change in Average Values.

Table 4-5. Results of ANOVA for Effect of Treatment, Age, and Unit on Total Cover for all Year 3 Units

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Unit	4	8384	2096	5.4	<0.001
Age	2	1236	618	1.6	0.2
Treatment	3	6904	2301	6.0	<0.001
Unit*Age	4	1089	272	0.69	0.60
Unit*Treatment	2	2333	1167	2.97	0.055
Age*Treatment	3	1575	525	1.34	0.27
Unit*Age*Treatment	1	62	62	0.16	0.69
Residual	138	55997	386		

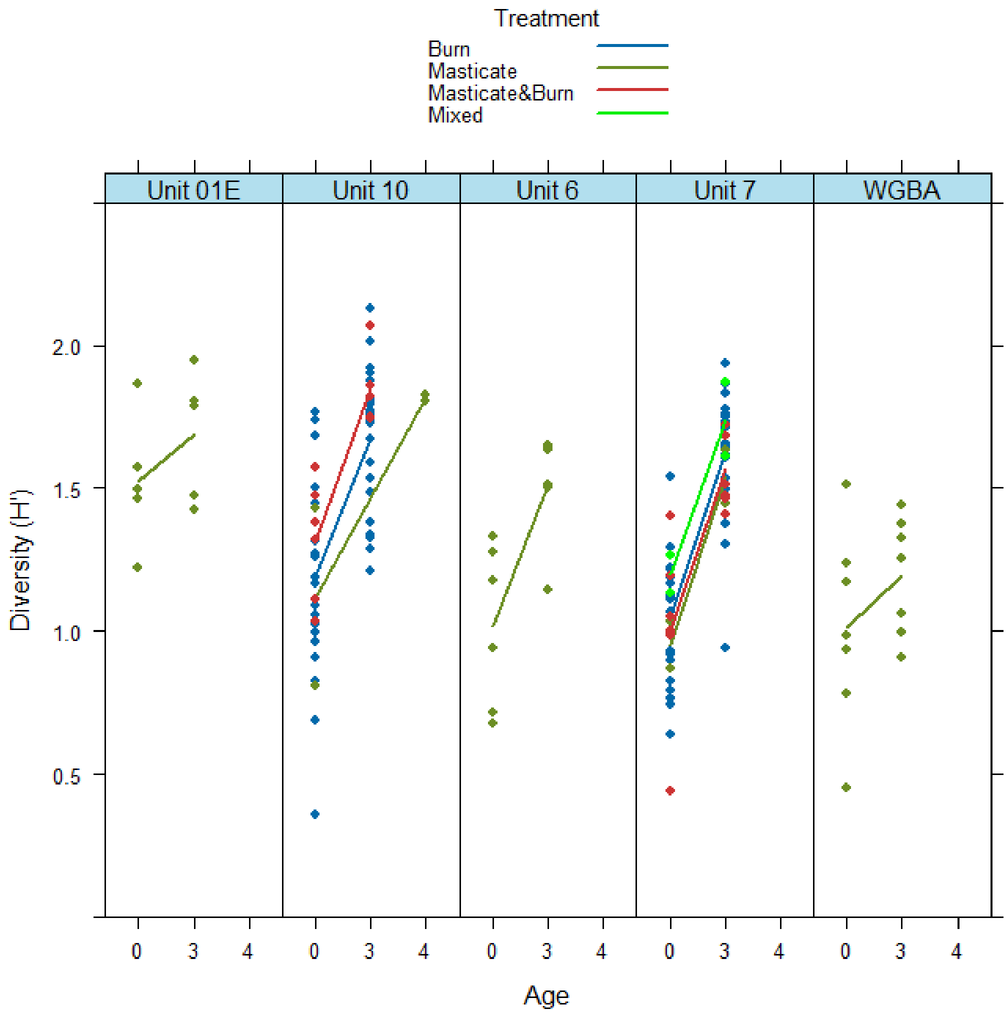

Figure 4-5. Community Diversity on Transects in Year 3 Units Between 2012 and 2015. Dots Represent Individual Transects. Lines Represent Change in Average Values.

Table 4-6. Results of ANOVA for Effect of Treatment, Age, and Unit on Diversity

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Unit	4	2.32	0.58	9.2	<0.001
Age	2	9.10	4.55	71.8	<0.001
Treatment	3	0.17	0.06	0.86	0.47
Unit*Age	4	0.68	0.17	2.7	0.03
Unit*Treatment	2	0.20	0.10	1.56	0.22
Age*Treatment	3	0.00	0.00	0.02	0.99
Unit*Age*Treatment	1	0.00	0.00	0.07	0.79
Residual	147	9.31	0.06		

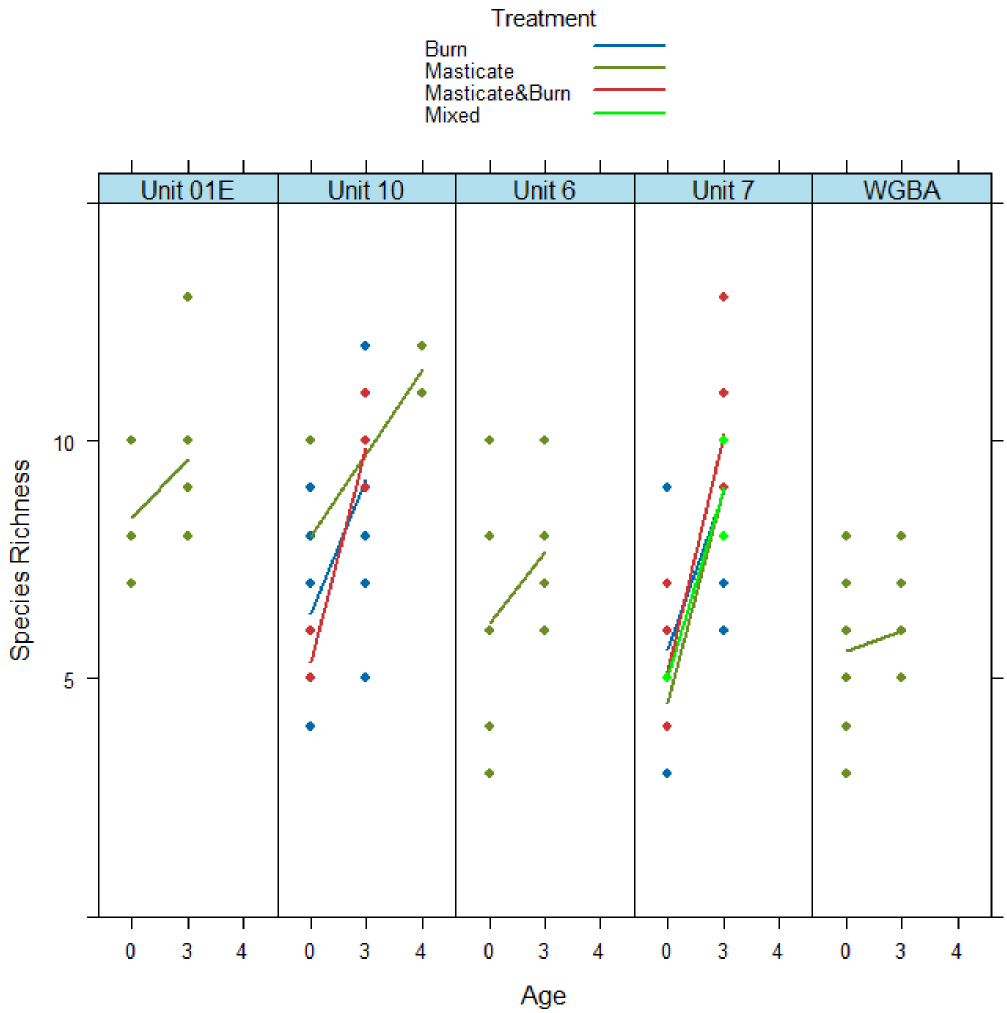

Figure 4-6. Species Richness on Transects in Year 3 Units Between 2012 and 2015. Dots Represent Individual Transects. Lines Represent Change in Average Values.

Table 4-7. Results of ANOVA for Effects of Treatment, Age, and Unit on Species Richness

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Unit	4	78	19.5	7.6	<0.001
Age	2	353	176.7	69.0	<0.001
Treatment	3	1	0.3	0.11	0.96
Unit*Age	4	49	12.1	4.7	0.001
Unit*Treatment	2	9	4.6	1.78	0.17
Age*Treatment	3	14	4.7	1.85	0.14
Unit*Age*Treatment	1	0	0.0	0.00	0.98
Residual	147	378	2.6		

Multivariate statistics (cluster and ordination analyses) were used to assess differences in species composition among transects (Jongman *et al.*, 1995). These techniques are based on measures of dissimilarity between samples (transects). This analysis was conducted using the R *vegan* package (Oksanen *et al.*, 2016; R Core Team, 2016).

The results of the NMDS ordination show a community level response relative to Year with a small treatment effect in Year 3 (Figure 4-7). This plot clearly shows the differences in community composition between the baseline and Year 3 communities.

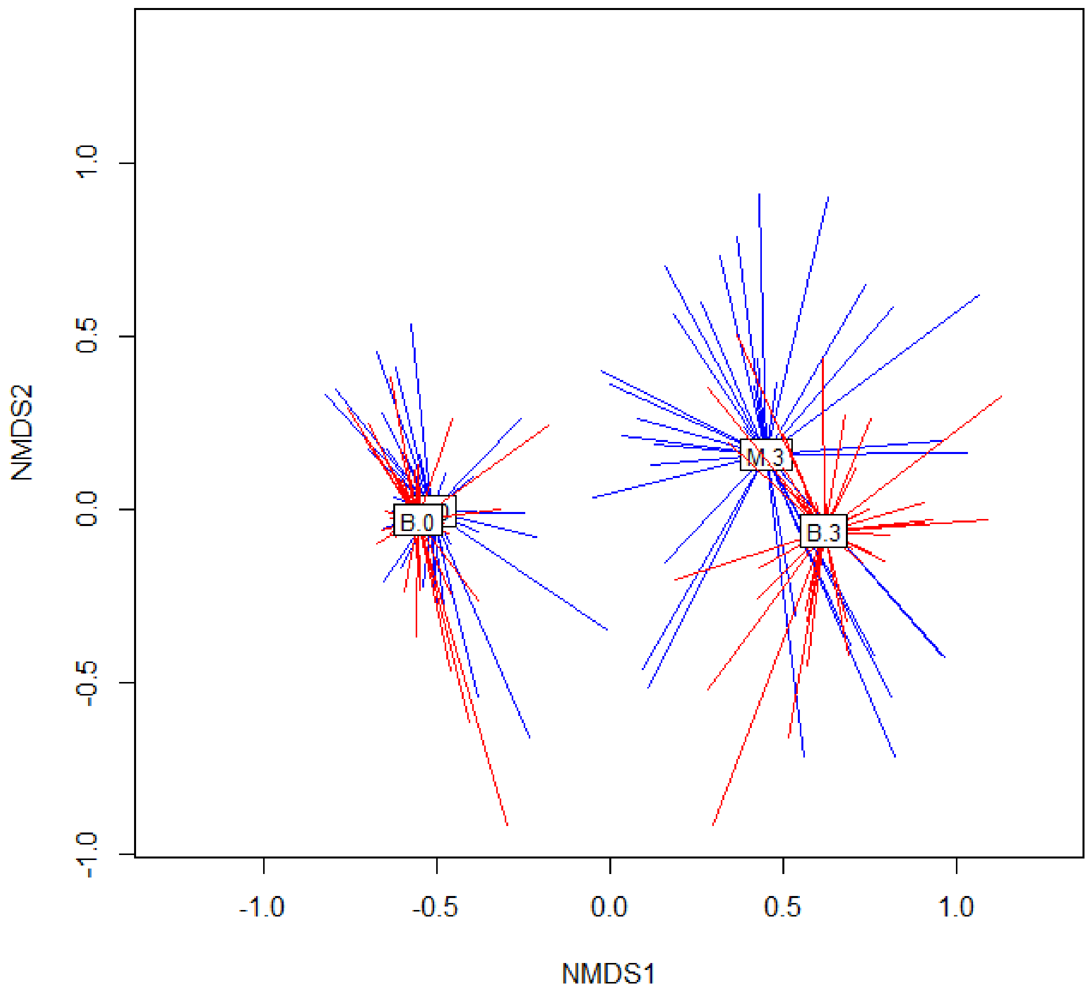

Figure 4-7. NMDS Ordination Plot of Shrub Community Structure in Units 01 East, 06, 07, 10, and WGBA and MOUT in Year 0 and Year 3. Labels Indicate the Centroid of Each Treatment/Year Group. Please Note That the M.0 (masticate, year 0) group is behind the B.0 group.

The dominant species in these shrub associations included shaggy-barked manzanita and chamise (Figure 4-8). These two species were present on nearly every transect in all four groups, although with higher cover in the pre-burn associations.

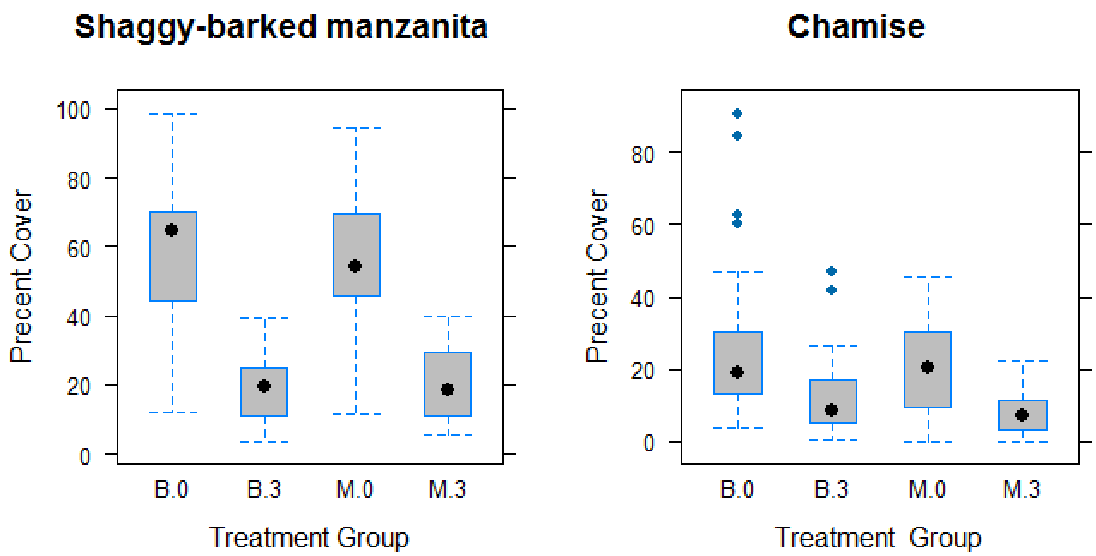

Figure 4-8. Total Cover of Dominant Shrub Species by Treatment Group in Year 3 Survey. B Indicates Burned Transects, and M Indicates Masticated Transects. Baseline Transects are Indicated by 0 and Year 3 Transects by 3.

While the above species are consistently found on transects, four other species are important in distinguishing between the baseline and post-treatment transects. Black sage occurred frequently on transects in the baseline association at approximately 10% cover (see Figure 4-9). For the post-treatment transects, it was found infrequently, and at lower cover. In contrast, deerweed (*Acmispon glaber*), dwarf ceanothus (*Ceanothus dentatus*), and peak rush rose (*Crocanthemum scoparium*) were highly infrequent on baseline transects, but were common at moderate cover on the post-treatment transects. Deerweed responded similarly to burning and mastication. Dwarf ceanothus and peak rush rose exhibited higher percent cover on burned transects than on masticated transects, and were the dominant species on burned transects.

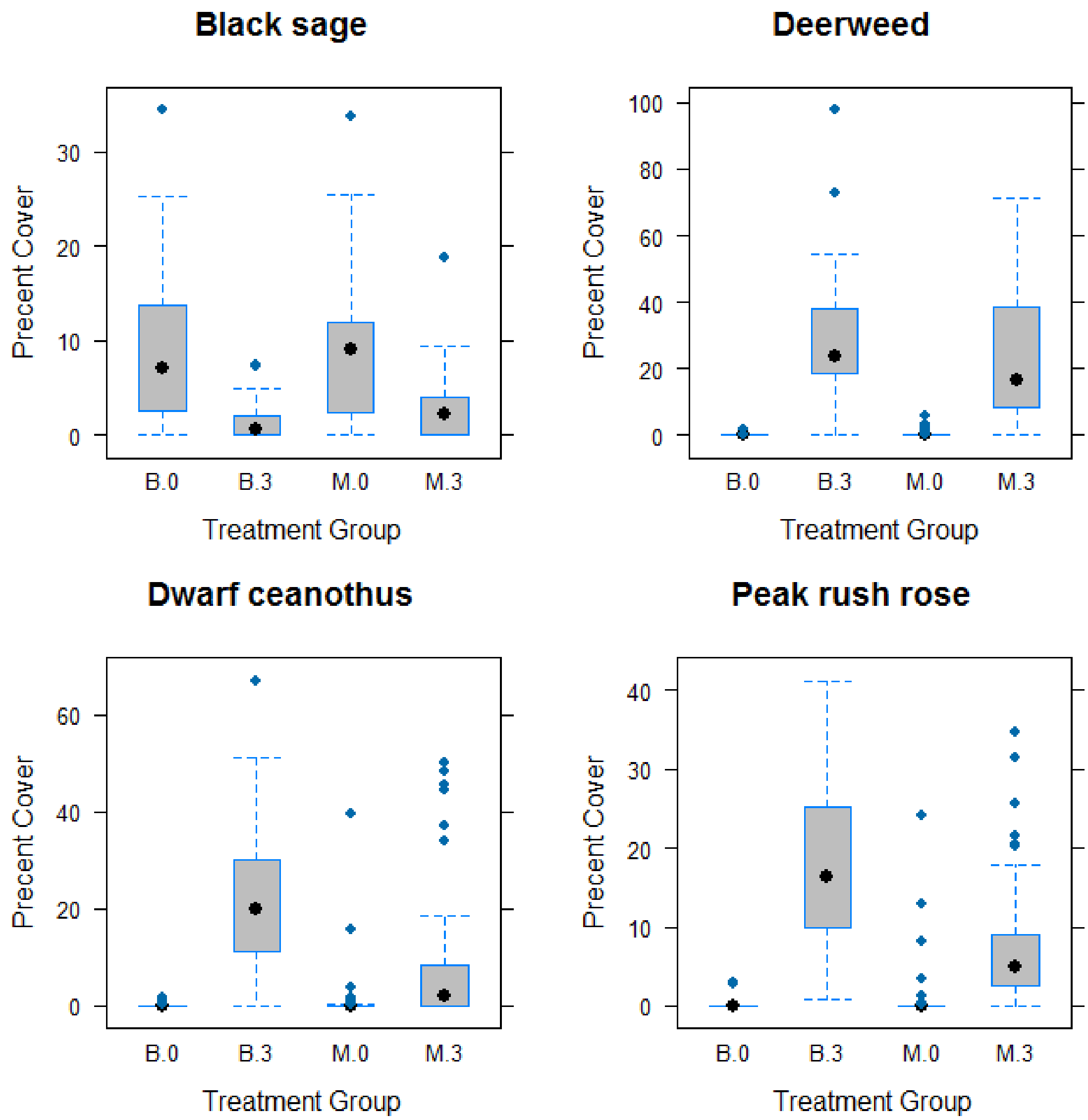

Figure 4-9. Key Species Distinguishing Between Treatment Groups. B Indicates Burned Transects, and M Indicates Masticated Transects. Baseline Transects are Indicated by 0 and Year 3 Transects by 3.

4.3.7 Annual Grass Monitoring

Annual grass surveys were limited to the periphery of Units 07, 10, and the MOUT (see Figures C-5, C-7, and C-9). Estimated areas occupied by annual grasses in Year 1 are summarized in Table 4-8. The area occupied by annual grasses ranged from 16.8 acres in Unit 07 to 63.0 acres in Unit 10. The area occupied by annual grasses increased in both Units 07 and 10, and remained constant in the MOUT between the Baseline survey and Year 3 (2016).

Table 4-8. Estimated Area Occupied (Acres) by Annual Grasses in Year 3 Surveys in Units 6, 7, 10, 33, WGBA, and MOUT

Cover Class	Unit 07 (see Figure C-5)		Unit 10 (see Figure C-7)		MOUT (see Figure C-9)	
	Baseline	2016	Baseline	2016	Baseline	2016
1 (low) = 1–5%	4.0	4.5	39.5	45.2	5.8	4.9
2 (medium) = 6–25%	2.0	3.6	10.5	8.0	5.0	3.9
3 (high) = >25%	4.7	8.7	9.0	9.8	8.6	10.2
Total Acreage	**10.7**	**16.8**	**59.0**	**63.0**	**19.4**	**19.1**

4.3.8 Invasive Species Monitoring

Six patches of iceplant and four patches of pampas grass were observed along trails and disturbed areas in Unit 07 (see Figure C-6). An additional 10 patches of iceplant and one patch of pampas grass were observed in the adjacent Unit 10 (see Figure C-8).

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5 YEAR 5 VEGETATION SURVEYS: UNIT 04, INTERIOR OF UNITS 11 AND 12

5.1 Introduction

All of Units 04, 11, and 12 were masticated in late summer and early fall 2011 (Figure 5-1). No controlled burns were conducted on any of these units. Baseline monitoring was conducted in spring and early summer 2011, prior to mastication (Tetra Tech and EcoSystems West, 2012). This monitoring effort also included meandering transect surveys to map areas of occurrence of HMP herbaceous species; density monitoring for the HMP annual species Monterey spineflower, sand gilia, and seaside bird's-beak; transect surveys to sample shrub composition in the maritime chaparral; and annual grass monitoring in the primary containment areas around the perimeters of Units 11 and 12 included in the 2011 monitoring (Tetra Tech and EcoSystems West, 2012). After Units 11 and 12 were masticated in their entirety in 2011 to facilitate removal of highly explosive MEC, they were allowed to recover prior to a proposed burn of their interior portions in the fall of 2016. The containment lines of these units were re-masticated in fall 2015 and are included in Year 1 follow-up monitoring above (Section 3).

Year 1 follow-up monitoring was conducted in the spring and early summer of 2012 in these three units in order to assess recovery of the three HMP annual species in the first season after mastication as well as to assess the status of non-native annual grasses in the proposed primary containment areas. Year 3 and Year 5 follow-up monitoring was conducted in these units in spring and early summer 2014 and 2016, respectively.

The 2016 Year 5 follow-up monitoring consisted of the following:

- Density monitoring for three HMP annual species: Monterey spineflower, sand gilia, and seaside bird's-beak.
- Sampling of macroplots
- Repeat line intercept transect sampling of transects previously sampled in 2011 and 2014 to sample shrub species composition in the maritime chaparral that is recovering from past disturbance (2011 mechanical clearance and 2012 ordnance cleanup) (Tetra Tech and EcoSystems West, 2012, 2015).
- Mapping of non-native annual grasses within portions of the units that will be primary containment areas when burning is conducted per USFWS (2015) requirements.
- Mapping of invasive species.

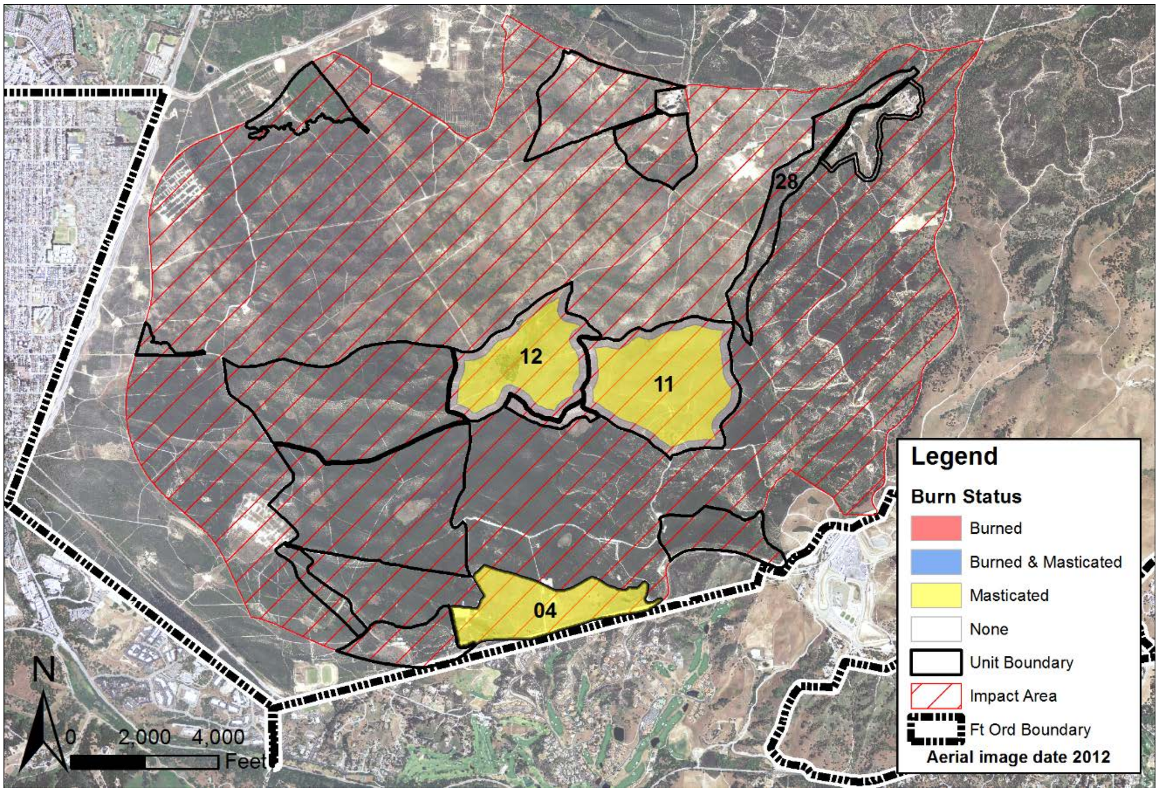

Figure 5-1. Year 5 Units Surveyed in 2016. Treatments are Shown as Colored Fill. Containment Lines in Units 11 and 12 are Addressed in Section 3.

5.2 Unit 04 and Units 11 and 12 Interior: Setting

Unit 04 encompasses an area of 145 acres (see Figure 5-1). This unit is located at the south end of former Fort Ord, adjacent to Unit 06 to the east. The terrain is mostly gently rolling to moderately steep. In baseline condition, this unit was vegetated primarily with mature maritime chaparral largely dominated by shaggy-barked manzanita. Other dominants sometimes include such species as sandmat manzanita, Monterey manzanita, chamise, and black sage. Sizable areas of coast live oak woodland and grassland occur in the eastern portion of the unit. Scattered individual trees or small clumps of coast live oak occur elsewhere in the unit. Disturbed areas of various sizes occur in the unit, including several areas in the extreme western portion where soil had been removed for lead remediation prior to the 2011 baseline monitoring. In October 2014, a prescribed burn in Units 07 and 10 jumped the fuel break and burned approximately 8.5 acres of the northwest corner of Unit 4 near the intersection of Phoenix Road and Evolution Road.

The interior portion of Unit 11 encompasses an area of 203 acres and Unit 12 encompasses an area of 135 acres (see Figure 5-1). These units are adjacent to each other in the south-central portion of the area of the Impact Area. The terrain is gently rolling to locally steep. In baseline condition, these units were vegetated primarily with mature maritime chaparral. Limited areas of coast live oak woodland occur in Units 11 and 12, more extensively in Unit 12. A large area of dry meadow habitat occurs in the northeastern portion of Unit 12, a sizable wetland occurs in the north-central portion of Unit 11. Only a small portion of these features are located in the interior of these units beyond the primary containment lines. Substantial areas of indurated sandstone outcrops occur in the south-central portion of Unit 11. Disturbed areas of various sizes occur on Unit 11 and, less extensively, on Unit 12.

According to the USDA (2012), the soil in all of Units 4, and 12 included in 2016 Year 5 monitoring, and most of Unit 11 is Arnold-Santa Ynez complex. One small area in the southern portion of Unit 11 is mapped as Xerorthents, dissected soil. Characteristics of these soils are presented in Table 2-1.

5.3 Unit 04 and Units 11 and 12 Interior: Results and Discussion

Unit 04, and the interior of Units 11 and 12 were masticated in their entirety in 2011. No prescribed burning was conducted. A baseline survey was conducted in 2011 before mastication, and a Year 3 survey was conducted in 2014. No HMP annual plants were observed in the interior of Unit 11 during the 2011 baseline survey. Therefore, the interior of Unit 11 was not surveyed for HMP annuals. The interiors of Units 11 and 12 have been allowed to recover, prior to a proposed burn in 2016. Maps of survey grids for the sampled units are provided in Appendix B.

5.3.1 Sand Gilia

Sand gilia was present only in the interior of Unit 12 and was not found in Unit 4 (see Table 5-1; see Figures B-34 and B-39). The average density class in Unit 12 ranged from 0.2 in 2014 (Year 3) to 1.0 in 2016 (Year 5) (see Figure 5-2). Likewise, the frequency of occurrence in sampled plots in Unit 12 was minimal (5 of 28 grids; 18%) in 2014, and maximal (16 of 28 grids; 57%) in 2016.

5.3.2 Seaside Bird's-Beak

Seaside bird's-beak was absent in all grids sampled in Units 04 and 12 in 2016 (see Figures B-35 and B-40). This species was also absent in all sampled grids in previous years.

5.3.3 Monterey Spineflower

The Monterey spineflower is the most frequently occurring and has the highest densities of the three species considered in this monitoring program. Between 2011 and 2016, it maintained t a 93% frequency of occurrence in the sampled grids (see Table 5-2; see Figures B-36 and B-41). The average density class of Monterey spineflower in Unit 12 was lowest in 2014 (Year 3) and increased back to baseline densities in 2016 (Year 5) (see Figure 5-2).

Table 5-1. Sand Gilia – Number of Grids per Density Class in Units 04 and 12

Density	Unit 04				Unit 12, interior			
	2011	2012	2014	2016	2011	2012	2014	2016
0 plants/grid (percent of total grids)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	17 (61%)	16 (57%)	23 (82%)	12 (43%)
1–50 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	11 (39%)	12 (43%)	5 (18%)	7 (25%)
51–100 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6 (21%)
101–500 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (11%)
> 500 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Density Class	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**	**0.4**	**0.2**	**1.0**
Total Occupied Grids	**0**	**0**	**0**	**0**	**11**	**12**	**5**	**16**
Total Grids Sampled	**2**	**2**	**2**	**2**	**28**	**28**	**28**	**28**

[1] Each grid is 100- x 100- feet, or 10,000 square feet, or 0.23 acre.

Table 5-2. Monterey Spineflower – Number of Grids per Density Class in Units 04 and 12

Density	Unit 04				Unit 12, interior			
	2011	**2012**	**2014**	**2016**	**2011**	**2012**	**2014**	**2016**
0 plants/grid (percent of total grids)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (11%)	3 (11%)	6 (21%)	2 (7%)
1–50 plants/grid (percent of total grids)	1 (50%)	0 (0%)	1 (50%)	1 (50%)	4 (14%)	7 (25%)	9 (32%)	5 (18%)
51–100 plants/grid (percent of total grids)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	5 (18%)	4 (14%)	7 (25%)	5 (18%)
101–500 plants/grid (percent of total grids)	1 (50%)	0 (0%)	1 (50%)	1 (50%)	6 (21%)	8 (29%)	1 (4%)	10 (36%)
> 500 plants/grid (percent of total grids)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	10 (36%)	6 (21%)	5 (18%)	6 (21%)
Average Density Class	**2.0**	**3.0**	**2.0**	**2.0**	**2.6**	**2.3**	**1.6**	**2.5**
Total Occupied Grids	**2**	**2**	**2**	**2**	**25**	**25**	**22**	**26**
Total Grids Sampled	**2**	**2**	**2**	**2**	**28**	**28**	**28**	**28**

[1] Each grid is 100- x 100- feet, or 10,000 square feet, or 0.23 acre.

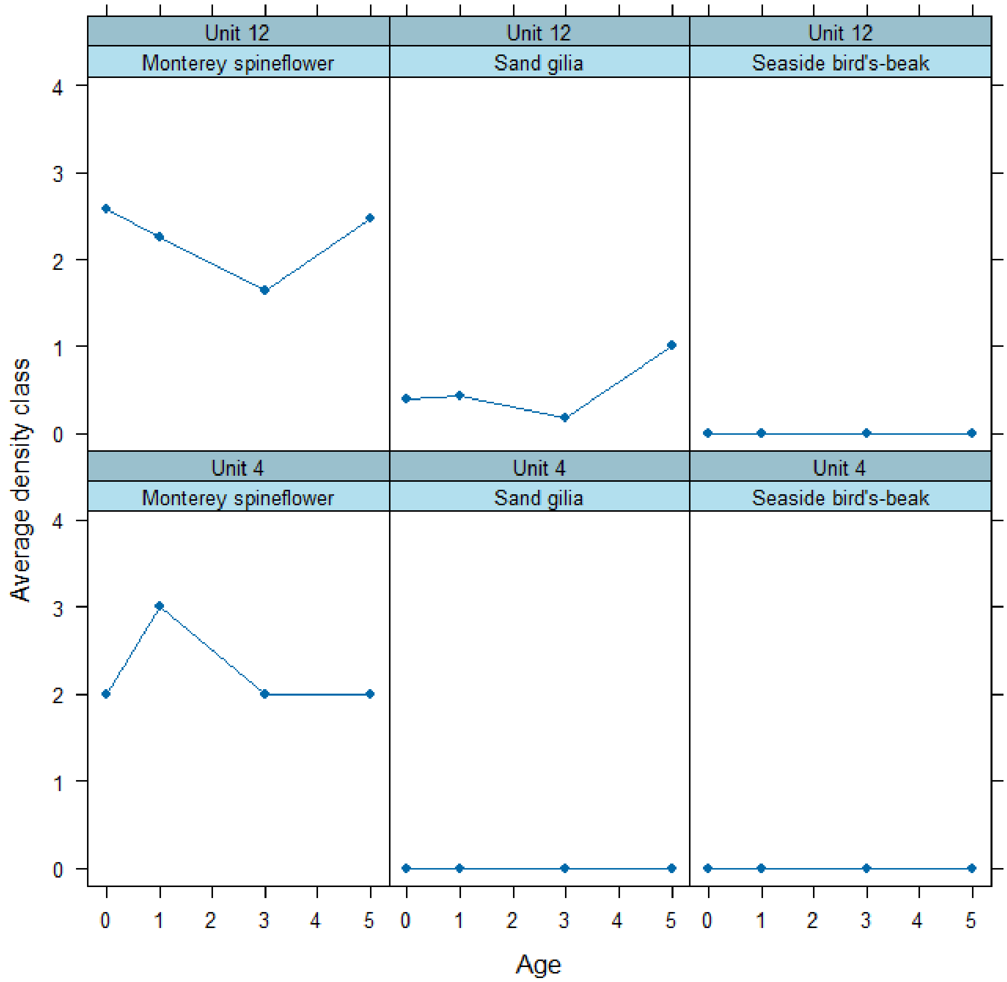

Figure 5-2. Temporal Trends in Density Class of HMP Species in Year 5 Units. Crosses Represent Density Classes in Individual Grids. Lines Represent Average Values. Baseline Surveys Were Conducted in 2011.

5.3.4 Yadon's Piperia

Yadon's piperia was not observed in any of the Year 5 Units.

5.3.5 Shrub Transect Monitoring

A total of 39 transects were sampled in Units 04, and the interior of Units 11 and 12 (see Figures B-37, B-38, and B-42). Total shrub cover for all units and transects averaged 82.6% and ranged from 51.0% to 130.2% (see Table 5-3; see Figure 5-3). Total cover decreased substantially in Year 3, but has rebounded in Year 5. Herbaceous cover averaged 1.39% and ranged from 0.49% to 2.02% and exhibited a slight increase relative to Year 3 (see Figure 5-3). Bare ground decreased relative to Year 3, and averaged 39.2% and ranged from 13.0% to 54.4% (see Figure 5-3). Raw data for shrub transects sampled in 2015 are provided in Appendix E.

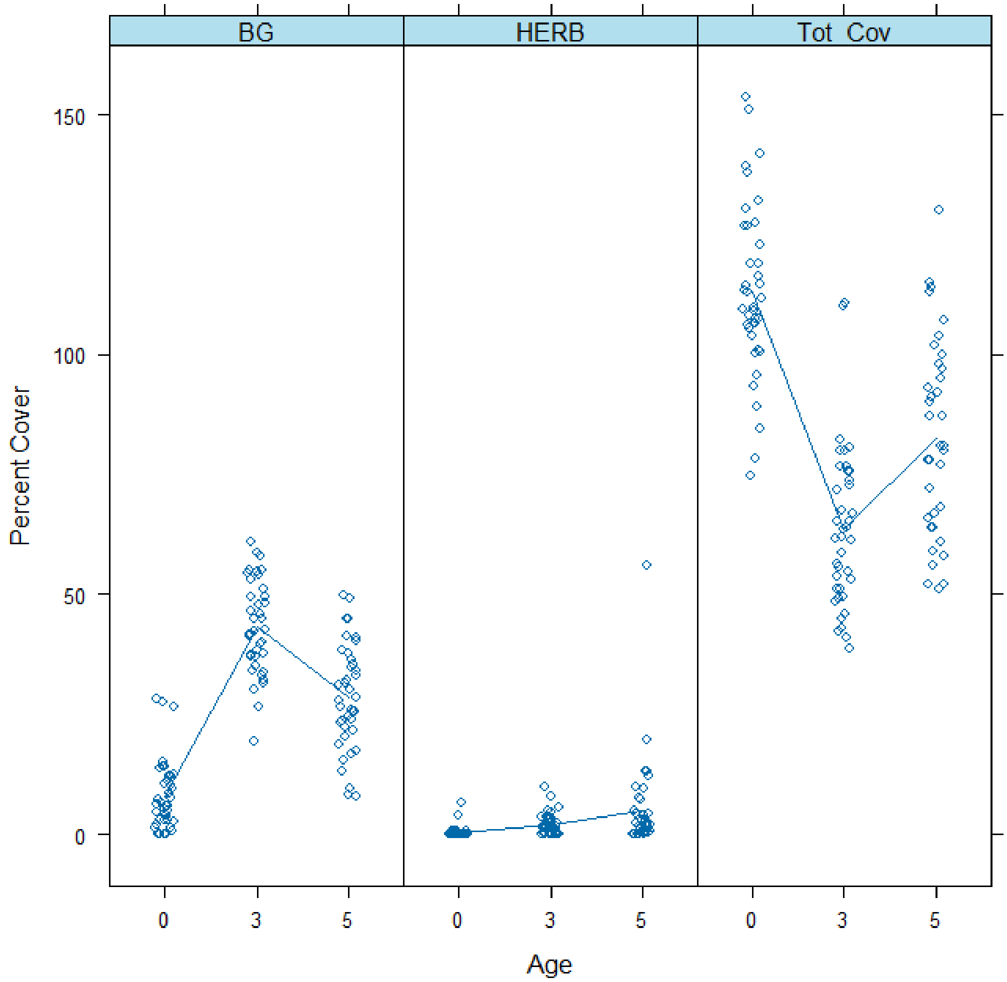

Figure 5-3. Percent Cover by Vegetation Strata in Year 5 Units. Individual Transects are Indicated by Open Circles. The Blue Line Represents the Average Cover in Each Group.

Table 5-3. Community Structure Parameters for Baseline and Year 5 Transects in Units 04, and Interior of Units 11 and 12

	Parameter							
	Total Cover (%)		Species Richness (S)		Diversity (H')		Evenness (J')	
	Year 0	Year 5	Year 0	Year 5	Year 0	Year 5	Year 0	Year 5
Minimum	74.6	51.0	2	4	0.18	0.49	0.22	0.28
25%ile	104.8	66.2	5	8	1.04	1.24	0.59	0.60
Median	109.8	81.2	6	8	1.16	1.37	0.65	0.65
Mean	113.1	82.6	6.3	8.7	1.13	1.39	0.63	0.65
75%ile	124.8	96.3	8	10	1.33	1.63	0.71	0.71
Maximum	153.6	130.2	10	12	1.93	2.02	0.95	0.84

Temporal patterns of total cover, diversity, and species richness in each unit are shown graphically in Figure 5-4 – 5-6. ANOVA was used to test for the effects of unit and age on each of these three parameters. Total cover exhibited differences between units and age (see Table 5-4).

Diversity tended to increase similarly with age in all units (see Figure 5-5). The ANOVA indicated significant effects of age, but not of unit (see Table 5-5).

Species richness responded similarly to diversity, exhibiting an increase in the number of species after treatment (see Figure 5-6; see Table 5-6). However, there are significant differences between units with Unit 11 tending to have more species than Units 12 or 4 from baseline through year 5.

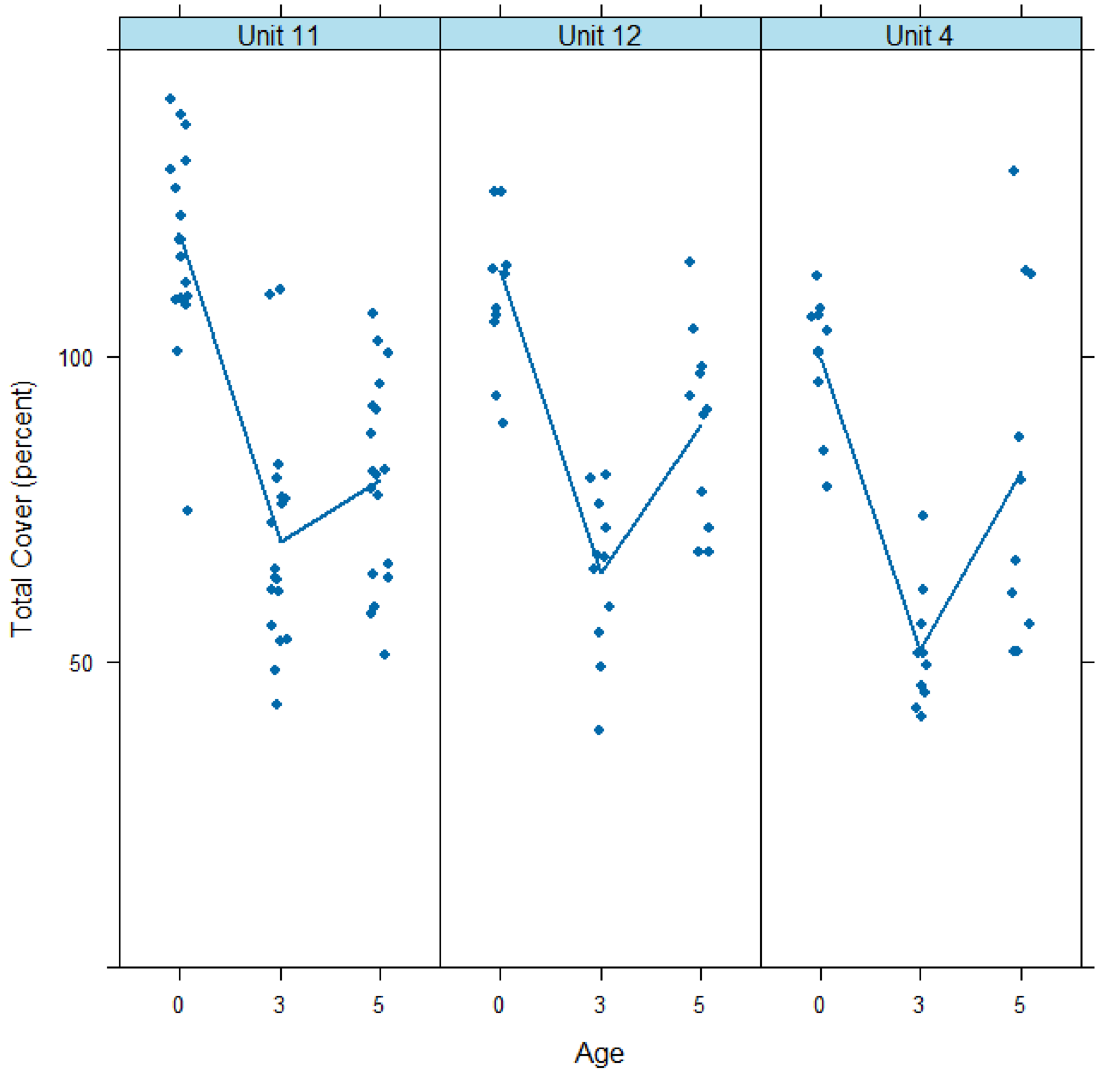

Figure 5-4. Total Percent Cover on Transects in Units 4, 11, and 12 Between 2011 and 2016. Individual Transects are Indicated by Dots. The Blue Line Represents the Average Cover in Each Group.

Table 5-4. Results of ANOVA for Effect of Age and Unit on Total Cover in Year 5 Transects

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Unit	2	3183	1592	5.3	0.007
Age	2	48550	24275	80.6	<0.001
Unit*Age	4	2123	531	1.76	0.14
Residual	108	32522	301		

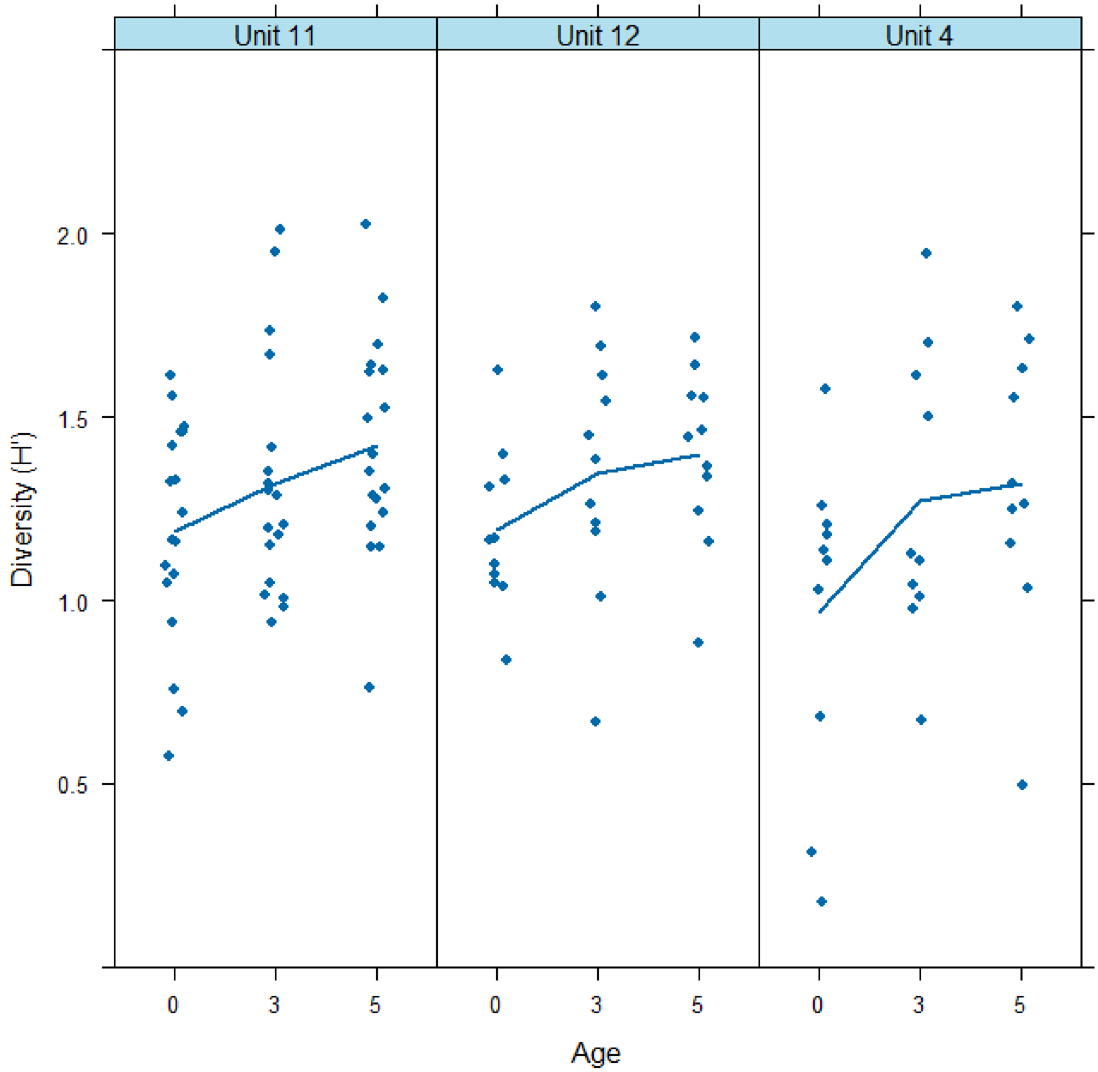

Figure 5-5. Diversity on Transects in Units 4, 11, and 12 Between 2011 and 2016. Individual Transects are Indicated by Dots. The Blue Line Represents the Average Cover in Each Group.

Table 5-5. Results of ANOVA for Effect of Age and Unit on Community Diversity in Year 5 Transects

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Age	2	1.36	0.68	6.5	0.002
Unit	2	0.35	0.17	1.64	0.20
Unit*Age	4	0.12	0.03	0.28	0.89
Residual	108	11.4	0.106		

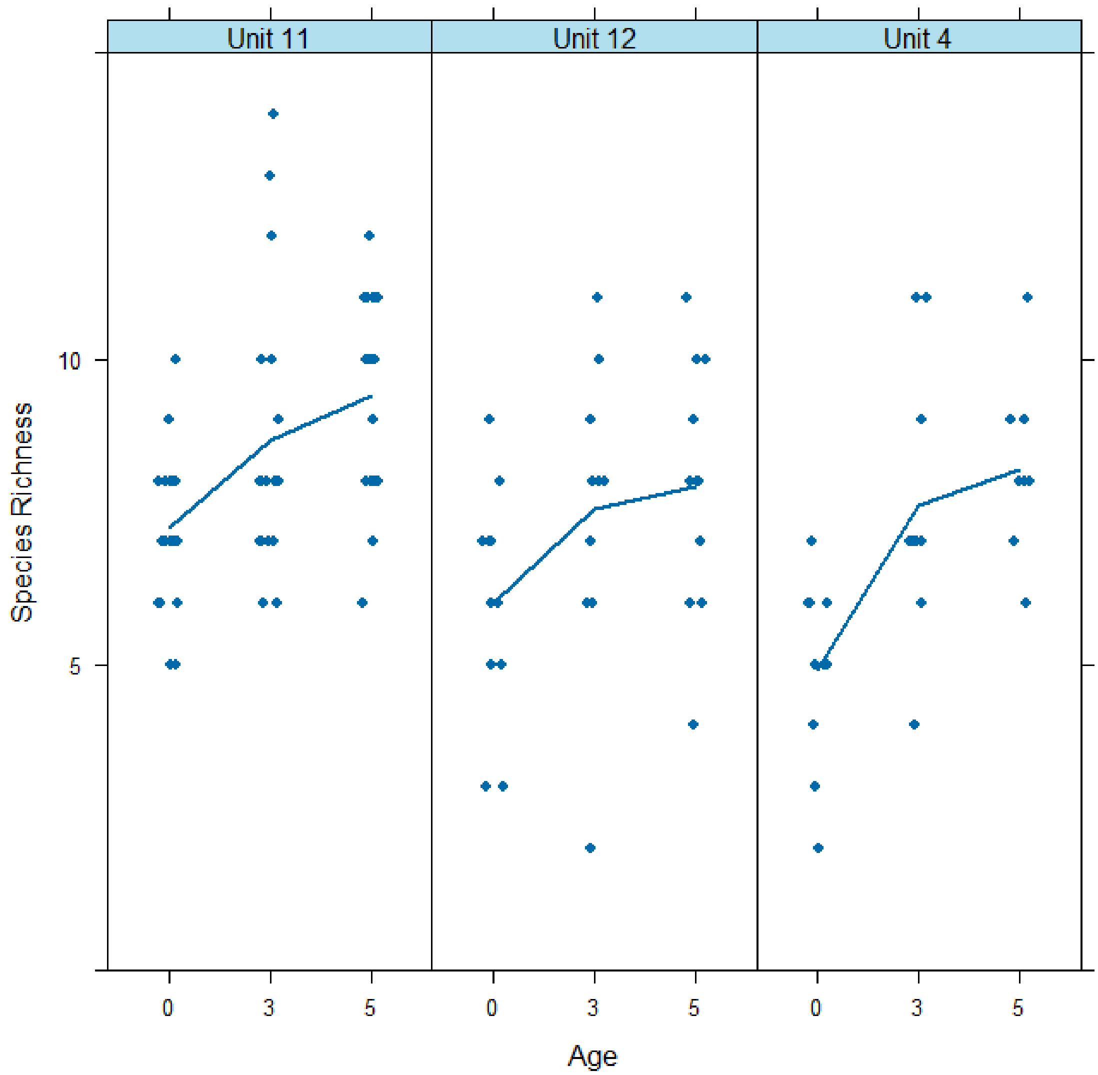

Figure 5-6. Species Richness on Transects in Units 4, 11, and 12 Between 2011 and 2016. Individual Transects are Indicated by Dots. The Blue Line Represents the Average Cover in Each Group

Table 5-6. Results of ANOVA for Effect of Age and Unit on Species Richness in Year 5 Transects

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Unit	2	58	28.8	8.1	<0.001
Age	2	120	60.2	16.9	<0.001
Unit*Age	4	8	2.0	0.56	0.70
Residual	108	384	3.6		

Units 04, 11, and 12 were masticated in 2011, and there has been time for successional trends to be observed in these units. To determine whether time had an effect on community structure an analysis was conducted using non-metric multidimensional scaling (NMDS) as implemented in function *metaMDS()* in the *vegan* package in R (Oksanen *et al.*, 2016; R Core Team, 2016). The results of the NMDS ordination show a community level response relative to Year and Unit (see Figure 5-7). This plot clearly shows the differences in community composition between Unit 04 and Units 11 and 12, and between the baseline, Year 3, and Year 5 communities. The recovery pattern is consistent with previous surveys that found a substantial shift away from baseline community structure in Year 3, then a slow progression towards the initial community structure with time.

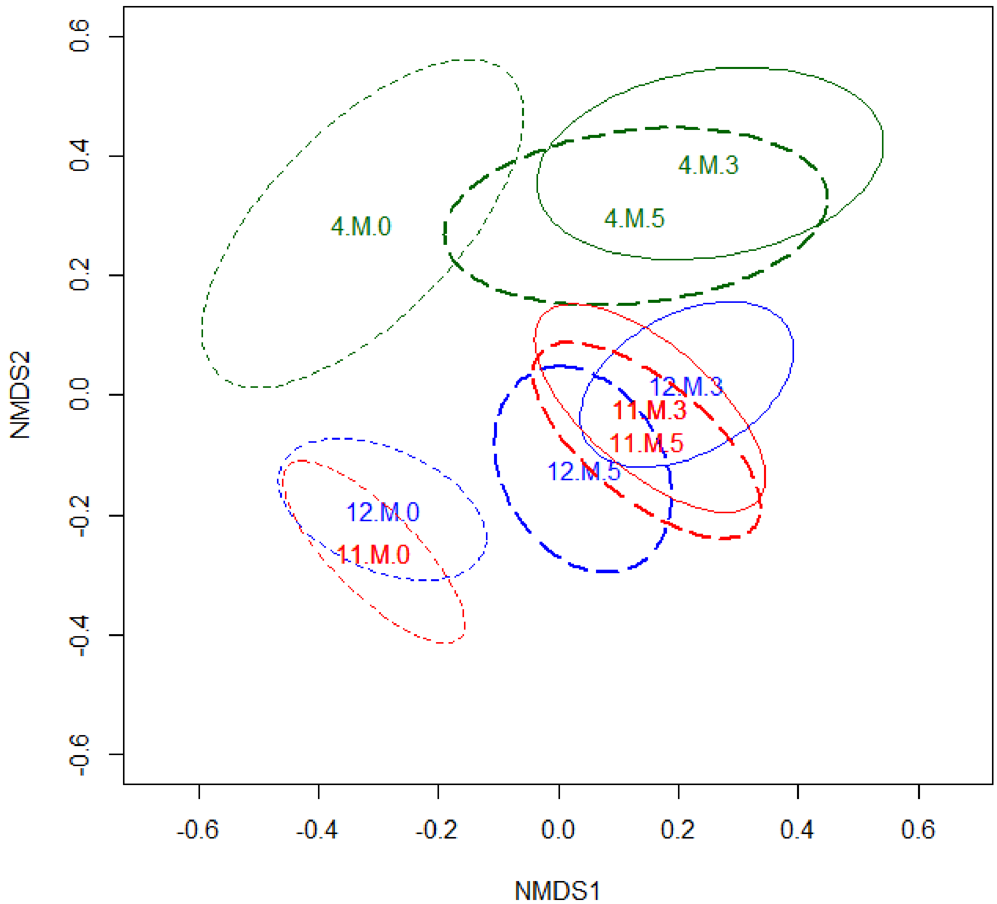

Figure 5-7. NMDS Ordination Plot of Shrub Community Structure in Units 04, 11, and 12 in Year 0, Year 3, and Year 5. Labels Indicate the Centroid of Each Unit/Year Group and the Ellipses Represent the 95th Confidence Region of Each Group in the Ordination Space.

5.3.6 Annual Grass Monitoring

Annual grass surveys were limited to the periphery of Unit 04. Estimated areas occupied by annual grasses in Year 5 are summarized in Table 5-7 (see Figure C-10). The area occupied by grasses in 2016 was 60% and is in the low density class.

Annual grasses were not surveyed for in the baseline year in Unit 04. Therefore a comparison is made between Year 3 and Year 5. The area occupied by annual grasses decreased substantially between Year 3 and Year 5, particularly in the high density (> 25 %) class.

Table 5-7. Estimated Area Occupied (Acres) by Annual Grasses in Year 3 and Year 5 Surveys in Unit 04

Cover Class	Year 3	Year 5
1 (low) = 1–5%	22.9	23.8
2 (medium) = 6–25%	4.9	7.3
3 (high) = >25%	18.24	8.0
Total Acreage	**46.1**	**39.1**

5.3.7 Invasive Species Monitoring

Eight areas of pampas grass and three areas of iceplant were observed in Unit 11 during field surveys (see Figure C-11). Three areas of iceplant were also observed in the southeast corner of Unit 12 (see Figure C-12).

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6 YEAR 8 VEGETATION SURVEYS: UNITS 18, 22

6.1 Introduction

Baseline sampling of shrubs and HMP annuals in Units 18 and 22 was conducted by Shaw Environmental in 2008 (Shaw, 2009). In this baseline sampling, Shaw sampled a total of 22 shrub transects in Unit 18 and 14 transects in Unit 22. Shaw also surveyed for the HMP annual species Monterey spineflower, sand gilia, and seaside bird's-beak in 2008. Grid-based density monitoring was not conducted; however, areas of occurrence of the three HMP annual species were mapped. For each mapped area, sand gilia and seaside bird's-beak density was estimated by density class, and Monterey spineflower% cover was estimated by cover class.

A prescribed burn was conducted in Units 18 and 22 in December 2008. In 2009, Burleson Consulting, Inc. conducted first year follow-up density monitoring of the three HMP annuals (Burleson, 2009b). For this monitoring, a map of the pre-defined 100×100-ft grids was superimposed over the maps of areas occupied by one or more HMP annual species in 2008 (Shaw, 2009). In 2009, sampled grids were randomly selected from grids sampled in 2008. Those selected represented 20% of grids mapped as occupied, and 10% of grids along the outer boundaries of occupied areas. A total of 107 grids in Unit 18 and 91 grids in Unit 22 sampled in 2009 contained one or more of the three HMP annual species (some of the grids sampled in 2009 contained no HMP annuals). The methodology for the 2009 density sampling by Burleson Consulting was similar to that described previously (see Section 2.3) except that 2.5 m radius circular subplots were used exclusively to estimate density.

Shrub transect data for Units 18 and 22 from 2008 (baseline) were not available in the project database, and were therefore transcribed from tables in the original report into the data table for analysis (Shaw, 2009).

The Year 5 and Year 8 sampling in Units 18 and 22 was conducted at the same locations as for the 2011 Year 3 follow-up monitoring. Due to implementation of the revised vegetation monitoring protocol, HMP annual density monitoring was not conducted in 2016 (Tetra Tech and EcoSystems West, 2015b).

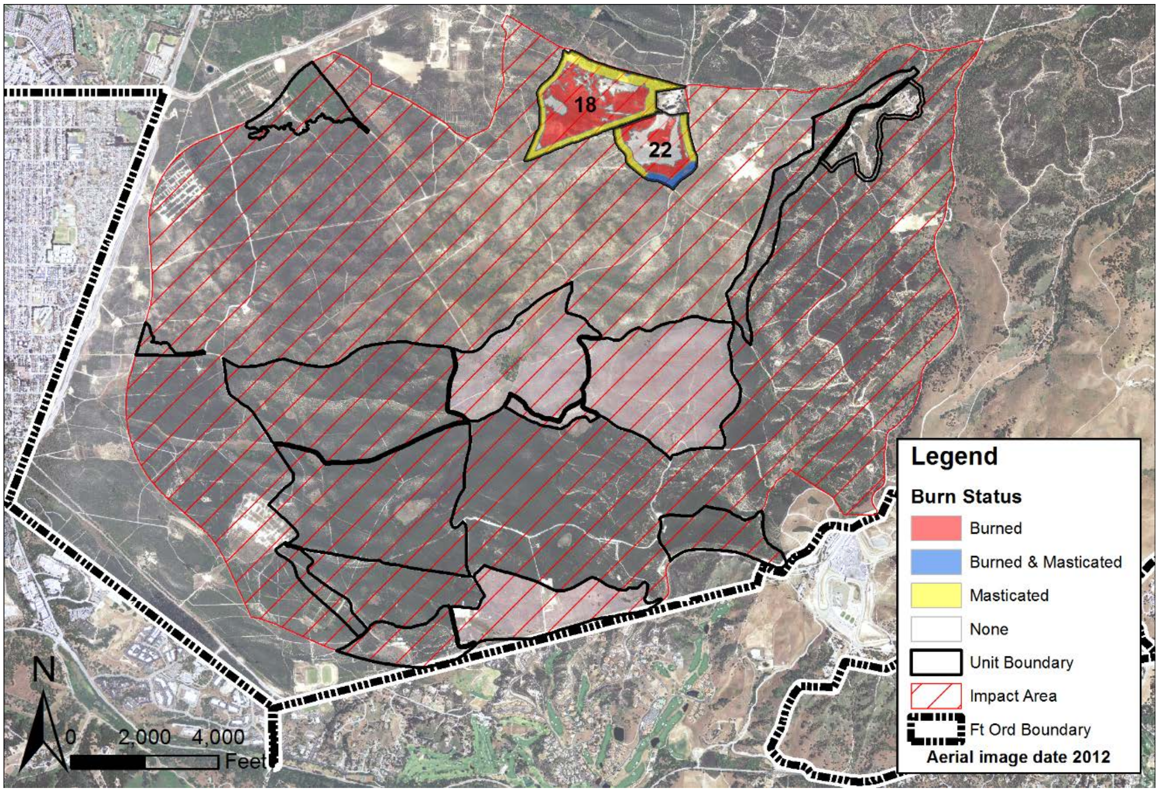

Figure 6-1. Year 8 Units Surveyed in 2015. Treatments are Shown as Colored Fill

The 2016 Year 8 follow-up monitoring in Units 18 and 22 consisted of the following activities:

- Repeat line intercept transect sampling of transects previously sampled in 2008, 2011, and 2013 to sample shrub species composition in the maritime chaparral that is recovering from past disturbance (the 2008 controlled burn and the 2009 munitions and ordnance cleanup) (Shaw, 2009; Tetra Tech and EcoSystems West 2012, 2014).
- Mapping of non-native annual grasses within portions of the primary containment areas around the perimeter of these units.
- Mapping of invasive species, including iceplant, pampas grass, and French broom, where encountered.

Per the revised protocol for vegetation monitoring no HMP annual surveys are required in Year 8 Units (Tetra Tech and EcoSystems West, 2015b). Therefore, no macroplot sampling was conducted in Units 18 and 22.

6.2 Units 18 and 22: Setting

Unit 18 is located south of Eucalyptus Road, east of Orion Road, and north of Broadway Avenue (see Figure 6-1). Unit 22 is located south of Broadway Avenue, west of Watkins Gate Road, and northeast of Chinook Road (see Figure 6-1). Unit 18 encompasses an area of 136 acres and Unit 22 encompasses an area of 73 acres. The terrain is gently rolling in both units with a steep south facing slope along the northern portion of Unit 22. Prior to treatment, the most widespread vegetation type in the two units was intermediate-aged maritime chaparral (Shaw, 2009). A seasonal wetland occurs near the center of Unit 22, surrounded by an extensive area of grassland. Smaller areas of grassland occur on Unit 18, and areas of coast live oak woodland occur on both units. Unit 18 also contains extensive disturbed soil remediation areas, especially in the northern portion.

Soils in both Year 8 monitoring units are mapped by USDA (2016) as Arnold-Santa Ynez complex. Characteristics of this soil type are presented in Table 2-1.

6.3 Units 18 and 22: Results and Discussion

Monitoring for HMP annual species was not required to be conducted in Units 18 and 22.

6.3.1 Shrub Transect Monitoring

Units 18 and 22 were cleared of vegetation in 2008. The interiors of Units 18 and 22 were burned and portions of the periphery were masticated as a fire break (see Figure 6-1).

A total of 35 transects were sampled in Units 18 and 22 during 2016 (see Figures B-43 and B-44). Total shrub cover averaged 70.0% and ranged from 32.2% to 120.2% (see Table 6-1; see Figure 6-2). Herbaceous vegetation occupied an average of 1.4%, and ranged from 0.96% to 2.0%. Bare ground averaged 31.2%, and ranged from 9.8% to 57.8%. Total cover continues to remain below baseline conditions, but shows evidence of an increasing trend (Figure 6-2). Whereas species richness, diversity and evenness were higher than in baseline conditions. Raw data for the shrub transects sampled in 2016 are provided in Appendix E.

Table 6-1. Community Structure Parameters for Baseline and Year 8 Transects in Units 18 and 22

	Parameter							
	Total Cover (%)		Species Richness (S)		Diversity (H')		Evenness (J')	
	Year 0	Year 8	Year 0	Year 8	Year 0	Year 8	Year 0	Year 8
Minimum	56.4	32.2	3	4	0.18	0.96	0.16	0.48
25%ile	71.0	51.0	4	8	0.85	1.31	0.56	0.66
Median	78.9	69.4	5	9	1.02	1.53	0.62	0.73
Mean	80.4	70.0	5.3	8.6	1.02	1.50	0.62	0.70
75%ile	80.2	89.4	6	10	1.19	1.67	0.71	0.77
Maximum	103.8	120.2	7	12	1.65	2.04	0.88	0.86

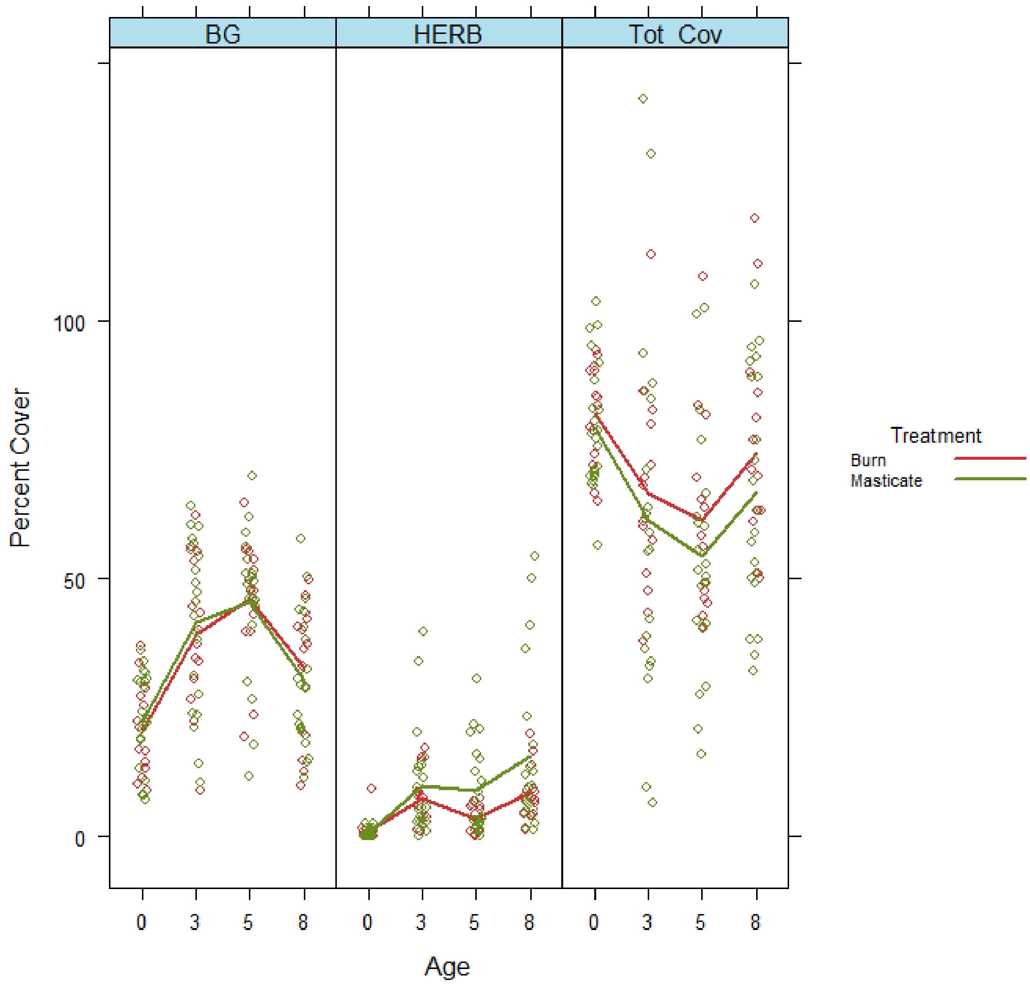

Figure 6-2. Changes in Bare Ground, Herbaceous Cover, and Total Shrub Cover Over Time in Units 18 and 22 Relative to Treatment. Circles Represent Individual Transects. Lines Represent Change in Average Values.

Temporal patterns of total cover, diversity, and species richness relative to treatment in each unit are shown graphically in Figure 6-3 – 6-5. ANOVA was used to test for the effects of unit, treatment, and age on each of these three parameters. The ANOVA indicated that total cover exhibited differences between units and age (see Table 6-2). Unit 22 tended to have higher total cover than Unit 18 in each year. Total cover in both units decreased after treatment, and subsequently recovered. Treatment did not have an effect on total cover.

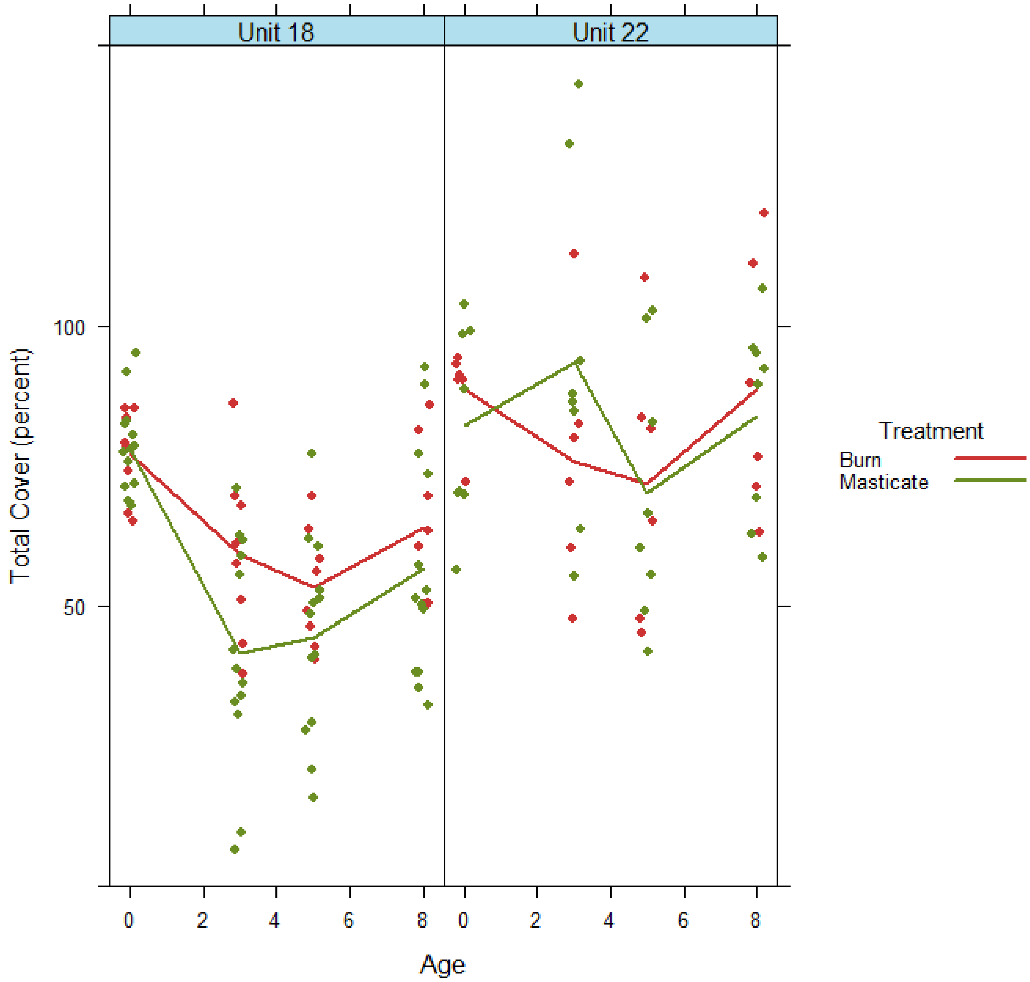

Figure 6-3. Temporal Changes in Total Shrub Cover on Units 18 and 22. Age Represents Years Since Treatment. Dots Represent Individual Transects. Lines Represent Change in Average Values.

Table 6-2. Results of ANOVA for Effect of Treatment, Age, and Unit on Total Cover in Year 8 Transects

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Unit	1	18204	18204	54.7	<0.001
Age	3	10761	3587	10.8	<0.001
Treatment	1	994	994	2.99	0.09
Unit*Age	3	4016	1339	4.0	0.009
Treatment*Age	3	150	50	0.15	0.93
Unit*Treatment	1	683	683	2.05	0.15
Unit*Treatment*Age	3	2033	678	2.04	0.11
Residual	125	41590	333		

Diversity tended to increase similarly with age in both units (see Figure 6-4). The ANOVA indicated an effect of age, but not of treatment or unit (see Table 6-3). Diversity increased through Year 5, then exhibited a slight decrease towards Year 8.

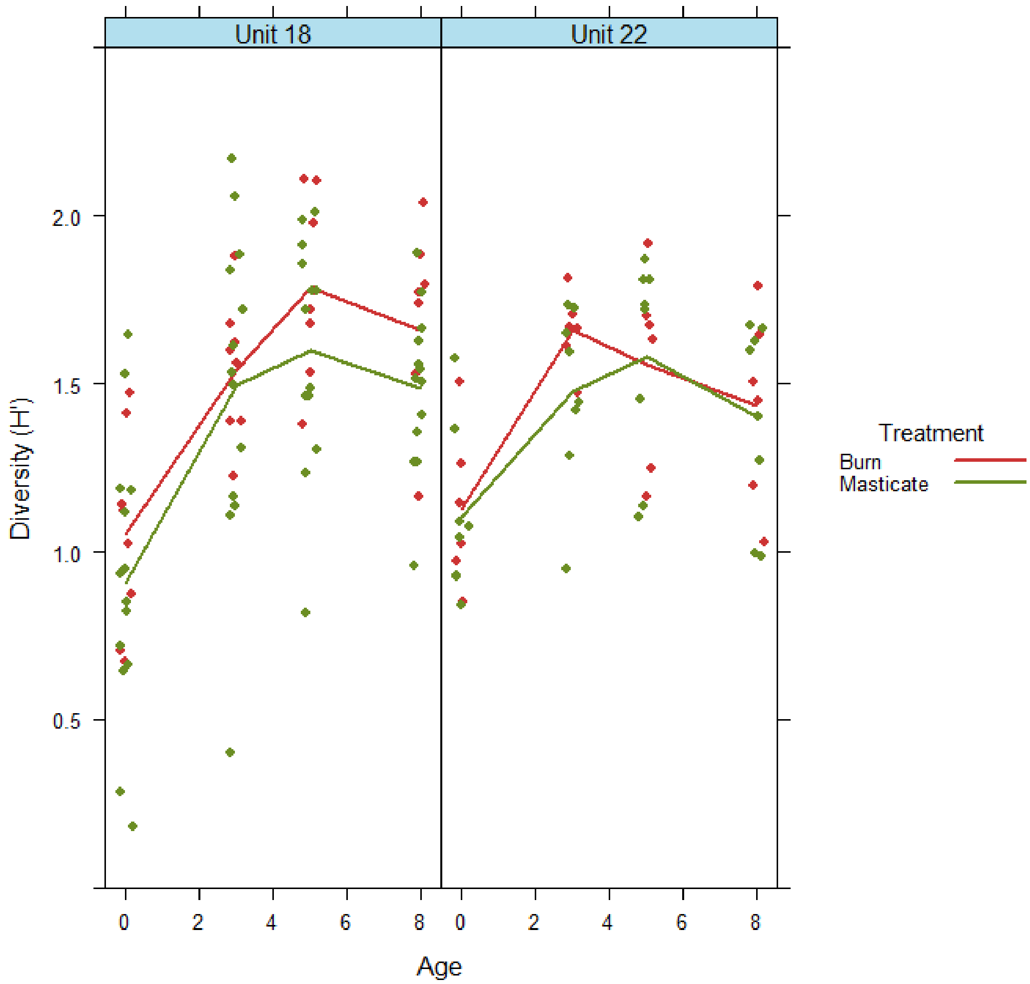

Figure 6-4. Temporal Changes in Diversity on Units 18 and 22. Age Represents Years Since Treatment. Dots Represent Individual Transects. Lines Represent Change in Average Values.

Table 6-3. Results of ANOVA for Effect of Treatment, Age, and Unit on Community Diversity in Year 8 Transects

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Unit	1	0.00	0.01	0.01	0.92
Treatment	1	0.40	0.40	3.99	0.048
Age	3	7.9	2.6	26.5	<0.001
Unit*Treatment	1	0.06	0.06	0.59	0.44
Unit*Age	3	0.45	0.15	1.50	0.22
Treatment*Age	3	0.00	0.001	0.01	0.999
Unit*Treatment*Age	3	0.14	0.045	0.45	0.72
Residual	125	12.4	0.10		

Species richness exhibited an increase in the number of species shortly after treatment (see Figure 6-5; see Table 6-4). Species richness then remained relatively constant from Year 3 to Year 8.

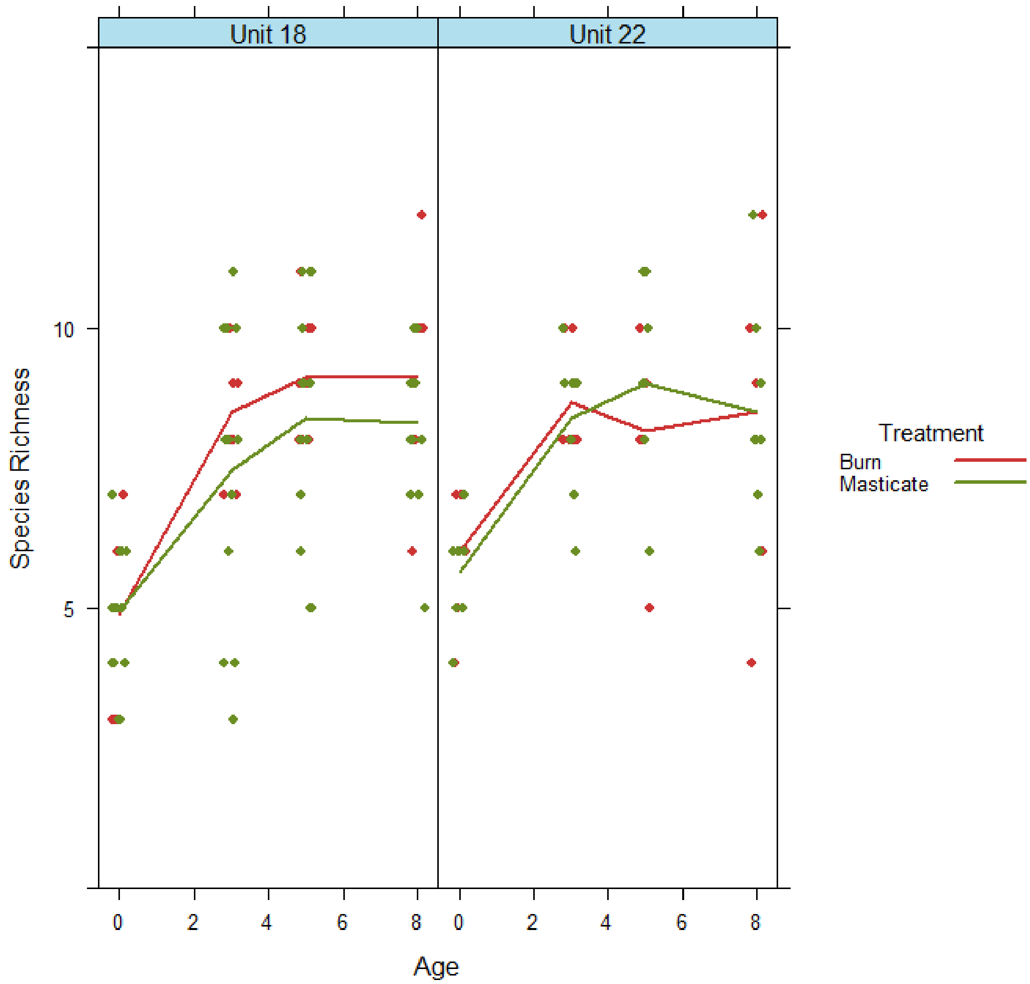

Figure 6-5. Temporal Changes in Species Richness on Units 18 and 22. Age Represents Years Since Treatment. Dots Represent Individual Transects. Lines Represent Change in Average Values.

Table 6-4. Results of ANOVA for Effect of Treatment, Age, and Unit on Species Richness in Year 8 Transects

Source	Df	Sum Sq.	Mean Sq.	F	Pr (>F)
Treatment	1	6	5.5	1.89	0.17
Age	3	279	93.1	31.8	<0.001
Unit	1	4	3.6	1.24	0.27
Treatment*Age	3	2	0.8	0.27	0.85
Treatment*Unit	1	4	3.7	1.28	0.26
Age*Unit	3	6	2.0	0.69	0.56
Treatment*Age*Unit	3	4	1.4	0.48	0.70
Residual	137	391	2.9		

To examine effects of treatment, age, and Unit on association structure, multivariate statistics (cluster and ordination techniques) were used. These techniques are based on measures of dissimilarity between samples (transects). This analysis was conducted using NMDS as implemented in function *metaMDS()* in the *vegan* package in R (Oksanen *et al.*, 2016; R Core Team, 2016).

The results of the NMDS ordination show a community level response relative to time. Temporal changes are clearly evident in Units 18 and 22 (see Figure 6-6 – 6-7). The confidence ellipsoids seen in the figures are a two-dimensional representation of the 95 percent confidence interval surrounding the average position (i.e. centroid) of each group. The baseline transects are clearly separated from both post-treatment years, and the Year 8 transects are more similar to Year 0 (baseline) transects than are the Year 3 and 5 transects, suggesting that community structure is progressing towards baseline conditions.

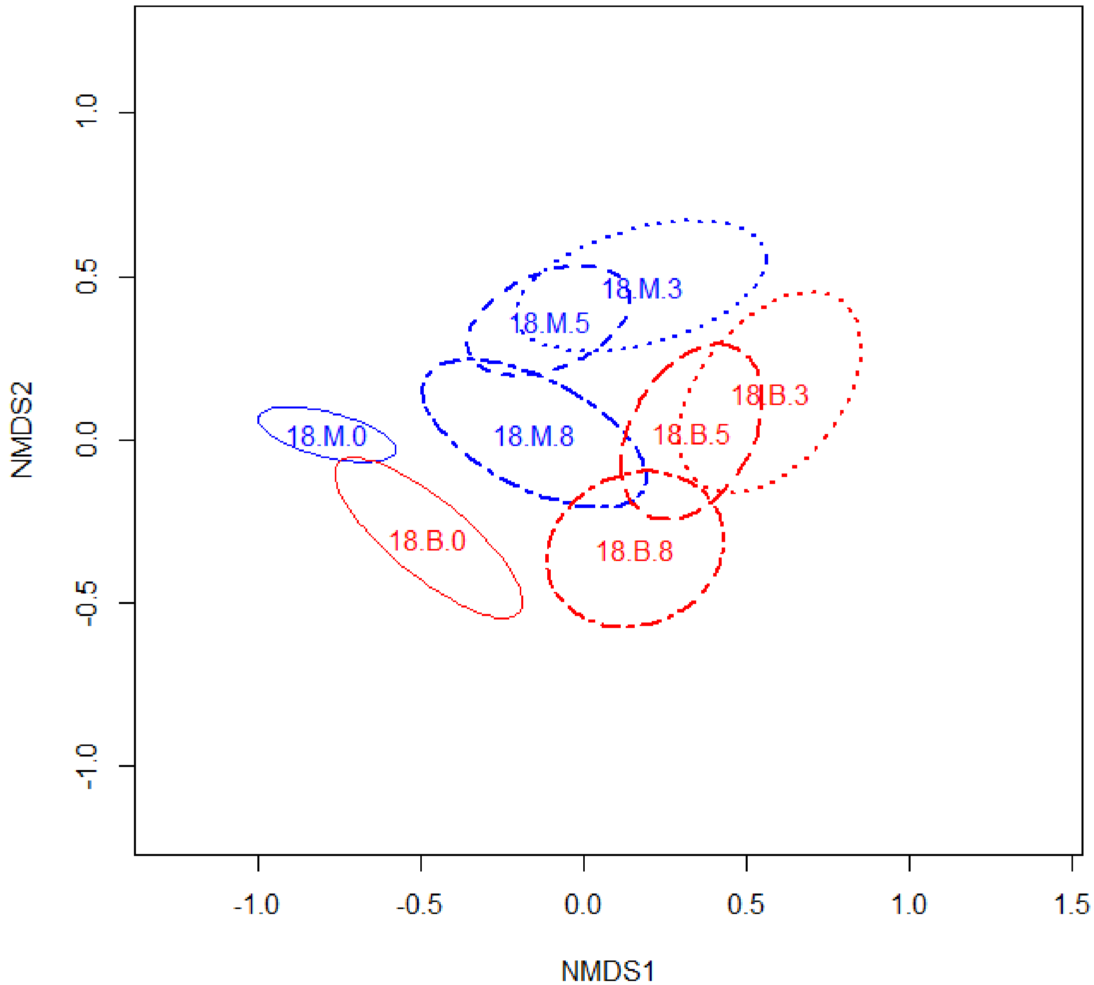

Figure 6-6. NMDS Ordination Plot of Shrub Association Structure (95 Percent Confidence Ellipsoids) on Unit 18 With Respect to Time. Burned Transects are Indicated by Red Ellipses and Masticated Transects by Blue Ellipses. The Central Code is Comprised of the Unit, Treatment and Age.

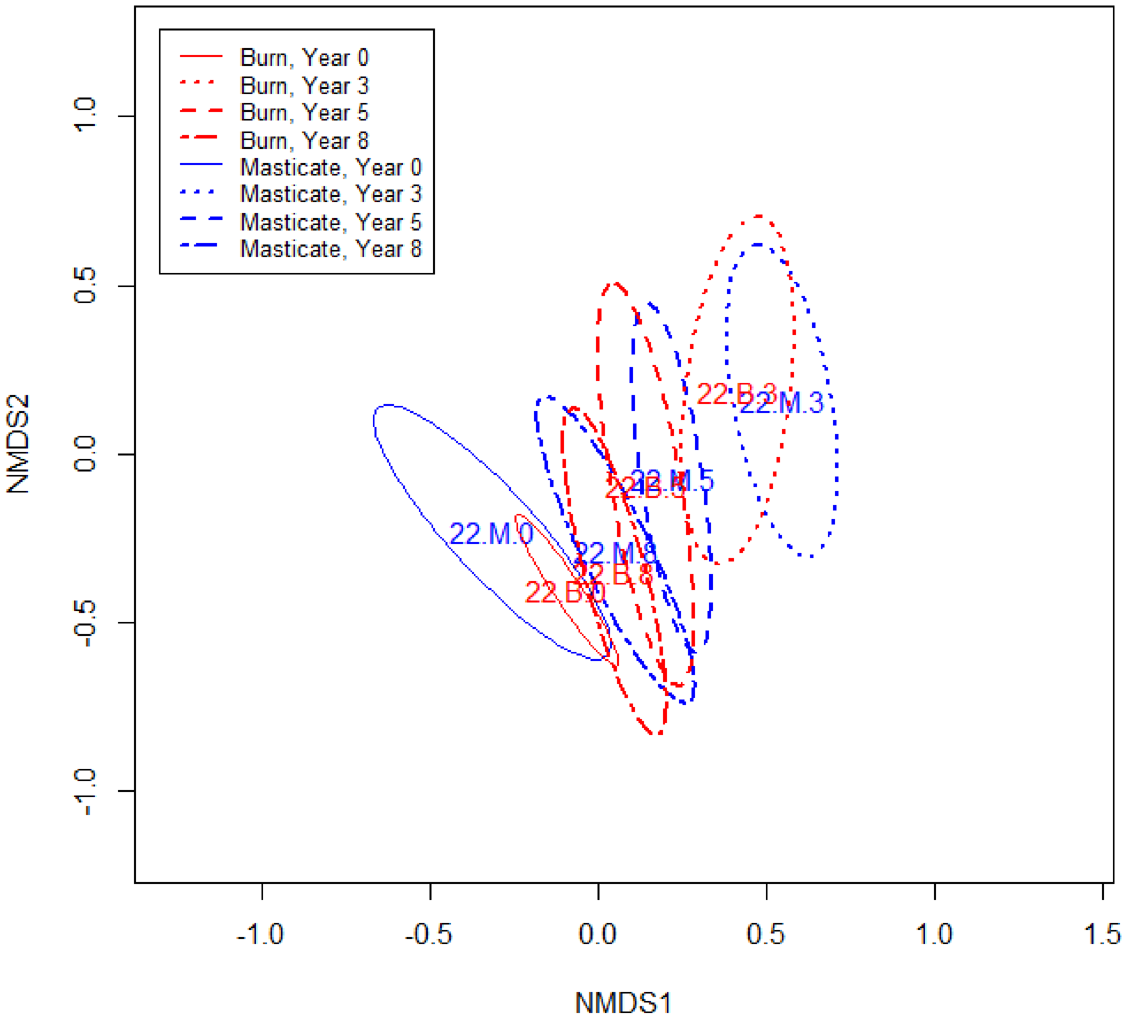

Figure 6-7. NMDS Ordination Plot of Shrub Association Structure (95 Percent Confidence Ellipsoids) on Unit 22 With Respect to Time. Burned Transects are Indicated by Red Ellipses and Masticated Transects by Blue Ellipses. The Central Code is Comprised of the Unit, Treatment and Age. Ordination Space is the Same as Shown in Figure 6-6.

6.3.2 Annual Grass Monitoring

Annual grasses were not surveyed in Units 18 and 22 in 2016, because surveys were not conducted in the baseline year.

6.3.3 Invasive Species Monitoring

A single patch of iceplant was observed within the northern mastication buffer of Unit 18 (Figure C-13).

7 Macroplot Survey

7.1 Introduction

Macroplot surveys were first proposed in the *Revised Protocol for Conducting Vegetation Monitoring* (Tetra Tech and EcoSystems West, 2015b). Additional guidance on the implementation of macroplot sampling for 2016 is provided in *Addendum to Revisions of Survey Protocol for HMP Annual Plants: Implementation of Macroplot Sampling at Former Fort Ord* (Tetra Tech and EcoSystems West, 2016). The objective of the macroplot sampling is to provide a means to assess changes in the distribution of HMP annual species in response to treatment. This is accomplished by evaluating the number of grids containing the HMP species within each macroplot.

It was hypothesized that the HMP annual species would expand outward from the quantitatively sampled grid at the center of a macroplot once mastication or fire had removed the shrub cover that shaded the HMP annuals. This expansion in distribution would be detected by noting the presence or absence of the species in the surrounding grids within a macroplot.

In this section, we analyze the data from the macroplot surveys using two approaches. The first approach (macroplot level) examines changes in distribution within macroplots between the baseline conditions and the 2016 macroplot survey results. This approach determines if the distributions of the HMP annual species change after treatment.

The second approach (occupancy analysis) attempts to identify the factors that affect the distribution of the HMP annual species using the 2016 macroplot survey results. This approach examines the extent that age, treatment, or density of the species in the central macroplot grid control the distribution of HMP annual species.

7.2 Methods

7.2.1 Macroplot Selection

Macroplots consisted of nine standard 100 x 100-ft sampling grids, arranged in a 3 by 3 square, and centered on a grid that was sampled for HMP density. The presence or absence of each of the three HMP annual plants was determined in each of the grids within a macroplot.

Macroplots were selected based on the following rules:

1. Macroplot center points will be randomly selected from the grids selected for quantitative density sampling for HMPs.

2. Initial detection frequencies (number of grids out of 9 grids within the macroplot that were occupied) for all possible macroplots within a unit were estimated based on the results of the meandering transects. This provides the baseline (Year 0) estimate of detection frequency.

3. Macroplots will be selected from those potential macroplot locations which have a baseline detection frequency of 5/9 or less.

4. Macroplots may not overlap.

5. For macroplots that are established along boundaries (either unit or treatment), the position/shape of the macroplot may be adjusted to ensure that it remains within the subject area.

6. Macroplot size will be maintained at nine grids.

7. There was no stratification by treatment type (i.e., mastication or burning) within a unit when selecting macroplots.

8. There was no stratification by HMP annual species.

A total of 34 macroplot locations were selected for sampling in 2016 (see Figure 7-1). This number was based on a minimum sample size of 10% of the quantitative HMP grids, plus three additional macroplots in units with larger numbers of grids. The randomly selected macroplots were mapped, and then reviewed for suitability. Macroplots that were located in unsuitable areas (e.g., steep slopes) were eliminated and replaced with other randomly selected locations. Four alternate macroplot locations were also identified in Units 28 and WGBA. Maps showing final macroplot locations along with Baseline year density classes for each Unit are provided in Appendix D.

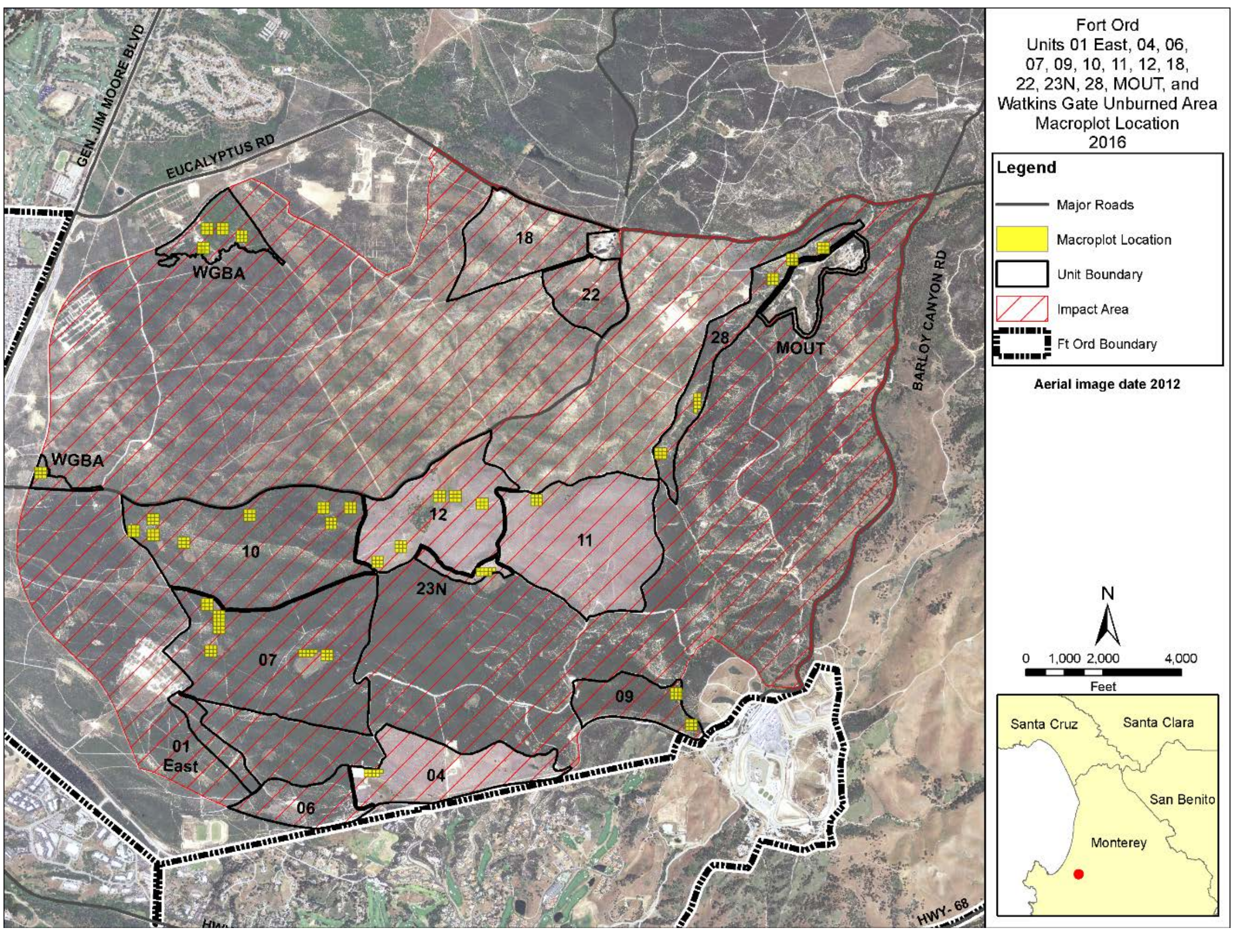

Figure 7-1. Locations of Macroplots Surveyed in 2016

In the field, the survey team walked every grid within each macroplot and recorded whether each of the three HMP annual species was present within the grid. Each grid is treated as a separate observation of the presence of the HMP annual species in a macroplot.

7.2.2 Statistical Approach

Changes in distribution of HMP annual species are characterized by changes in the number of individual grids in which the species is present within a macroplot. The analysis was conducted using two approaches. In the first approach (macroplot-level), the data were analyzed on a macroplot basis based on the fraction of grids with the HMP species within each macroplot. In the second approach (occupancy analysis) the presence or absence of an HMP annual species in individual grids within macroplots were analyzed, as well as the mechanisms affecting presence or absence.

7.2.2.1 Power Analysis

The ability to detect changes between years in the average frequency of occurrence of HMP species within macroplots was evaluated in the *Addendum to Revisions of Survey Protocol for HMP Annual Plants: Implementation of Macroplot Sampling at Former Fort Ord* by assuming theoretical distributions of the change (Tetra Tech and EcoSystems West, 2016). This analysis is revisited in the present report using the observed changes between baseline (meandering transects) and 2016 observations.

For each macroplot and HMP species (except seaside bird's-beak), the change in the number of occupied grids was calculated by subtracting the number of occupied grids in each macroplot in the Baseline survey from the number observed in the 2016 survey. The average change in each Age-class was then subtracted from the individual changes in the macroplots to provide the distribution of deviations from the mean. These deviations were then evaluated using quantile-quantile plots (Q-Q plots; see Appendix F) to assess agreement with the normal distribution and to allow comparison of the variances of the distributions.

Bootstrapping was used to evaluate the power to detect a true difference of 1, 2, or 3 grids between surveys. For each difference, 1000 samples were selected based on the observed deviations from the mean, with replacement. Each sample consisted of between 3 and 20 observations. Power was estimated as the number of times out of the 1000 samples that the null hypothesis of no change in average number of occupied grids per macroplot was correctly rejected at $\alpha = 0.1$ (i.e., the 90% confidence interval did not overlap 0).

7.2.2.2 Macroplot Level Analysis

2016 was the first year of the macroplot surveys, and therefore there is no earlier set of observations to allow evaluation of changes in frequency of occurrence of HMPs in grids within macroplots. To fill this data gap, the results from the baseline meandering transects (see Section 2.2 for a description of methodology) in each unit were used to construct an estimate of the frequency of occurrence of each species in the surveyed macroplots during the baseline survey (Year 0). Since the purpose of these meandering transects was to identify areas with HMP annual species, and the meandering transects were implemented rapidly, the estimated frequency of occurrence of the HMP species may be underestimated.

The analyses conducted at this level used the results from the 34 sampled macroplots to estimate frequency of occurrence within macroplots. Data were summarized by calculating mean frequency of occurrence for different groups of macroplots based on age and treatment. Analysis of variance (ANOVA) was used to assess differences between these groups.

7.2.2.3 Occupancy Analysis

The statistical technique of occupancy analysis is used to simultaneously analyze two components:

1. Occupancy – the proportion of the total macroplots that support an HMP annual species, and
2. Detectability – the probability of detecting an HMP annual species given that the macroplot is occupied. Each grid within the macroplot is treated as an independent observation of the presence of the species. Hence the number of grids supporting the HMP species is an indication of the detectability.

As described in Section 7.2.1, macroplots were selected such that they were known to contain at least one HMP annual species. As a result, occupancy is expected to be high, especially for the Monterey spineflower. However, detectability was expected to be variable, and is a measure of the species distribution within a macroplot. Because the intent of the macroplot survey was to assess changes in distribution (as indicated by the presence/absence of the species in individual grids within a macroplot), effort focused on estimating detectability.

Detailed analysis of the macroplot occupancy data was conducted using the package *unmarked* in R statistical software (Fiske and Chandler, 2011; R Core Team, 2016). The analyses presented in this section were conducted using the function *occu()* which models the two components of species occupancy and probability of detection (MacKenzie *et al.*, 2002). This function allows covariates (e.g., treatment type, age class, and density class) to be used to estimate model parameters.

Each species was analyzed independently. The analysis began by fitting a null model which did not contain any covariates for either occupancy or detectability. This model yields estimates of the total occupancy (portion of macroplots supporting the species) and the average detectability across all macroplots (number of grids supporting the species divided by the total number of grids). Occupancy was held constant for the null model.

The analysis then proceeded by fitting various models to estimate detectability using combinations of covariates including plot age (i.e., time since treatment), treatment type, and density class in the central grid. Models included single covariates as well as combinations of covariates.

Once the models were fitted to these data, they were compared using the Akaike Information Criterion (AIC) to select the most efficient model (Akaike, 1974). The AIC is a measure of the relative quality of statistical models for a given set of data, it is not an absolute measure of fit. Once the “most efficient” model was selected based on the AIC, the significance of the individual covariates on the predicted detectability was evaluated. Once the final model was selected, the *predict()* function was used to provide data to graph the results.

7.3 Results and Discussion

Monterey spineflower was observed in 33 of the 34 macroplots, and sand gilia was observed in 17 of the 34 macroplots in 2016. However, only two macroplots supported seaside bird’s-beak. Five grids with seaside bird’s-beak were present in macroplot A2I4I3, and one grid with seaside bird’s-beak was present in macroplot B2B6J0 (see Figure D-9, Unit 7; see Figure D-12, Unit 10).

7.3.1 Power Analysis

The number of occupied grids in each macroplot in the baseline and 2016 surveys for Monterey spineflower and sand gilia are presented in Table 7-1. Power analysis was not conducted for seaside bird's-beak due to its limited occurrence. Table 7-2 summarizes the average change in the number of grids per macroplot in which either the Monterey spineflower or sand gila was present.

The Q-Q plot analysis indicated that, for each species, the variances did not differ between Age classes. Therefore the data were pooled across the three Age classes. The slopes of the Q-Q plots were different for the Monterey spineflower and sand gilia; therefore the species were evaluated separately. The sand gilia data also contained a number of macroplots in which the species was absent in both the baseline and 2016 surveys, suggesting that those macroplots did not support suitable habitat for the sand gilia. These macroplots were removed from the data set used to estimate power.

The results of these simulations are presented in Figure 7-2 (Monterey spineflower) and Figure 7-3 (sand gilia). The power to detect an average difference of 1 grid is small for all sample sizes and both species. Whereas, a sample size of 7 macroplots would be able to detect a difference of 2 grids with a power of 0.6 for both species. Power would exceed 0.8 for a sample size of 6 macroplots and a difference of 3 grids. The comparison of the Baseline and 2016 surveys (Table 7-2) suggests that an average change of 2.2 to 2.5 grids should be expected.

Table 7-1. Number of Grids Containing HMP Species within Each Macroplot

Unit	Macroplot	Age	Treatment	Monterey Spineflower		Sand Gilia	
				Baseline	2016	Baseline	2016
Unit 23N	B3A1C2	1	M	1	6	0	0
Unit 28	B3D5D7	1	M	5	5	0	0
Unit 28	B3E6H6	1	M	7	8	1	9
Unit 28	B3H8I6	1	M	5	4	1	4
Unit 28	B3I9D1	1	M	5	7	2	8
Unit 28	B3I9G9	1	M	5	5	3	5
Unit 9	A3G6D5	1	M	1	0	0	0
Unit 9	A3H6B1	1	M	3	5	0	0
Unit 10	B2B2C6	3	B	3	5	0	6
Unit 10	B2B2D1	3	B	2	2	0	2
Unit 10	B2B2G6	3	B	5	6	3	8
Unit 10	B2B3A4	3	B	4	9	0	9
Unit 10	B2B5H1	3	B	4	6	0	0
Unit 10	B2B6J0	3	B	2	1	0	7
Unit 10	B2B7F2	3	B	5	8	1	9
Unit 10	B2B7J7	3	B	2	7	0	3
Unit 7	A2I4C1	3	B	4	7	0	0
Unit 7	A2I4I3	3	B	3	9	0	4
Unit 7	A2I6B6	3	B	2	6	0	0
Unit 7	A2I7B1	3	B	4	1	0	0
Unit 7	A2J3E0	3	B	4	2	0	0
Unit 7	A2J4B3	3	B	2	9	0	0
WGBA	B1C9I7	3	M	4	9	0	1
WGBA	B2I3G9	3	M	5	7	0	1
WGBA	B2I4J9	3	M	5	5	0	0
WGBA	B2J3B0	3	M	1	6	0	0
WGBA	B2J4B4	3	M	4	5	0	0
Unit 11	B3C2B5	5	M	3	3	0	0
Unit 12	B2A8F4	5	M	2	8	1	6
Unit 12	B2A8J0	5	M	4	6	2	7
Unit 12	B2C0C4	5	M	2	6	3	5
Unit 12	B2C9C0	5	M	5	8	0	0
Unit 12	B3C1A1	5	M	2	2	0	0
Unit 4	A2F8A2	5	B	2	5	0	0

Table 7-2. Average and Range of Differences in Number of Occupied Grids Between Baseline and 2016 Surveys for Monterey Spineflower and Sand Gilia by Age Class.

Age Class	Monterey Spineflower			Sand Gilia		
	Minimum	Average	Maximum	Minimum	Average	Maximum
1	-1	1	5	0	2.3	8
3	-3	2.3	7	0	2.4	9
5	0	2.5	6	0	1.7	5

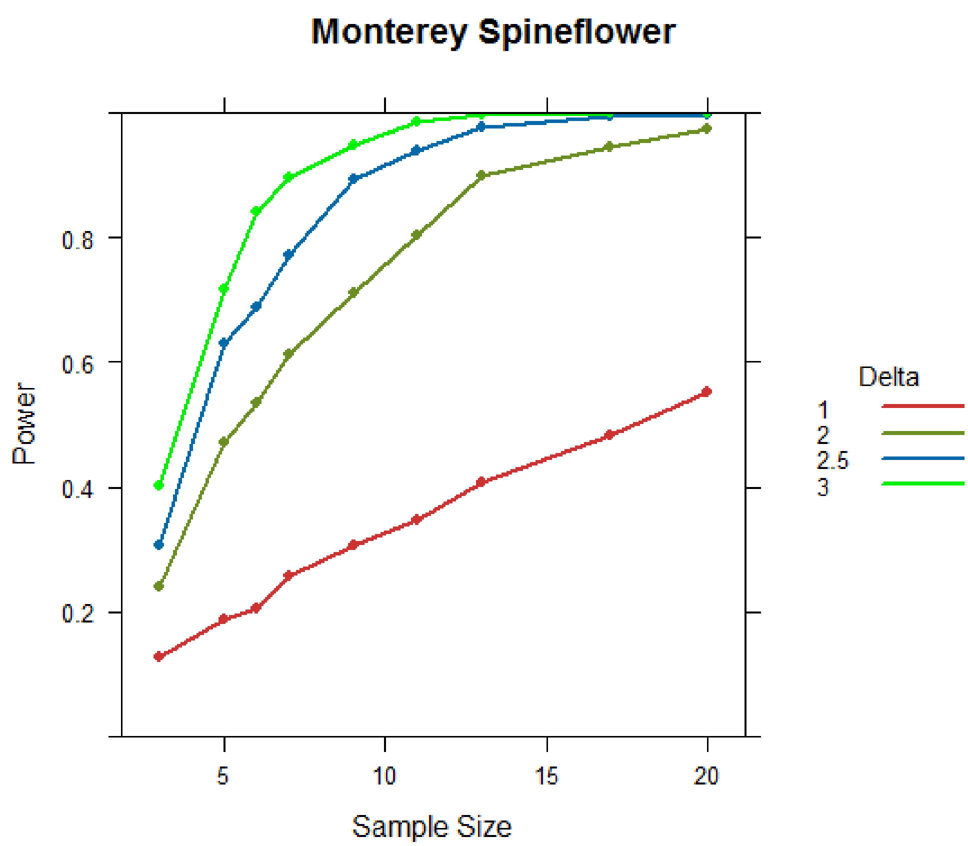

Figure 7-2. Power Curves for Monterey Spineflower for Detectable Differences of 1, 2, and 3 Grids, as well as the observed average change.

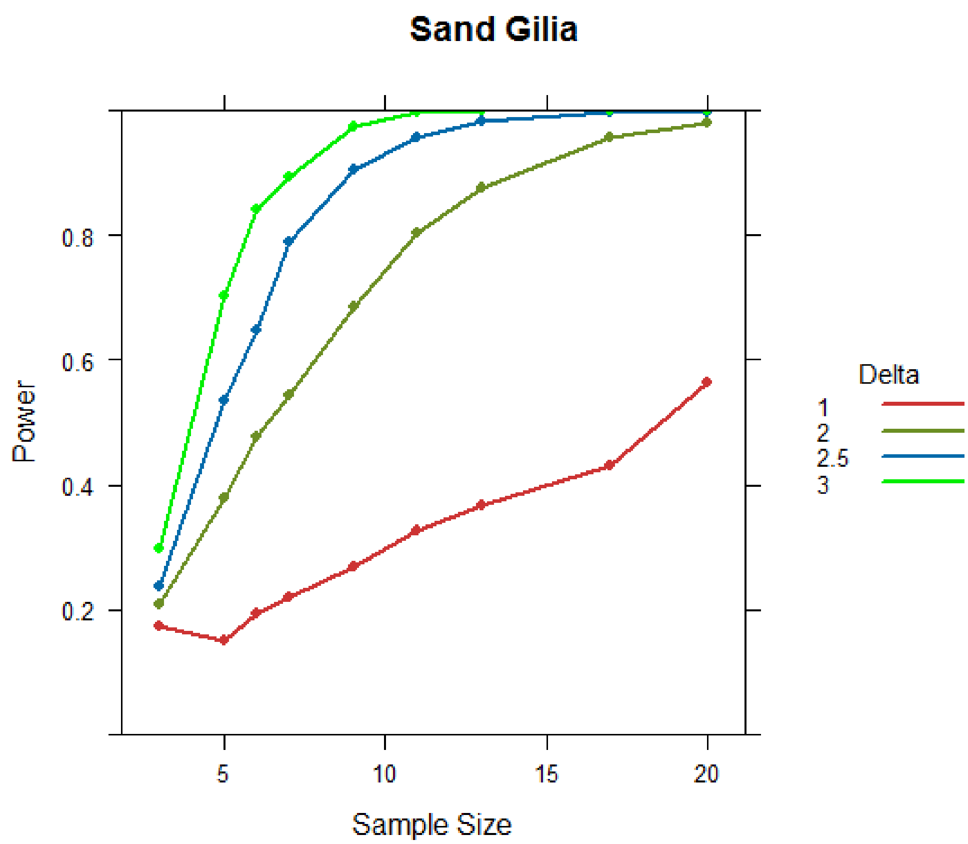

Figure 7-3. Power Curves for Sand Gilia for Detectable Differences of 1, 2, and 3 Grids, as well as the observed average change.

7.3.2 Macroplot Level Analysis

The objective of the macroplot level analysis is to determine whether there were changes in the species distribution (frequency of occurrence within a macroplot) between the baseline and 2016 surveys. Both Monterey spineflower and sand gilia generally exhibited substantial increases in distribution between the Baseline and 2016 surveys although timing differed. In addition, burned macroplots exhibited a slightly higher fraction of occupied grids than did masticated macroplots.

The macroplot data were summarized to partition the frequency of occurrence of HMP species between burn and mastication treatments over all 34 macroplots (see Table 7-3). Approximately equal numbers of macroplots had been burned (15), or masticated (19). The HMP species tended to have a greater frequency of occurrence in macroplots that had been burned as compared to those macroplots that had been masticated.

Table 7-3. Macroplot Occupancy and Frequency of HMP Occurrence in Macroplot Grids for the 2016 Macroplot Survey

Species	Number of Macroplots Occupied	Treatment (average fraction of grids occupied)		Overall Average Fraction Grids Occupied
		Burned	Masticated	
Monterey spineflower	33 / 34	0.64	0.61	0.61
Sand gilia	17 / 34	0.37	0.27	0.31
Seaside bird's-beak	2 / 34	0.05	-	0.02

Average frequency of occurrence in the macroplots in each age class was estimated for Monterey spineflower and sand gilia. Seaside bird's-beak was not observed in any of the baseline grids associated with the macroplots. A comparison of the fraction of grids occupied by Monterey spineflower in the baseline and 2016 surveys for each age class is provided in Table 7-4. In the baseline years, Monterey spineflower was present, on average, in slightly more than one-third of the grids within each macroplot. However, due to lower effort in the baseline meandering transects, the fraction of grids occupied may be underestimated. In 2016, this species was present in 57% to 65% of the grids within the macroplots.

Table 7-4. Average Frequency of Occupied Grids by Monterey Spineflower in Baseline and 2016 Macroplot Surveys

Age Class in 2016	Number of Macroplots	Baseline Frequency of Occurrence	2016 Frequency of Occurrence
Year 1 Units	10	0.41	0.57
Year 3 Units	19	0.38	0.64
Year 5 Units	5	0.33	0.60

Monterey Spineflower

There is substantial variability in frequency of occurrence of Monterey spineflower between macroplots in the different age classes (see Figure 7-4). However, a general trend of increasing frequency of occurrence can be observed. In 2016, only one macroplot did not contain Monterey spineflower.

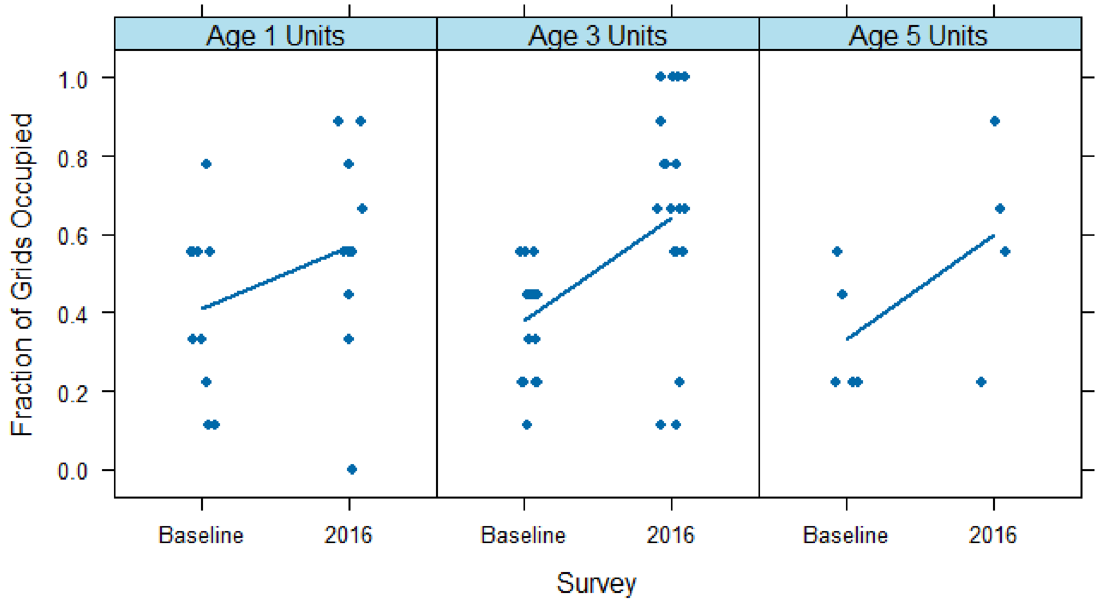

Figure 7-4. Monterey Spineflower Frequency of Occurrence During Baseline and 2016 Macroplot Surveys

In order to determine whether this variability could be affecting the apparent trends, ANOVAs were conducted for each age class to determine if differences between years were statistically significant (see Table 7-5). No significant differences in frequency of occurrence were observed in the Age 1 Units between the baseline survey (2015) and the Year 1 survey in 2016 (p=0.18). The results of the ANOVA on Age 3 units showed a significant increase in frequency of occurrence (p=0.001) between Baseline and Year 3 surveys. However, differences in frequency of occurrence between surveys in the Age 5 units were marginally significant, possibly due to the relatively small sample size (p=0.075; n=5). These results suggest that Monterey spineflower increases slowly in distribution peaking in Year 3 and starting to decrease in Year 5.

Table 7-5. Summary of ANOVAs of Monterey Spineflower Frequency of Occurrence Between Baseline and 2016 Surveys

Units	Baseline Year	# Macroplots	Probability of Effect
Age 1 Units	2015	10	p = 0.18
Age 3 Units	2013	19	p = 0.001
Age 5 Units	2011	5	p = 0.075

Sand Gilia

Sand gilia was absent from 17 of the 34 macroplots in both the baseline and 2016 surveys (Table 7-3). This suggests that the habitat was not suitable for sand gilia at these locations. Therefore those macroplots have been removed from the dataset analyzed for changes in distribution.

A comparison of the frequency of occurrence of sand gilia in the baseline and 2016 surveys for each age class is provided in Table 7-6. In the baseline years, sand gilia was present in 28%, or less, of macroplot grids with suitable habitat. However, in 2016 frequency of occurrence ranged from 56% to 71% of the grids.

Table 7-6. Average Frequency of Occupied Grids in Baseline and 2016 Macroplot Surveys for Those Macroplots that Supported Sand Gilia

Age Class in 2016	Number of Macroplots	Baseline Frequency of Occurrence	2016 Frequency of Occurrence
Year 1	5	0.17	0.71
Year 3	10	0.04	0.56
Year 5	2	0.28	0.67

There is substantial variability in frequency of occurrence of sand gilia between macroplots in the different age classes (see Figure 7-5). Similar to the Monterey spineflower, a general trend of increasing frequency of occurrence can be observed.

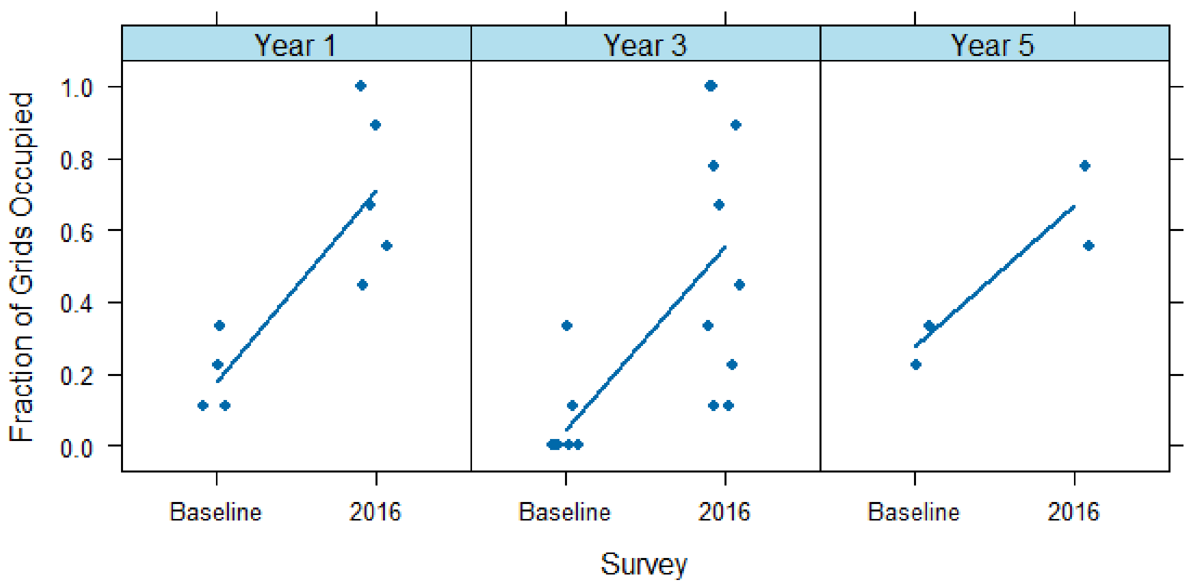

Figure 7-5. Sand Gilia Frequency of Occurence During Baseline and 2016 Macroplot Surveys. Macroplots that did not Support Sand Gilia in Either the Baseline or 2016 Surveys Are Removed from the Analysis.

ANOVAs were also conducted on the sand gilia data to assess differences between the baseline and 2016 surveys (see Table 7-7). The Age 1 units exhibited significant differences between surveys (p=0.001). The results of the ANOVA on Age 3 units showed a significant increase in detectability (p=0.0003). The Age 5 Units exhibited a marginally significant difference in frequency of occurrence between the baseline and 2016 surveys (p=0.09). However, only two Year 5 macroplots supported sand gilia in either the Baseline or 2016 survey. These results suggest that sand gilia expands rapidly in Years 1 and 3.

Table 7-7. Summary of ANOVAs of Sand Gilia Frequency of Occurrence Between Baseline and 2016 Surveys for Each Age Class

Units	Baseline Year	# Macroplots	Probability of Effect
Age 1 Units	2015	5	p = 0.001
Age 3 Units	2013	10	p = 0.0003
Age 5 Units	2011	2	p = 0.09

7.3.3 Occupancy Analysis

The second approach to analyzing the macroplot results involved the use of occupancy analysis (MacKenzie *et al*., 2002). Occupancy analysis was conducted independently for each species to assess the effects of Age, density class, and treatment on detectability within macroplots. This technique allows more detailed analysis of the factors affecting detectability. For both Monterey spineflower and sand gilia, density class of the species in the central grid was the most important factor affecting the detectability (number of grids occupied per macroplot). In addition, sand gilia exhibited a decrease in detectability in Year 5.

Monterey Spineflower

The null model for the Monterey spineflower provided an occupancy estimate of 1 (all macroplots were occupied) and a probability of detection of 0.61, both of which conformed to the initial data summary (Table 7-3). Six additional models were then constructed to allow evaluation of effects of the covariates on probability of detection of Monterey spineflower (Table 7-8).

Table 7-8. AIC Table Showing All Models. The Most Efficient Model for Monterey Spineflower Contained Only the Density of the Central Grid as a Covariate. The Number of Parameters for Nominal Categorical Covariates Include Dummy Variables, Where *n*-1 Parameters are Used for Each Variable. The Number of Parameters for Ordinal Categorical Covariates do not Include Dummy Variables. The Covariates *Treatment* and *Age* Were Treated as Nominal While *Density* Was Treated as Ordinal for This Analysis.

Covariates	Number of Parameters	AIC	Delta	AIC weight	Cumulative weight
Density	3	365.49	0.00	0.59	0.59
Density, Treatment	4	367.43	1.94	0.22	0.81
Density, Age	5	368.54	3.05	0.13	0.94
Density, Age, Treatment	6	369.95	4.46	0.063	1.00
Treatment	3	405.13	39.64	$1.4 * 10^{-9}$	1.00
Age	4	407.18	41.70	$5.2 * 10^{-10}$	1.00
Null	2	412.05	46.56	$4.5 * 10^{-11}$	1.00

For the Monterey spineflower, the most efficient model, as indicated by the AIC, included only the density class in the center grid at the time of sampling. The ANOVA table for the effect of density class on detectability indicated a significant relationship between density class and probability of detection (Table 7-9 and Figure 7-6). The effect of treatment on detectability in the second most efficient model was not significant. Therefore, the first model was selected.

Table 7-9. Effect of Covariates in the Most Efficient Model on Detectability of Monterey Spineflower

Covariate	Coefficient	p
(Intercept)	-0.68	0.007
Density class	0.60	<<0.001

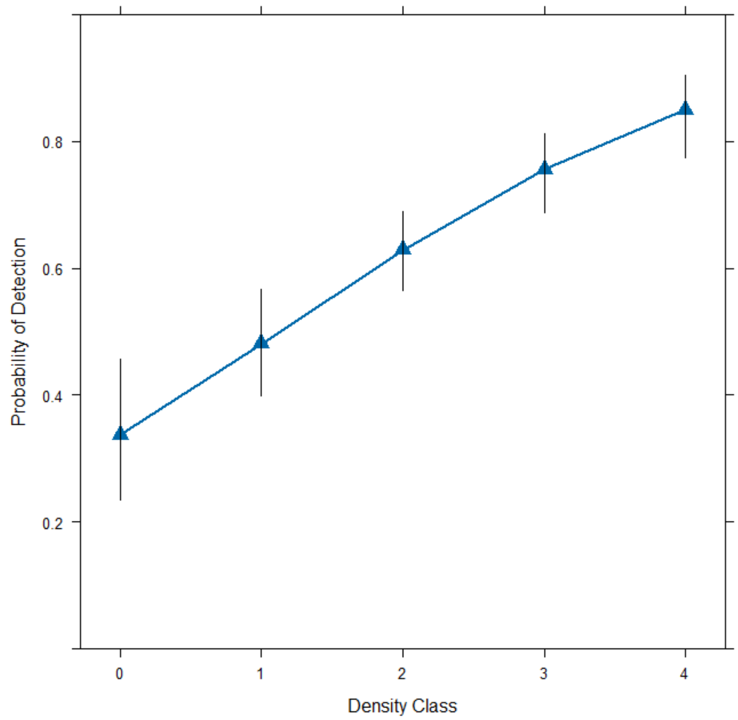

Figure 7-6. Relationship Between Probability of Detection of Monterey Spineflower Within a Macroplot and Density Class of Center Grid in 2016

Sand Gilia

A similar analysis was performed on the sand gilia data. The null model predicted an occupancy of 0.50, and a detectability of 0.614 (when the macroplot was occupied). Again, this corresponds with the initial data summary (Table 7-3). Six additional models were then constructed to allow evaluation of effects of the covariates on probability of detection of sand gilia (Table 7-10).

Table 7-10. AIC Table Showing All Models. The Most Efficient Model for Sand Gilia Contained Only the Density of the Central Grid as a Covariate. The Number of Parameters for Nominal Categorical Covariates Include Dummy Variables, Where *n*-1 Parameters are Used for Each Variable. The Number of Parameters for Ordinal Categorical Covariates do not Include Dummy Variables. The Covariates *Treatment* and *Age* Were Treated as Nominal While *Density* Was Treated as Ordinal for This Analysis.

Covariates	Number of Parameters	AIC	Delta	AIC weight	Cumulative weight
Density, Age	5	208.82	0.00	0.64	0.64
Density, Age, Treatment	6	210.00	1.17	0.36	1.00
Density	3	220.99	12.17	0.0015	1.00
Density, Treatment	4	221.48	12.65	0.0011	1.00
Null	2	255.15	46.33	$5.6 * 10^{-11}$	1.00
Treatment	3	255.57	46.75	$4.5 * 10^{-11}$	1.00
Age	4	255.79	46.97	$4.1 * 10^{-11}$	1.00

The most efficient model for detectability as indicated by the AIC included terms for both density and age. The ANOVA table for the effect of density class and age on detectability indicated a significant relationship between density class and probability of detection (Table 7-11 and Figure 7-7). Evaluation of the ANOVA table for the second model (density, age, treatment) indicated the treatment did not have a significant effect on probability of detection. Therefore the first model was selected. This analysis indicates that detectability increases with density class and that age has an effect. In Years 1 and 3, detectability is high, and there is no significant difference between the two years. However, detectability in Year 5 is substantially reduced compared to Years 1 and 3 (see Figure 7-7).

Table 7-11. Effect of Covariates on Detectability of Sand Gilia

Covariate	Coefficient	p
(Intercept)	-2.50	<<0.001
Density	2.72	<<0.001
Age(3)	-0.028	0.94
Age(5)	-3.31	<<0.001

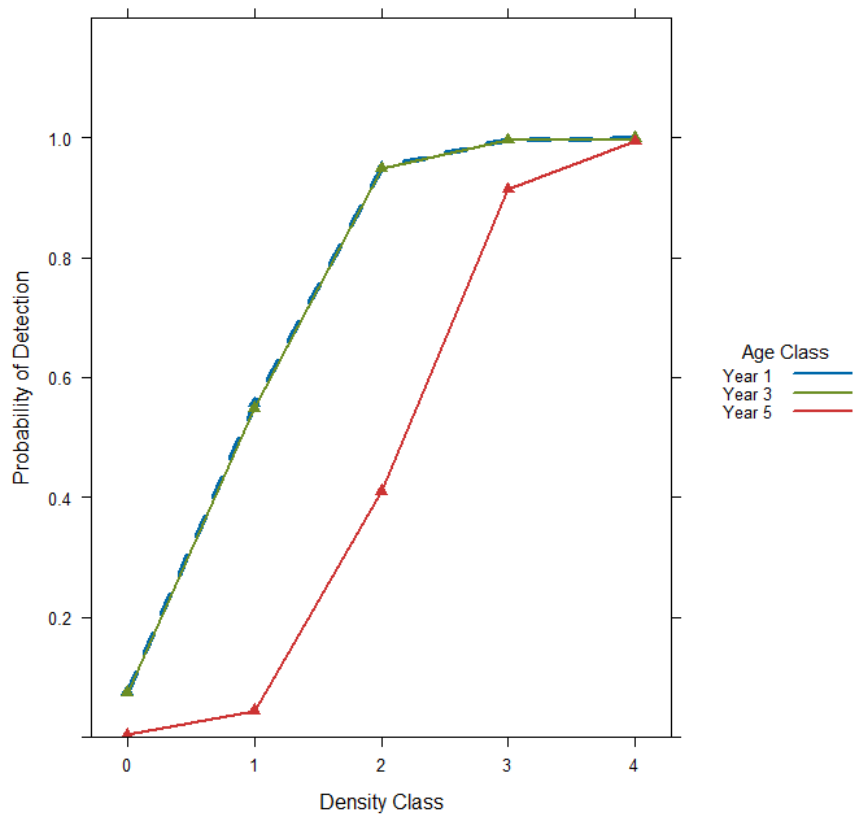

Figure 7-7. Relationship Between Probability of Detection of Sand Gilia Within a Macroplot and Density Class of Center Grid by Age of Plot

Seaside Bird's-Beak

The null model (no covariates) for seaside bird's-beak provided an estimate for occupancy of 0.061, and a probability of detection of 0.32, when the plant is present. These results conform to the summary results of the survey. Since only 2 macroplots supported seaside bird's-beak no further analysis was conducted on this species.

7.4 Macroplot Survey Conclusion

The results of the 2016 macroplot survey indicate that the number of individual grids within a macroplot that contain an HMP annual species (i.e., detectability) increased between the baseline surveys and 2016. Because the level of effort in the meandering transects conducted in the baseline surveys was potentially less than the level of effort made to identify plants in the 2016 macroplot survey, the detectability in these surveys may be slightly underestimated. Therefore, the magnitude of differences between the baseline surveys and the macroplot survey may be less than reported.

The occupancy analysis indicated that the detectability (as measure of distribution of the species) is primarily related to the density of the plant in the center grid of the macroplot. Treatment did not appear to have a significant effect on detectability. However, age did have an effect on the detectability of sand gilia. There was a high probability of detection in Years 1 and 3, whereas, the probability of detection decreased in Year 5. This suggests that either the distribution of sand gilia decreases in Year 5 potentially due to interactions with shrubs, or that the plant is more difficult to observe due to increased cover of shrub species.

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8 Conclusions

8.1 Sand Gilia, Seaside Bird's-Beak, and Monterey Spineflower Surveys

Between 2010 and 2015, 584 baseline HMP annual survey grids in 24 units were sampled following the vegetation sampling protocol. No baseline units were sampled in 2016. The Monterey spineflower occurred in 99% of these baseline grids (see Table 8-1). Sand gilia was the next most frequent HMP annual occurring in 25% of the baseline grids. In contrast, seaside bird's-beak occurred in only 1.5% (9 of 584) of the surveyed grids.

The results of surveys from HMP annual species on multiple units and for varying amounts of time have shown that these species continue to persist after vegetation clearance activities. In 2016, only the Year 3 surveys allowed comparison between treatments. Based on the Year 3 data, there does not appear to be a differential response of HMP species to treatment, with the exception of an increase in density of sand gilia in burned grids in Unit 10.

Table 8-1. Densities of HMP Annual Species in Baseline Grids (2010-2015)

Species	Frequency of Occurrence in Sampled Grids	Density Class (when present[1])	Density Class (overall[2])
Monterey spineflower	576	3.0	2.96
Sand gilia	146	1.4	0.36
Seaside bird's-beak	9	1.2	0.019

[1] Calculation does not include grids in which species was not present (density class 0).

[2] Calculation includes all sampled grids including those where species was absent.

In general, the observed densities and frequency of occurrence of these HMP annual species are consistent with the historic baseline conditions (see Table 8-1). However, Monterey spineflower tended to have slightly lower than average densities in 2016.

Sand gilia and Monterey spineflower vitality rates are both strongly correlated with rainfall (Fox *et al.*, 2006; Fox, 2007). Thus, the densities of these species would be expected to fluctuate between years in response to rainfall. In general, both species have increased survival and seed set during years of higher spring rainfall and temperatures. Seaside bird's-beak densities are also known to fluctuate dramatically between years based on rainfall and other weather patterns.

The *Revised Protocol for Conducting Vegetation Monitoring for Compliance with the Installation-Wide Multispecies Habitat Management Plan, Former Fort Ord, Monterey, California* (Tetra Tech and EcoSystems West, 2015b) provided specific success criteria for the re-establishment of HMP annual species after treatment. Comparisons of the survey data to these success criteria are provided in Table 8-2. The only criterion that could not be assessed was the comparison of the percentage of bare ground relative to baseline conditions, because no transect surveys were required in Year 1 units. However, given that bare ground continues to be present in high percentages in Year 3 and later units, it is likely that sufficient bare ground was present in Year 1 units to support HMP annual species.

Table 8-2. Evaluation of Success Criteria for HMP Annual Species

Year Class	Units	Criterion	Rationale	Pass/Fail
Year 1	Unit 09, 23N, 28, 11, 12	Frequency of HMP annual species > 90% of baseline frequency	Table 3-1 and Table 3-2	Pass
		Bare ground > Baseline condition	-	-
Year 3	Unit 01E, 06, 07, 10, WGBA, MOUT	Frequency of HMP annual species > 90% of baseline frequency	Table 4-1 to Table 4-3	Pass
		Bare ground > Baseline condition	Figure 4-3	Pass
Year 5	Unit 04, 11, 12	Frequency of HMP annual species > 90% of baseline frequency	Table 5-1 and Table 5-2	Pass
		Bare ground > Baseline condition	Figure 5-3	Pass

8.2 Macroplot Survey

The macroplot analysis examined data from the 2016 survey, supplemented with data obtained from the original meandering transects in each unit. Initial comparisons of the frequency of occupied macroplot grids supporting HMP species indicate increases in their distributions between baseline and 2016 surveys. This is consistent with the hypothesized response. This response was most pronounced in the Year 3 units, which exhibited highly significant difference for both Monterey spineflower (see Table 7-5) and sand gilia (see Table 7-7). However, since each year class had a different baseline survey year and consisted of different units, temporal patterns of grid occupancy across year classes should be treated with caution.

The detailed occupancy analysis results of the 2016 macroplot survey indicated that the density of the species in the center grid of the macroplot was a good predictor of HMP species detectability (i.e. number of grids occupied). For the Monterey spineflower, the age of the macroplot was not an important contributor to detectability. In contrast, age (Year 5) reduced the probability of detection of sand gilia within a macroplot (see Figure 7-7). No difference was detected in the response to burning as compared to mastication.

When additional years of data are accumulated for these macroplots, it will be possible to expand on these analyses. This will allow a more complete assessment of the rates of colonization and extinction of the HMP species within the macroplots. Tools including the function *colext()* in the *unmarked* package are designed for this type of analysis (Fiske and Chandler, 2011).

8.3 Vegetation Transect Survey

Results of the shrub community structure analyses reaffirm the results of the previous surveys. Year classes 5 and 8 showed a progressive change in community structure, returning towards the baseline assemblage in the ordination plots. This pattern has been observed in every monitoring year since 2010 and reflects predictable successional changes in the shrub community. In addition, the ordination plots provided the ability to distinguish between treatments in community structure. Treatment-related effects were observed in the Year 3 ordination. In the Year 8 Units, treatment effects were seen in the ordination results for Unit 18, whereas no treatment-related effects were observed in the adjacent Unit 22. The effects of treatment cannot be assessed for the Year 5 Units as they were all masticated, and not burned.

In contrast to the ordination results, standard summary community metrics (total cover, diversity, species richness) were generally insensitive to treatment. Treatment-related effects were noted in total cover of Year 3 Unit transects, but were not detected in diversity or species richness. No treatment-related effects were detected in measures of total cover, diversity, or species richness in Year 8 Units.

The *Revisions of Protocol for Conducting Vegetation Monitoring for Compliance with the Installation-Wide Multispecies Habitat Management Plan, Former Fort Ord, Monterey, California* (Tetra Tech and EcoSystems West, 2015b) identified success criteria for recovery of the shrub community in each year that shrub monitoring occurred. Criteria for Year 3 and Year 5 shrub communities are provided in Table 8-3.

Table 8-3. Evaluation of Success Criteria for Shrub Community in Year 3 and Year 5

Year Class	Unit	Criterion	Rationale	Pass/Fail
Year 3	Unit 01E, 06, 07, 10, WGBA, MOUT	Native sub-shrubs > 20% cover	Figure 4-9	Pass
		Bare ground > baseline	Figure 4-3	Pass
		Invasive plants < 10% cover	-	Pass
Year 5	Unit 04, 11, 12	Observation of community recovery	Figure 5-4 to Figure 5-7	Pass

As part of the *Revised Protocol* development, a series of three major shrub associations were identified based on dominant species present in the baseline survey (Tetra Tech and EcoSystems West, 2015b). Recovery was predicted to differ among these associations. Therefore, more detailed success criteria for each of the associations, as well as criteria for the amount of bare ground and cover of invasive species were developed for the Year 8 survey. These criteria are evaluated in Table 8-4. All specified criteria were met in Year 8. In addition, overall community structure has continued to move towards baseline conditions (see Figure 6-6 - Figure 6-7).

Table 8-4. Evaluation of Success Criteria for Dominant Chaparral Shrub Associations on Fort Ord in Year 8

Plant Association	Criterion	Unit	Baseline value	Year 8 value	P/F
A – ARTO dominated	Average cover of ARTO > 30% of baseline cover	22	57.7%	36.4%	Pass
	Frequency of dwarf ceanothus > 70% of baseline cover	22	0%	33%	Pass
	Frequency of Monterey ceanothus > 70% of baseline cover	22	100%	100%	Pass
B – ADFA dominated	Average cover of ADFA > 30% of baseline cover	18	39.7%	32.6%	Pass
		22	48.9%	54.8%	Pass
	Frequency of dwarf ceanothus > 70% of baseline frequency	18	0%	0%	Pass
		22	0%	0%	Pass
	Frequency of Monterey ceanothus > 70% of baseline frequency	18	50%	100%	Pass
		22	100%	100%	Pass
C/D – ARPU dominated	Average cover of ADFA > 30% of baseline cover	18	100%	86%	Pass
		22	100%	100%	Pass
	Frequency of dwarf ceanothus > 70% of baseline frequency	18	7%	50%	Pass
		22	0%	0%	Pass
	Frequency of Monterey ceanothus > 70% of baseline frequency	18	53%	79%	Pass
		22	33%	33%	Pass
Bare ground	Bare ground > 90% of baseline cover	18	23.2%	36.3%	Pass
		22	18.7%	23.7%	Pass
Invasive plants	Invasive plants < 10% cover per transect	18	-	Not present	Pass
		22	-	Not present	Pass

8.4 Annual Grasses

Annual grasses were generally present along the edges of roads, masticated areas, and other disturbed areas, and occasionally extend somewhat into the interior of the study sites. Although there are some localized areas of high annual grass density in cleared fuel break areas, overall it does not appear that colonization by annual grasses is a major problem in these areas.

Response of annual grasses varied between year classes and units. The cover of annual grasses increased in Year 3 Units 7 and 10 in 2016, whereas the annual grass cover remained constant in the MOUT (see Table 4-8).

The Year 5 Unit 4 showed a decrease in cover and density of annual grasses as compared to the Year 3 survey (see Table 5-7).

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APPENDIX A

SPECIES ACRONYMS

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Table A-1. Species Acronyms, Former Fort Ord

Acronym	Scientific Name	Common Name	Life Form
ACME	*Acacia melanoxylon*		
ACMI	*Achillea millefolium*		
ADFA	*Adenostoma fasciculatum*	chamise	shrub
AGXX	*Agoseris* sp.		
AICA	*Aira caryophyllea*		
AMMEI	*Amsinckia menziesii* var. *intermedia*		
ANAR	*Anagallis arvensis*		
ARCA	*Artemisia californica*		
ARHO	*Arctostaphylos hookeri* ssp. *hookeri*	Hooker's manzanita	shrub
ARMO	*Arctostaphylos montereyensis*	Monterey manzanita	shrub
ARPU	*Arctostaphylos pumila*	sandmat manzanita	shrub
ARPY	*Artemisia pycnocephala*		
ARTO	*Arctostaphylos tomentosa* ssp. *tomentosa*	shaggy-barked manzanita	shrub
ASXX	*Asteraceae*	unidentified Asteraceae	
AVBA	*Avena barbata*		
BAPI	*Baccharis pilularis*	coyote brush	shrub
BEPI	*Berberis pinnata*		
BRDI	*Bromus diandrus*		
BRHO	*Bromus hordeaceus*		
BRMA	*Briza maxima*		
BRMAR	*Bromus madritensis* ssp. *rubens*		
BRMI	*Briza minor*		
CABR	*Carex brevicaulis*		
CACO	*Camissonia contorta*		
CAED	*Carpobrotus edulis*	iceplant	perennial succulent herb
CAEX	*Castilleja exserta*		
CASU	*Calystegia subacaulis*		
CEDE	*Ceanothus dentatus*	dwarf ceanothus	shrub
CEME	*Centaurea melitensis*		
CERI	*Ceanothus rigidus* (*Ceanothus cuneatus* var. *rigidus)*	Monterey ceanothus	shrub
CETH	*Ceanothus thyrsiflorus*	blue blossom	shrub
CHDI	*Chorizanthe diffusa*		
CHPUP	*Chorizanthe pungens* var. *pungens*	Monterey spineflower	HMP annual
CIOC	*Cirsium occidentale*		
CLPE	*Claytonia perfoliata*		
COFI	*Corethrogyne* (*Lessingia*) *filaginifolia*		
COJU	*Cortaderia jubata*	jubata grass	large perennial grass
CORIL	*Cordylanthus rigidus* ssp. *littoralis*	seaside bird's beak	HMP annual

Table A-1. Species Acronyms, Former Fort Ord (Continued)

Acronym	Scientific Name	Common Name	Life Form
COXX	*Cortaderia* sp. (*C. jubata* or *C. selloana*)	jubata grass, pampas grass	large perennial grass
CRXX	*Cryptantha* sp.		
DAPU	*Daucus pusillus*		
DICA	*Dichelostemma capitatum*		
ELGL	*Elymus glaucus*		
ERAM	*Erysimum ammophilum*	coast wallflower	biennial to perennial
ERCA	*Eriodictyon californicum*	yerba santa	shrub
ERCI	*Erodium cicutarium*		
ERCO	*Eriophyllum confertiflorum*	golden yarrow	sub-shrub
ERER	*Ericameria ericoides*	mock-heather	shrub
ERFA	*Ericameria fasciculata*	Eastwood’s goldenbush	shrub
ERIGE	*Erigeron* (*Conyza*) sp.		
ERNU	*Eriogonum nudum*		
ERVI	*Eriastrum virgatum*		
HEGR	*Heterotheca grandiflora*		
HESC	*Helianthemum scoparium*	peak rush-rose	subshrub
HEXX	*Hemizonia* sp.		
HOCU	*Horkelia cuneata*		
HYGL	*Hypocharis glabra*		
HYRA	*Hypochaeris radicata*		
KOMA	*Koeleria macrantha*		
LACO	*Lasthenia conjugens*	Contra Costa goldfields	annual herb
LAPL	*Layia platyglossa*		
LECA	*Lepechinia calycina*	pitcher sage	shrub
LEPA	*Leptosiphon parviflorus*		
LEPE	*Lessingia pectinata* (var. *pectinata*?)		
LOGA	*Logfia* (*Filago*) *gallica*		
LOMAT	*Lomatium* sp.		
LOSC	*Acmispon glaber (Lotus scoparius*)	deerweed	subshrub
LOST	*Lotus strigosus*		
LUAL	*Lupinus albifrons* (var. *albifrons*?)	silver bush lupine	shrub
LUAR	*Lupinus arboreus*	bush lupine	shrub
LUBI	*Lupinus bicolor*		
LUCH	*Lupinus chamissionis*		
LUNA	*Lupinus nanus*		
MAEX	*Madia exigua*		
MAFA	*Marah fabaceus*		
MAGR	*Madia gracilis*		
MEIM	*Melica imperfecta*		
MIAU	*Mimulus aurantiacus*	sticky monkeyflower	shrub
MOUN	*Monardella undulata*		
NAHA	*Navarretia hamata*		

Table A-1. Species Acronyms, Former Fort Ord (Continued)

Acronym	Scientific Name	Common Name	Life Form
NAXX	*Navarretia* sp.		
PHDI	*Phacelia distans*		
PHRA	*Phacelia ramosissima*		
PLER	*Plantago erecta*		
PLXX	*Plantago* sp.		
POGL	*Potentilla glandulosa*		
POUN	*Poa unilateralis*		
POXX	*Poa* sp.		grass
PSXX	*Pseudognaphalium* sp.		
PTAQ	*Pteridium aquilinum*		
RUUR	*Rubus ursinus*	Pacific blackberry	woody vine
SACR	*Sanicula crassicaulis*		
SALA	*Salix lasiolepsis*	arroyo willow	shrub
SAME	*Salvia mellifera*	black sage	shrub
SCSY	*Scenecio sylvaticus*		
SESY	*Senecio sylvaticus*		
SIGA	*Silene gallica*		
SOAS	*Sonchus asper*		
SOUM	*Solanum umbelliferum*	blue witch	shrub
STVI	*Stephanomeria virgata*		
SYMO	*Symphoricarpos mollis*	creeping snowberry	subshrub
TODI	*Toxicodendron diversilobum*	poison-oak	shrub
TRBI	*Trifolium* cf. *bifidum*		
TRFR	*Trifolium fragiferum*		
URLI	*Uropappus lindleyi*		
VAOV	*Vaccinium ovatum*	huckleberry	shrub
VUBR	*Vulpia bromoides*		
VUMY	*Vulpia myuros*		

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APPENDIX B

MAPS: HMP GRIDS AND SHRUB TRANSECTS

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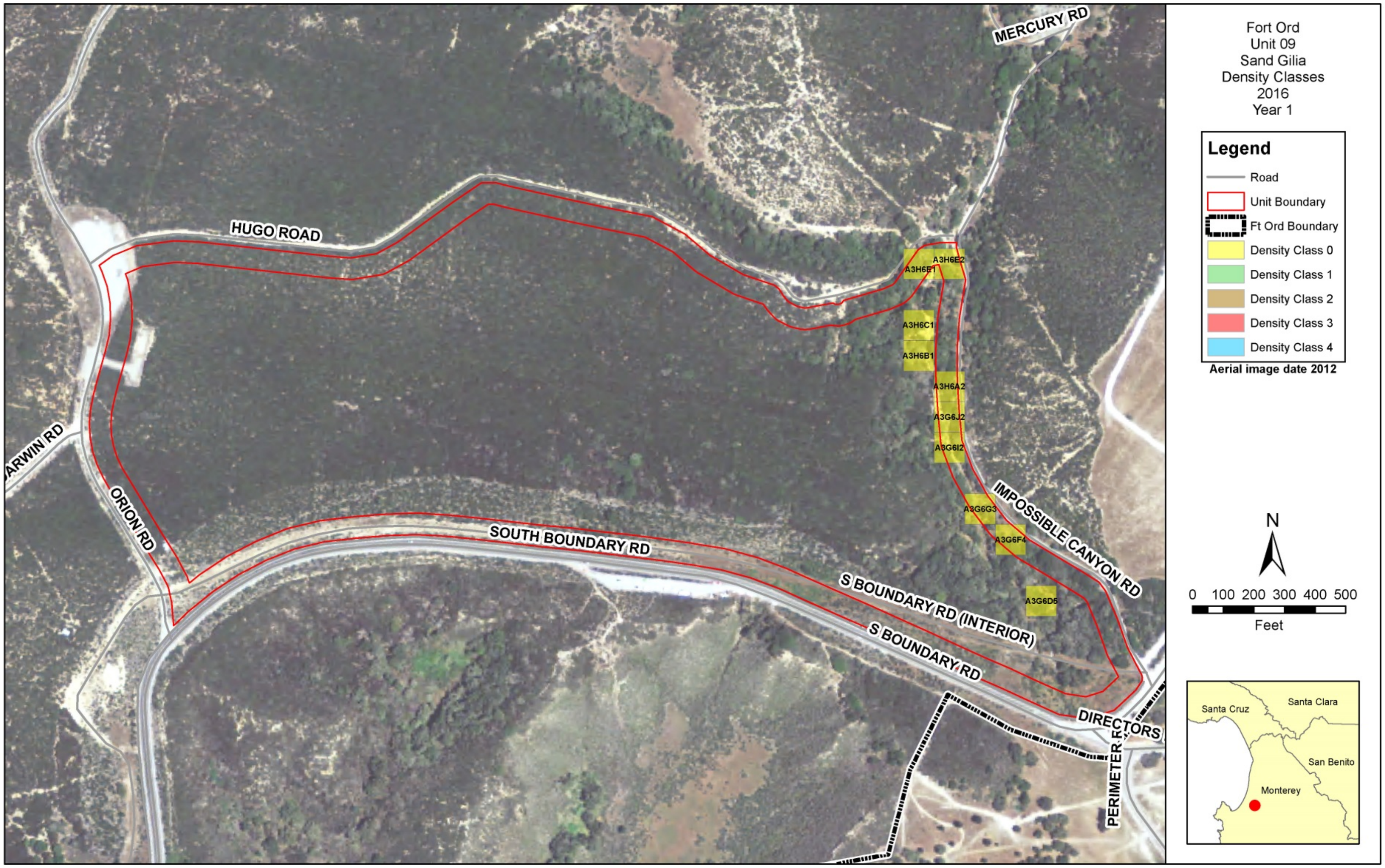

Figure B-1. Map of Sand Gilia Density, Unit 09

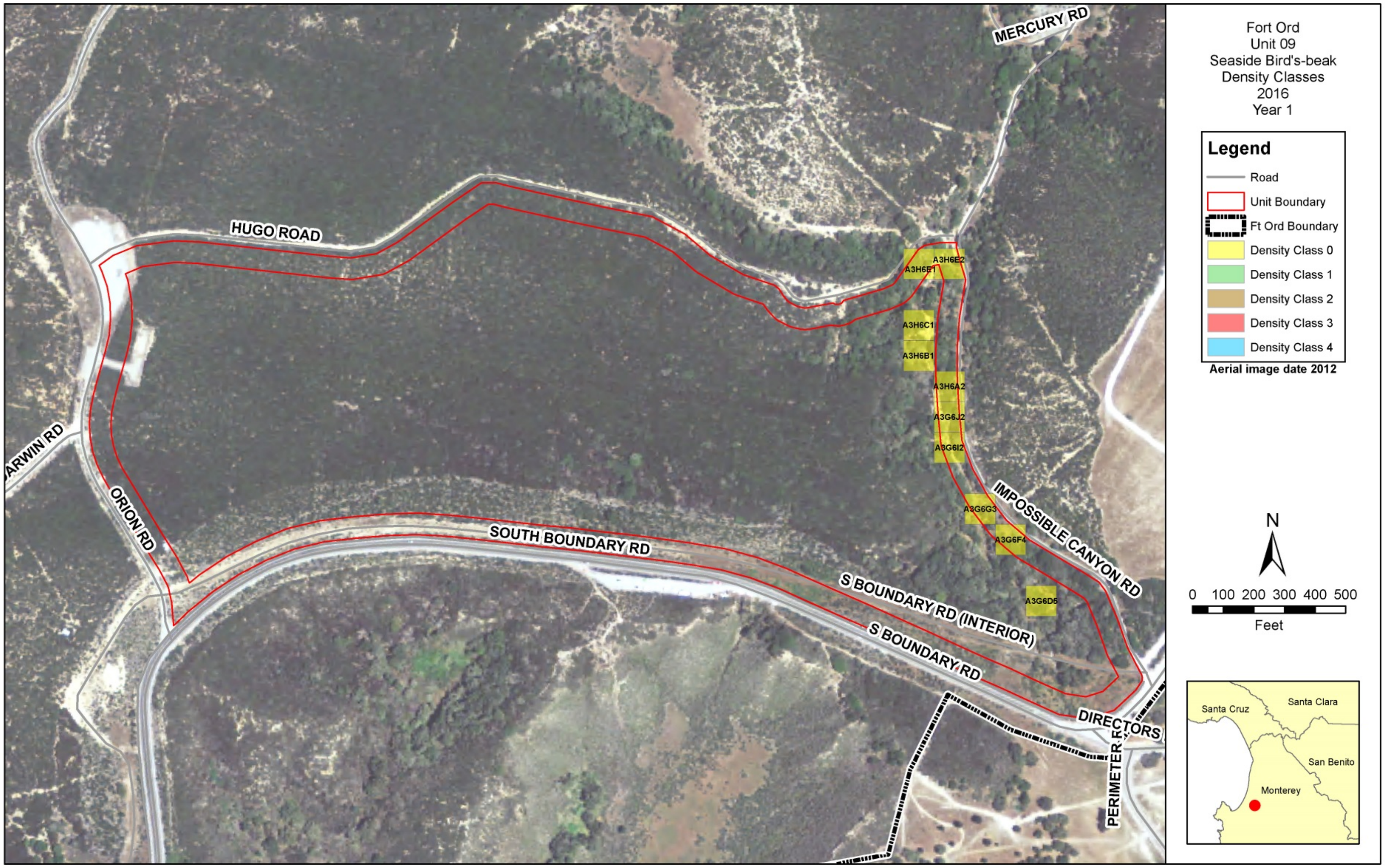

Figure B-2. Map of Seaside Bird's Beak Density, Unit 09

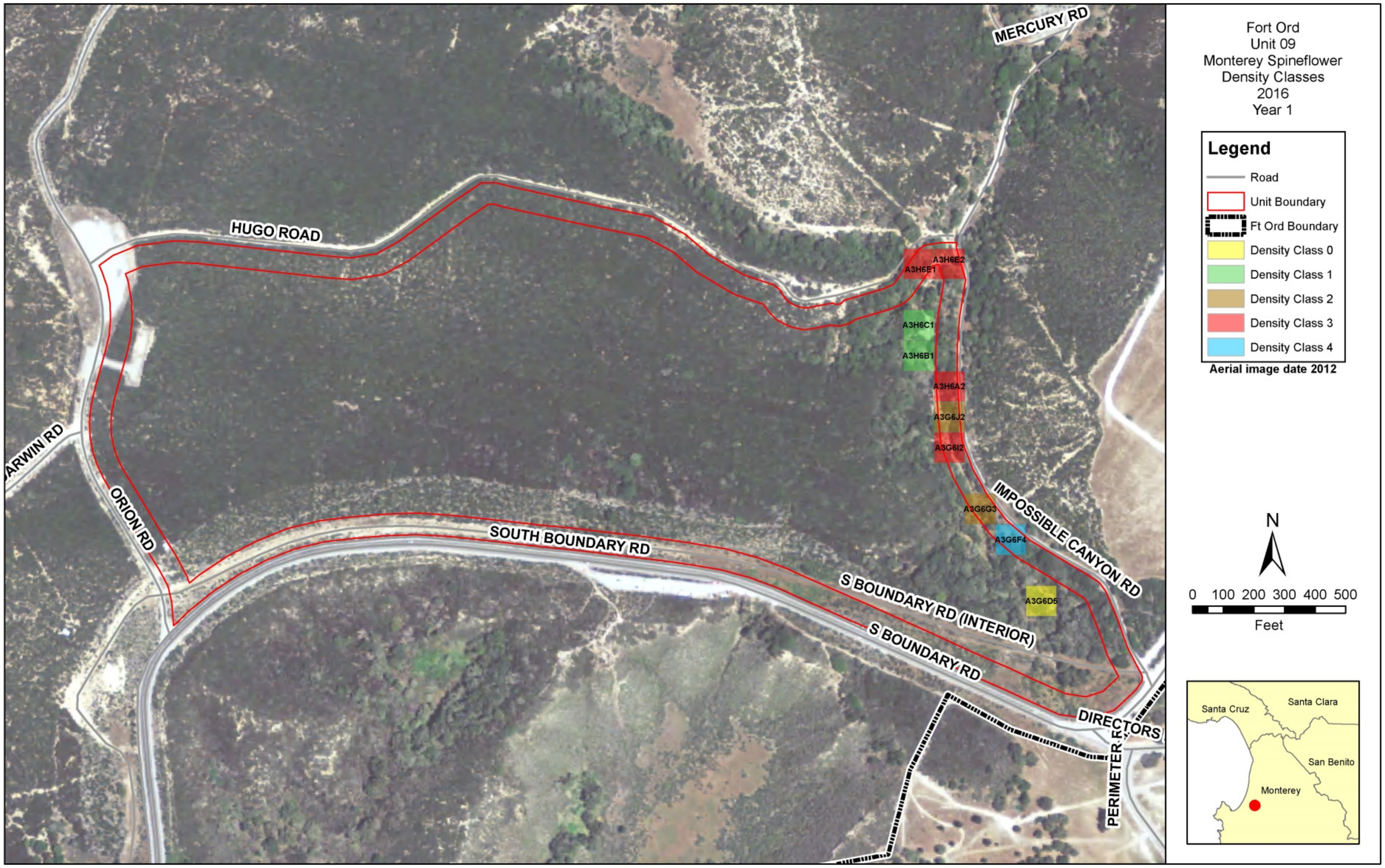

Figure B-3. Map of Monterey Spineflower Density, Unit 09

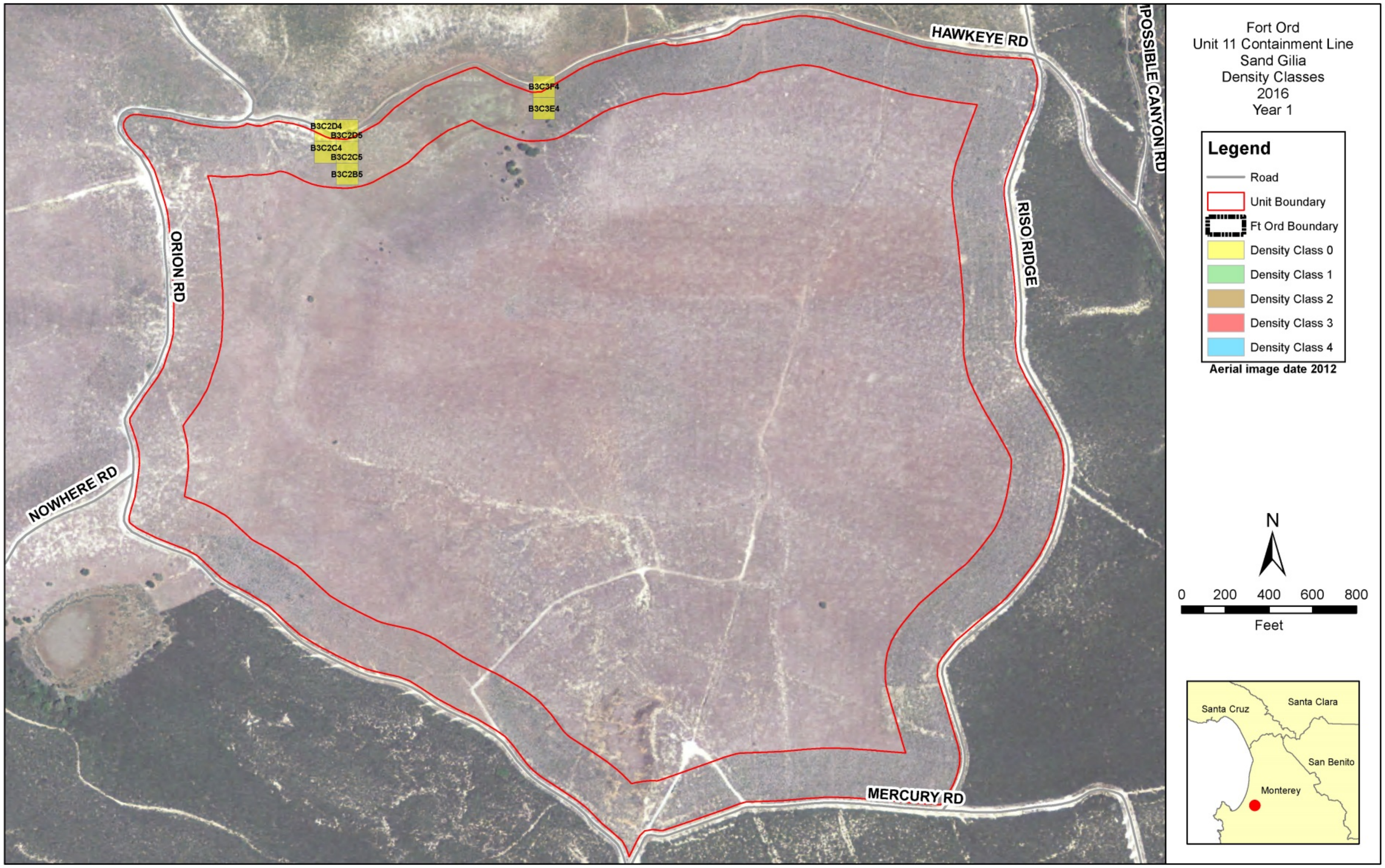

Figure B-4. Map of Sand Gilia Density, Unit 11 Containment Line

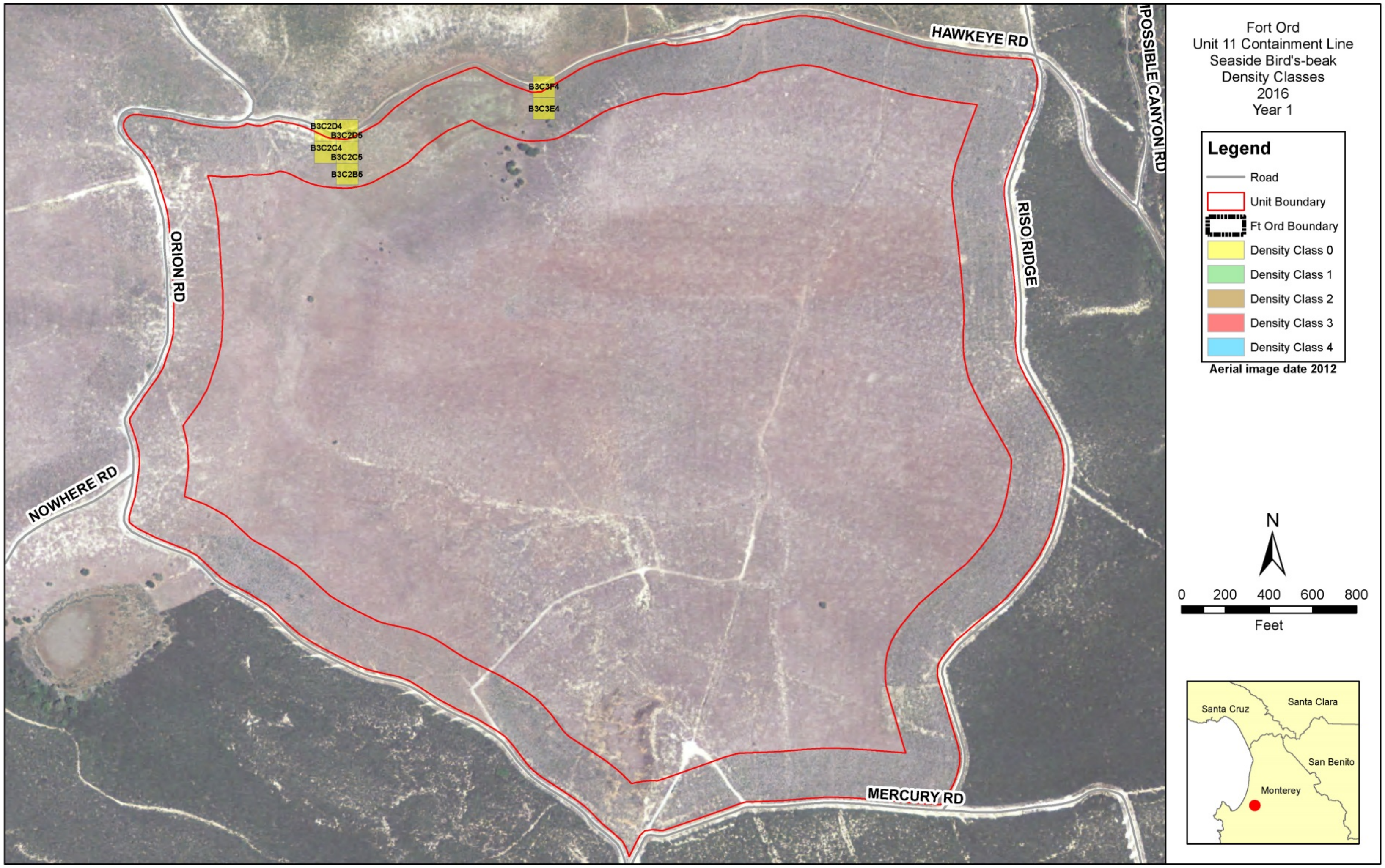

Figure B-5. Map of Seaside Bird's Beak Density, Unit 11 Containment Line

Figure B-6. Map of Monterey Spineflower Density, Unit 11 Containment Line

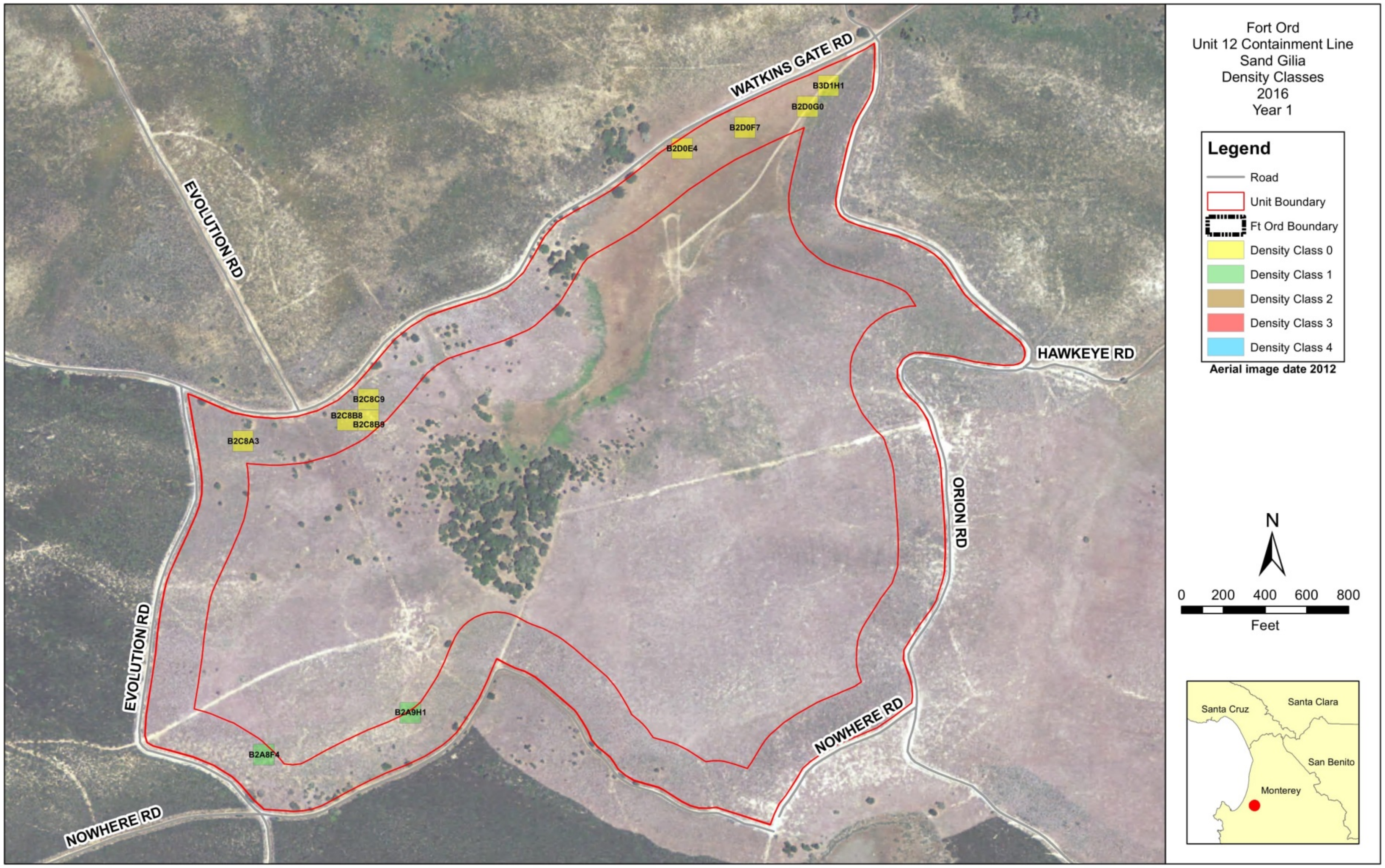

Figure B-7. Map of Sand Gilia Density, Unit 12 Containment Line

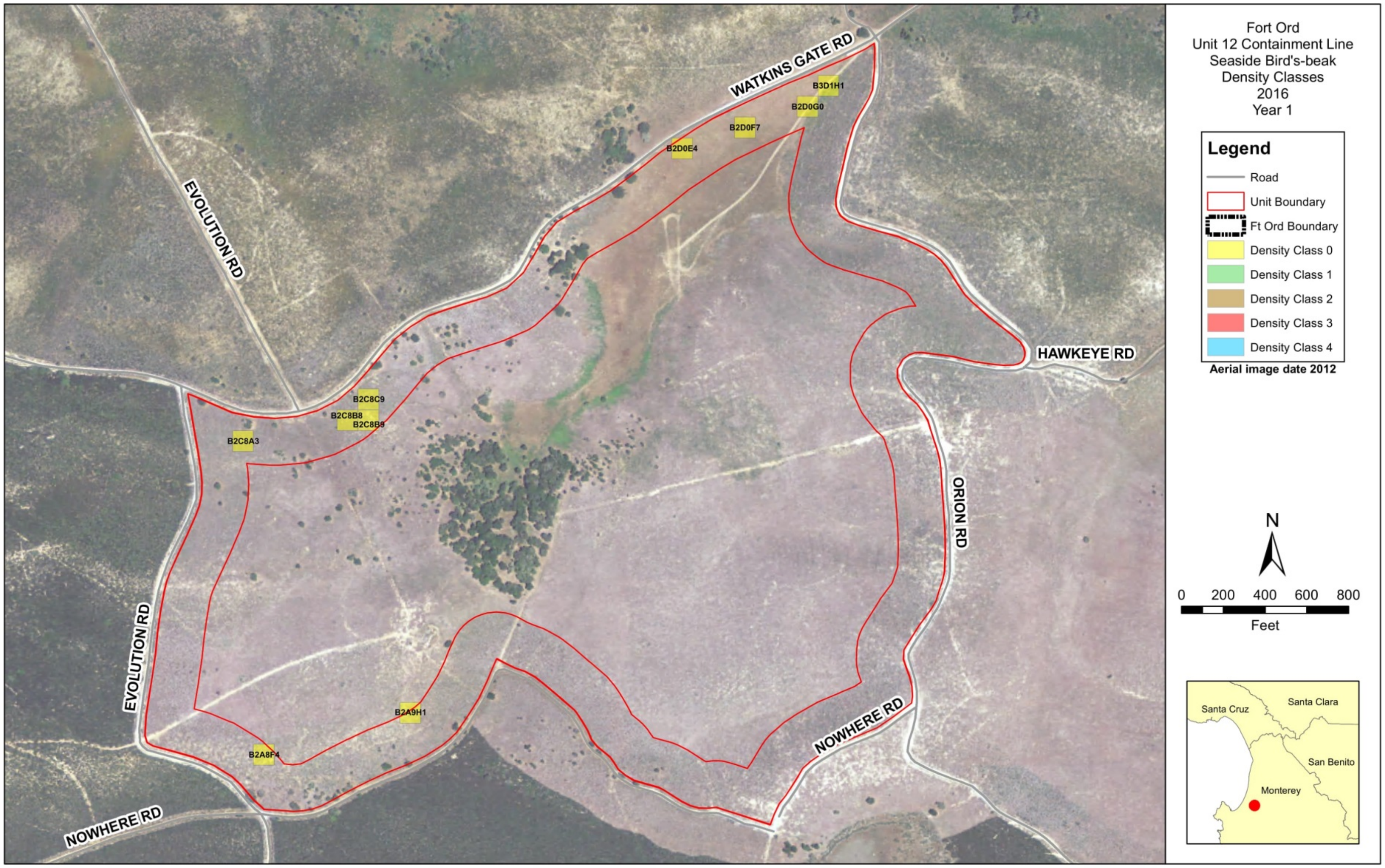

Figure B-8. Map of Seaside Bird's Beak Density, Unit 12 Containment Line

Figure B-9. Map of Monterey Spineflower Density, Unit 12 Containment Line

Figure B-10. Map of Sand Gilia Density, Unit 23N

Figure B-11. Map of Seaside Bird's Beak Density, Unit 23N

Figure B-12. Map of Monterey Spineflower Density, Unit 23N

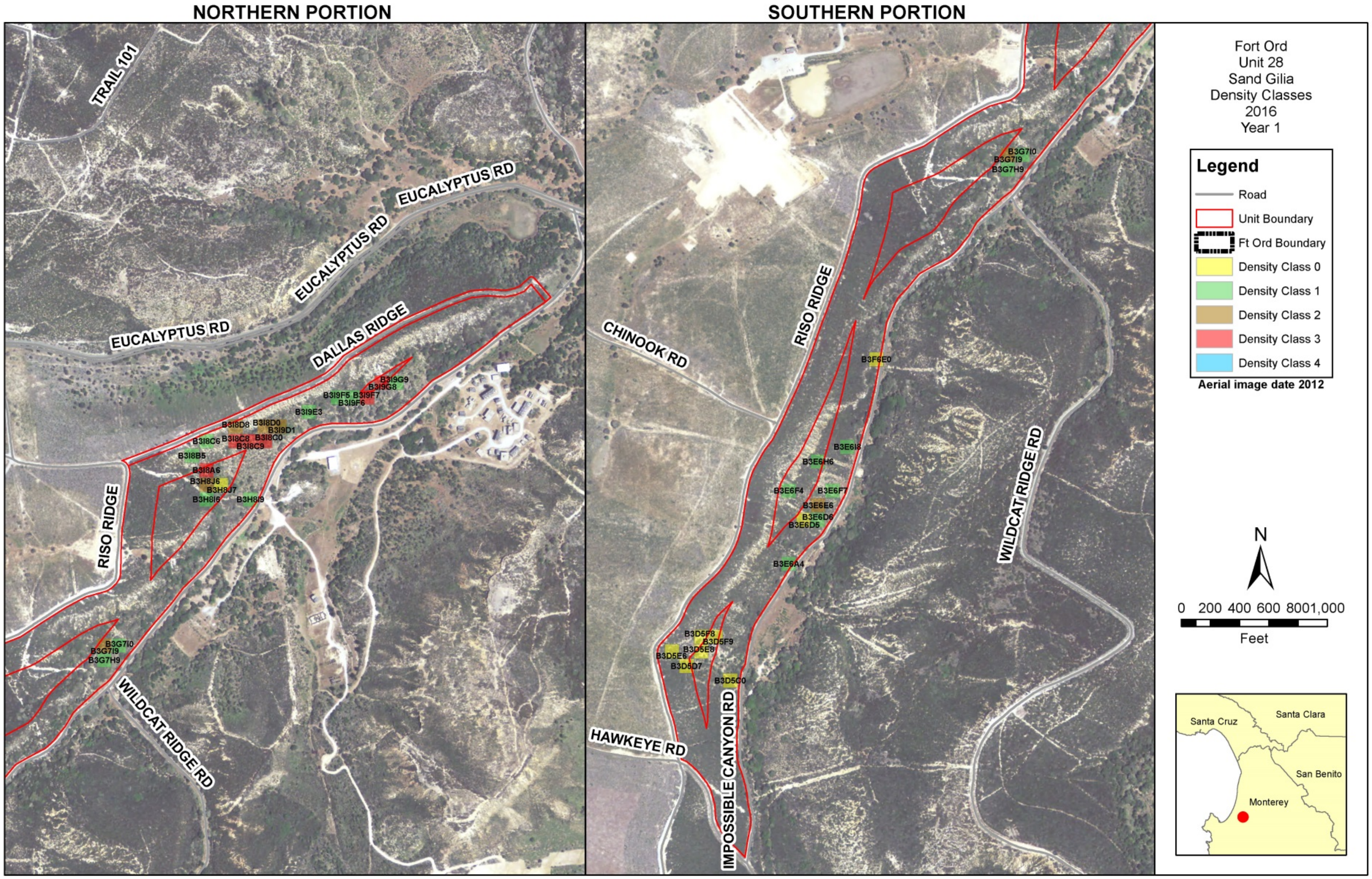

Figure B-13. Map of Sand Gilia Density, Unit 28

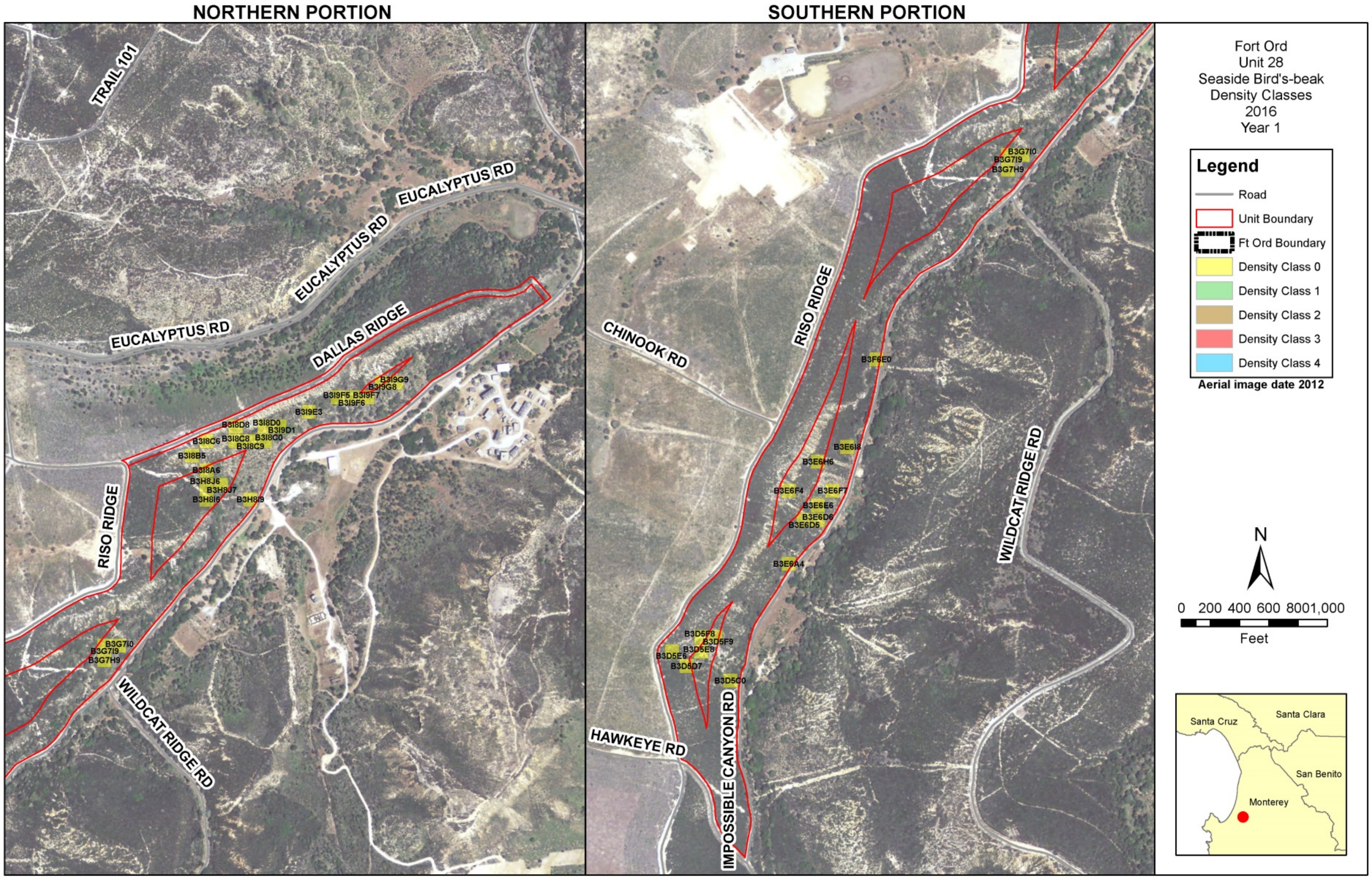

Figure B-14. Map of Seaside Bird's Beak Density, Unit 28

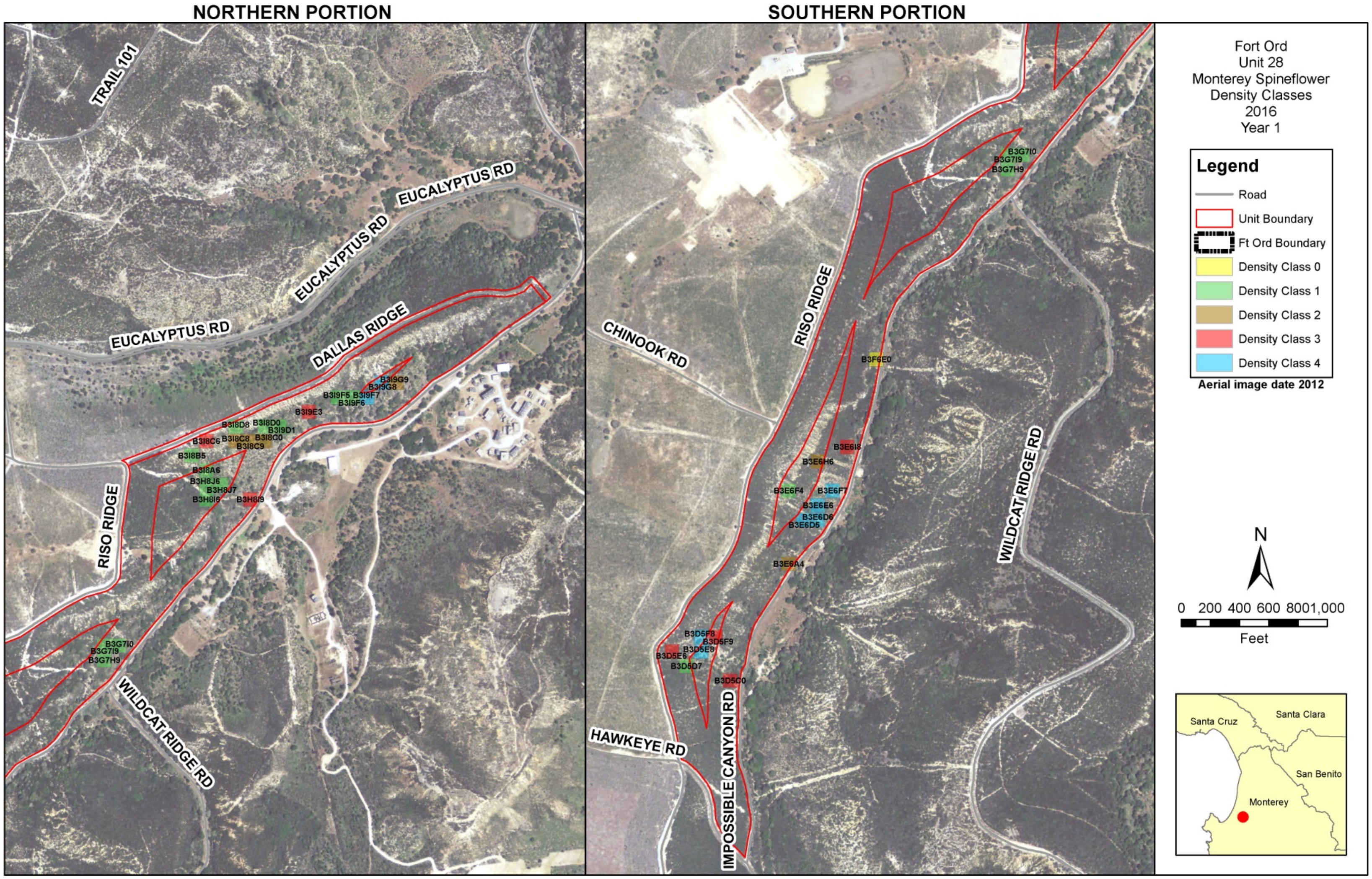

Figure B-15. Map of Monterey Spineflower Density, Unit 28

Figure B-16. Map of Shrub Transect Locations, Unit 01 East

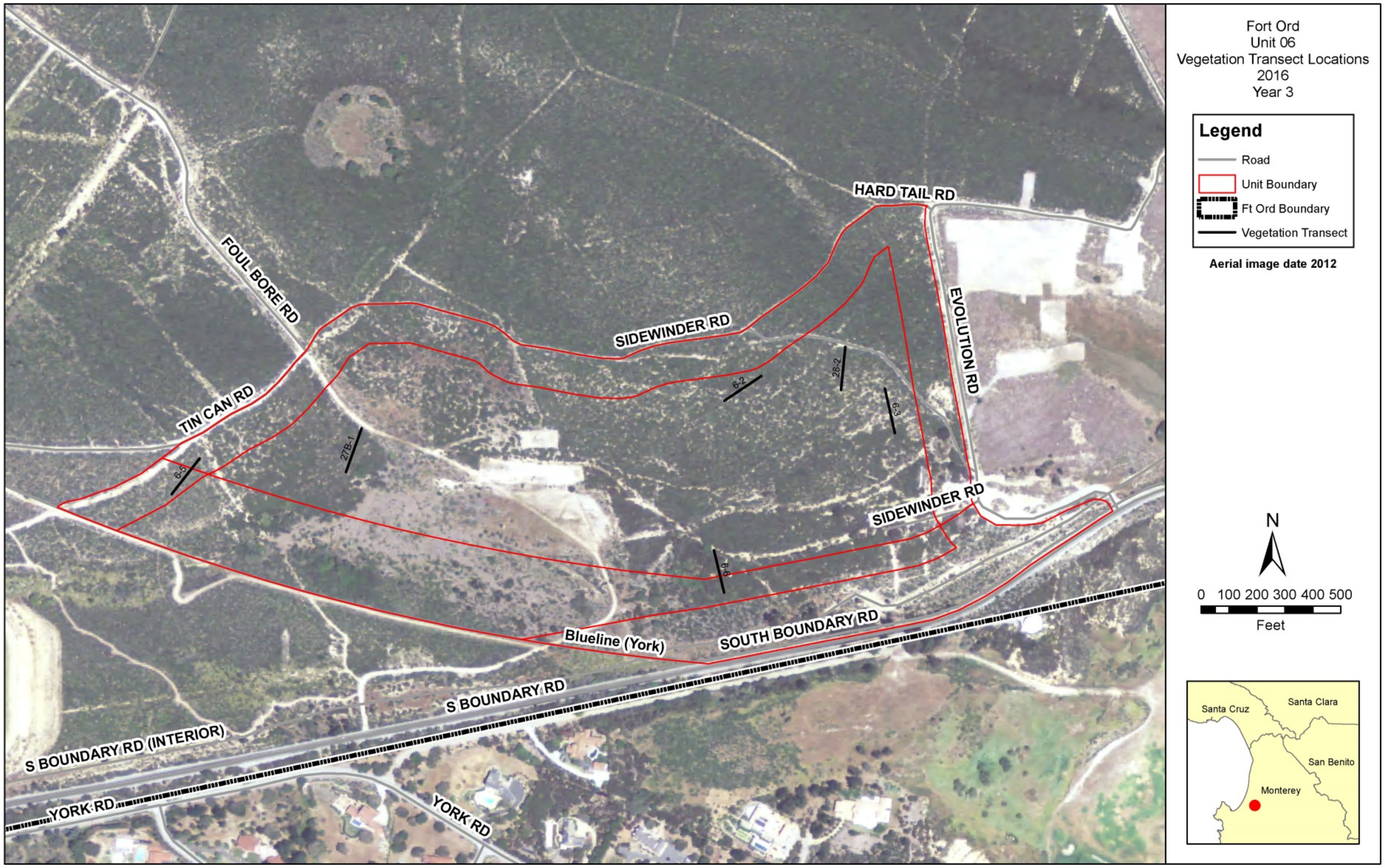

Figure B-17. Map of Shrub Transect Locations, Unit 06

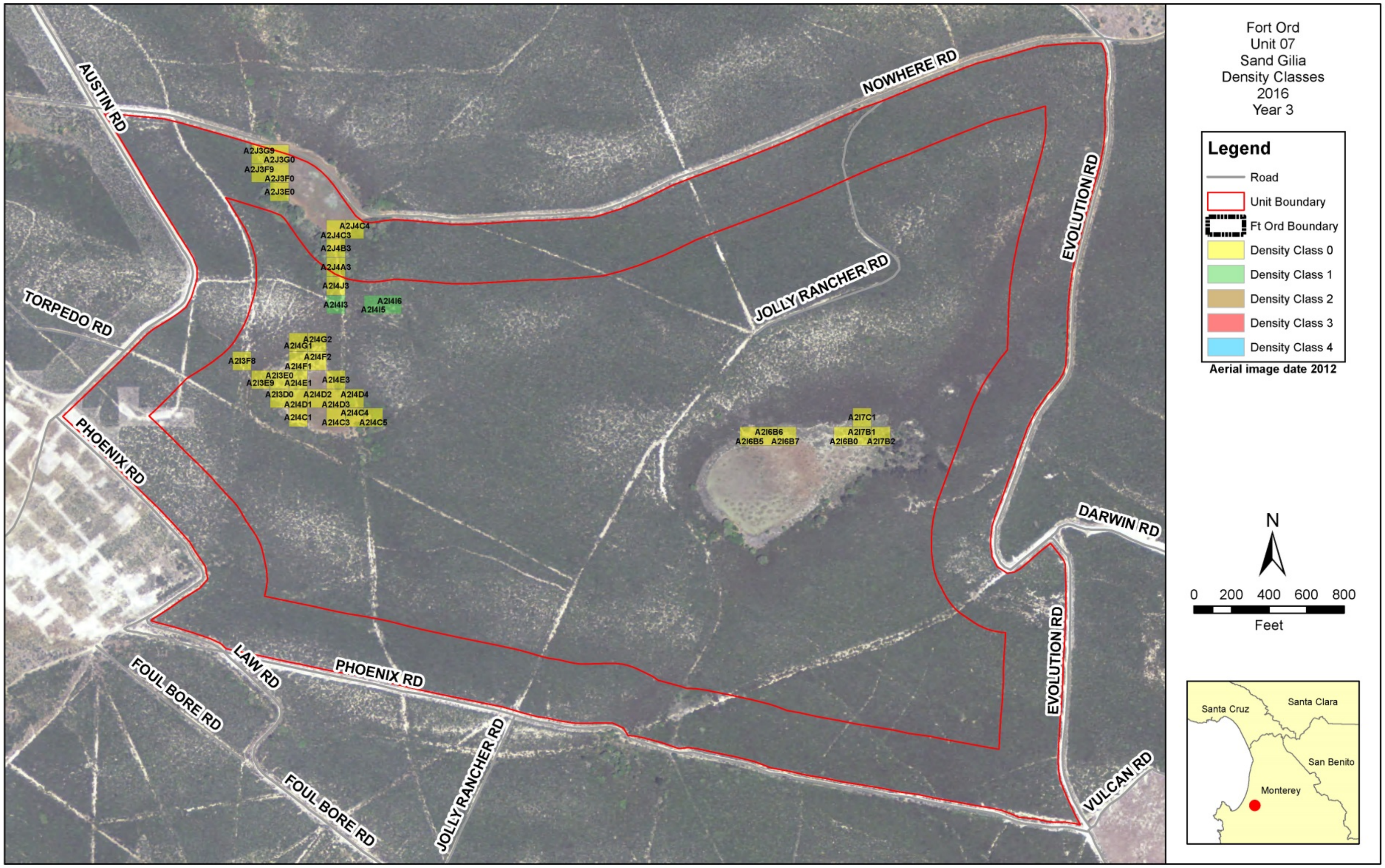

Figure B-18. Map of Sand Gilia Density, Unit 07

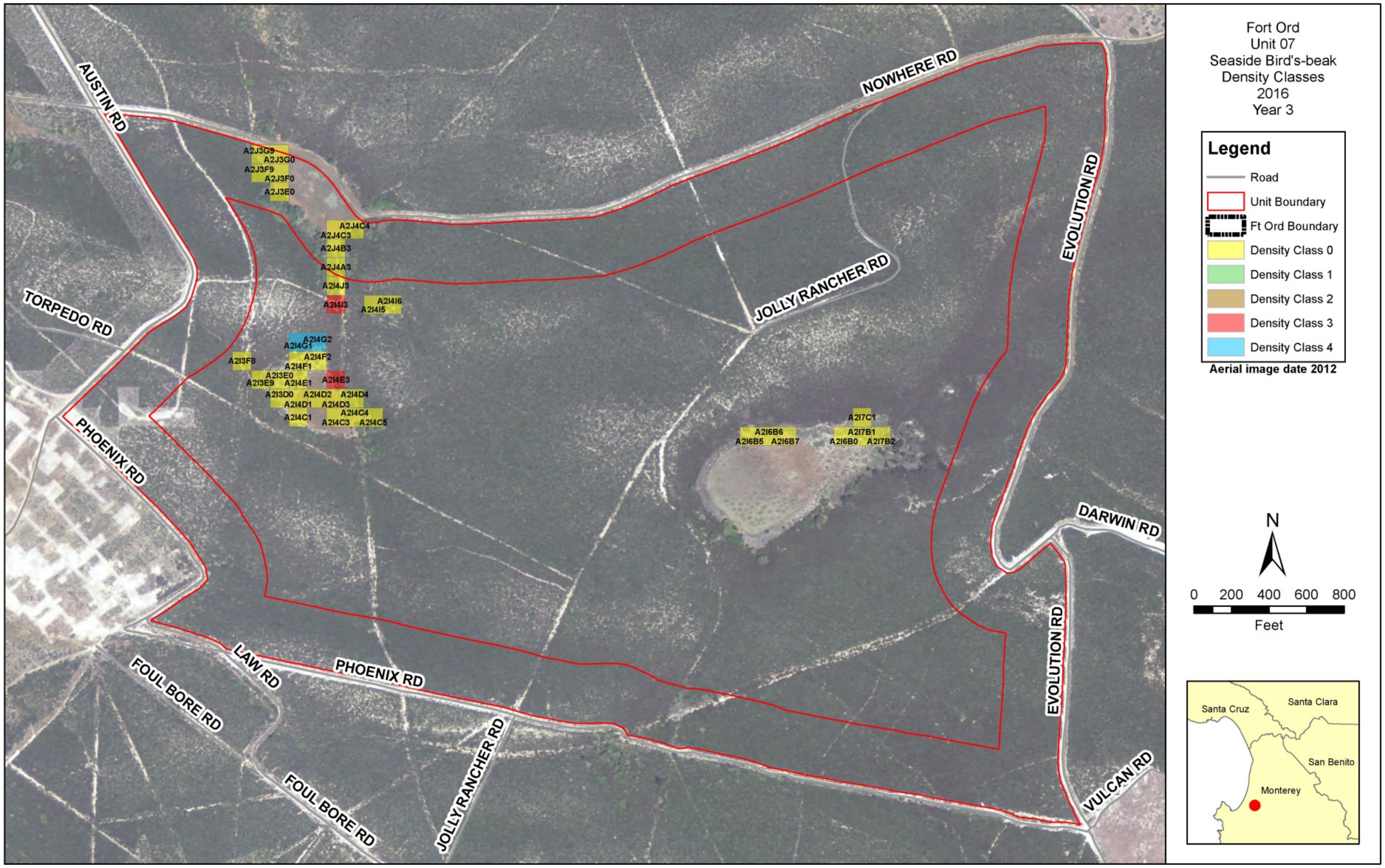

Figure B-19. Map of Seaside Bird's Beak Density, Unit 07

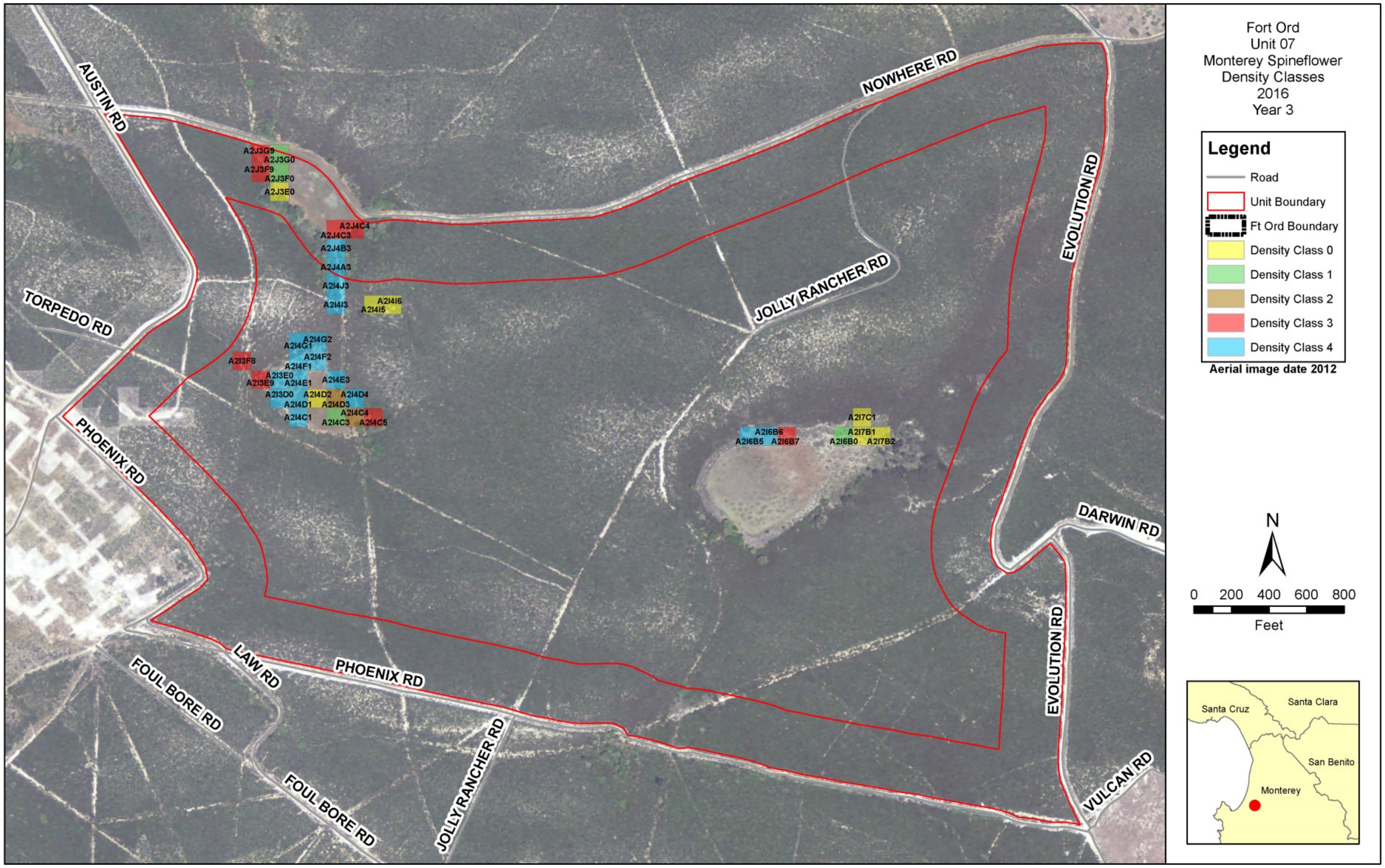

Figure B-20. Map of Monterey Spineflower Density, Unit 07

Figure B-21. Map of Shrub Transect Locations, Unit 07

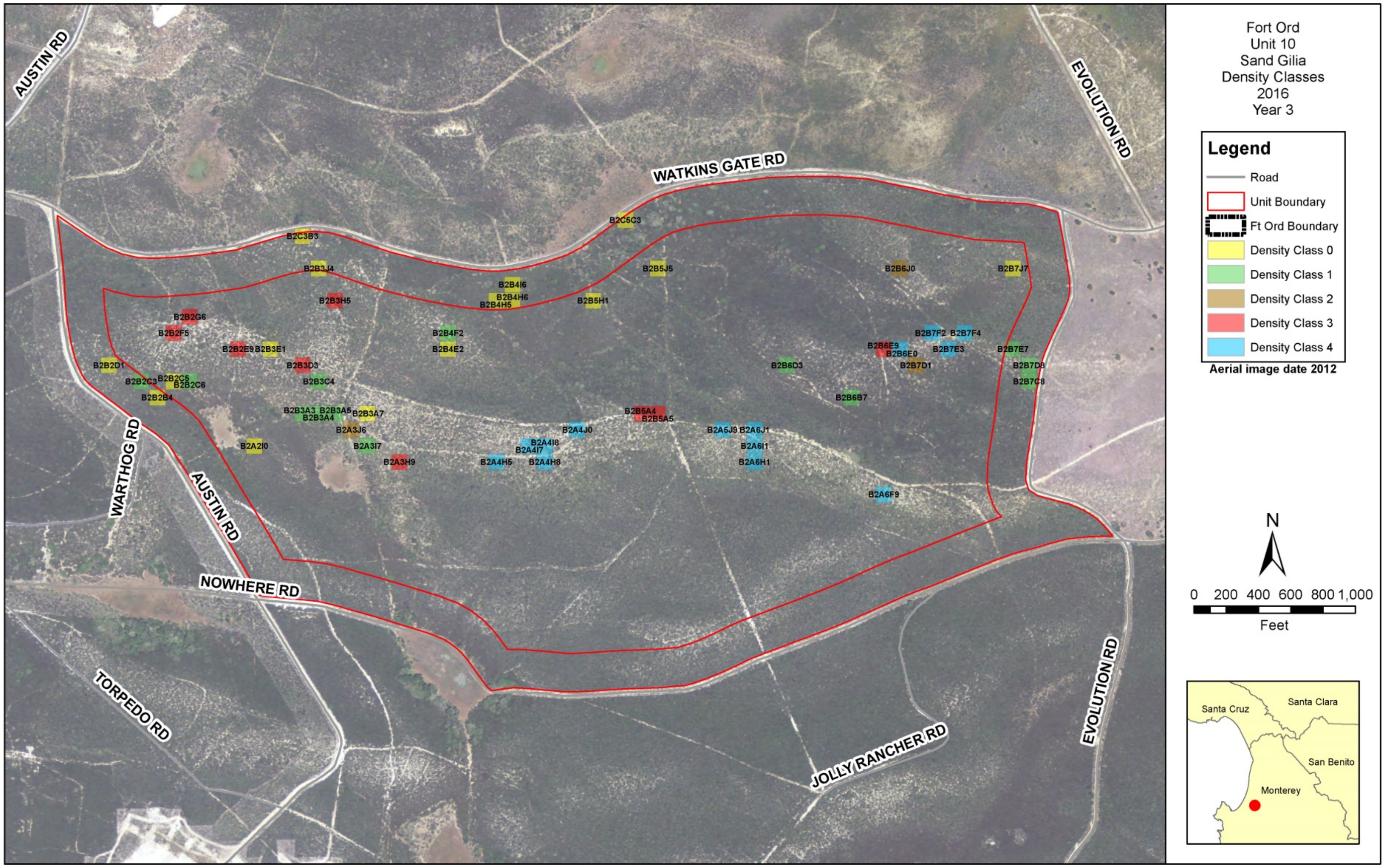

Figure B-22. Map of Sand Gilia Density, Unit 10

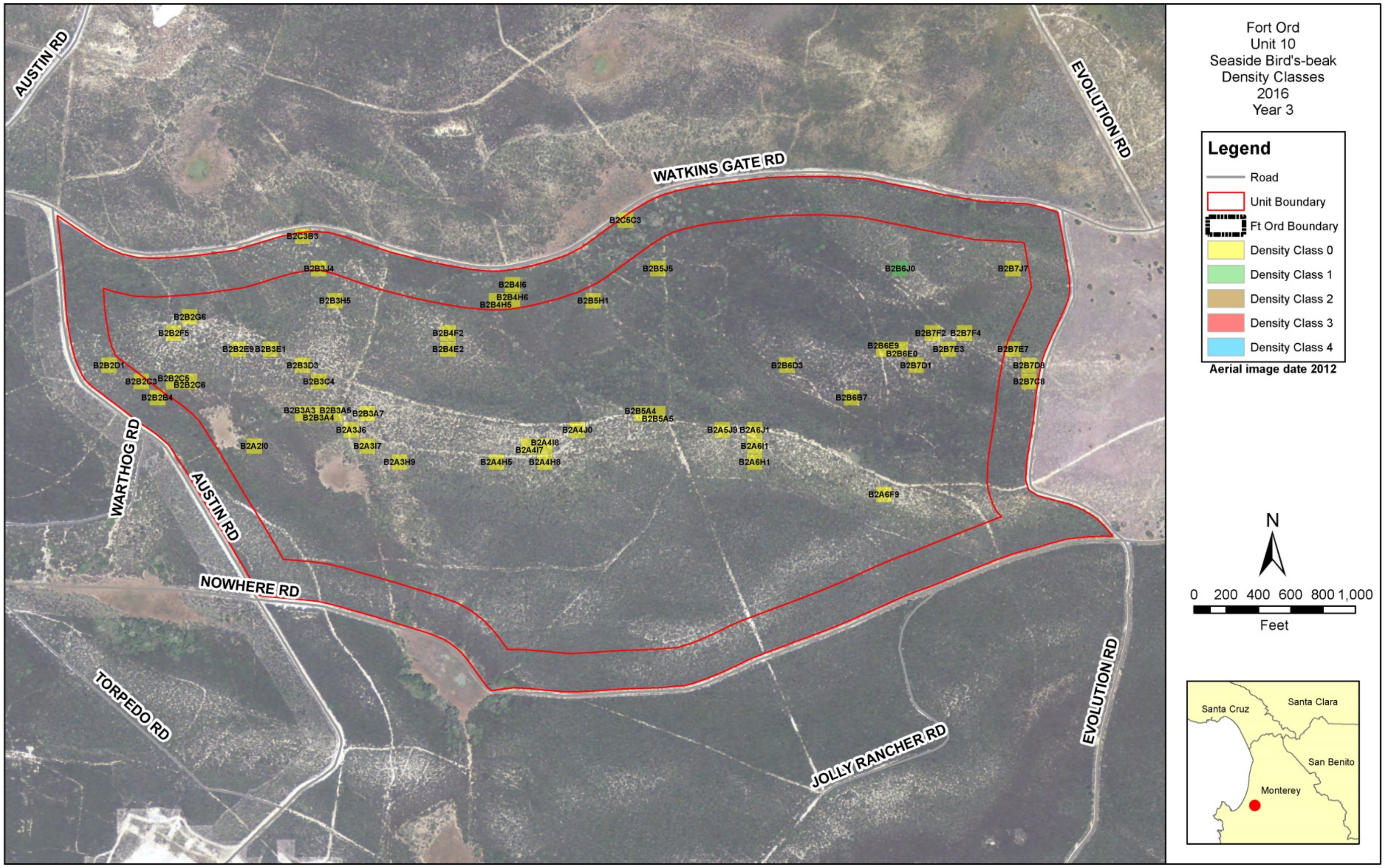

Figure B-23. Map of Seaside Bird's Beak Density, Unit 10

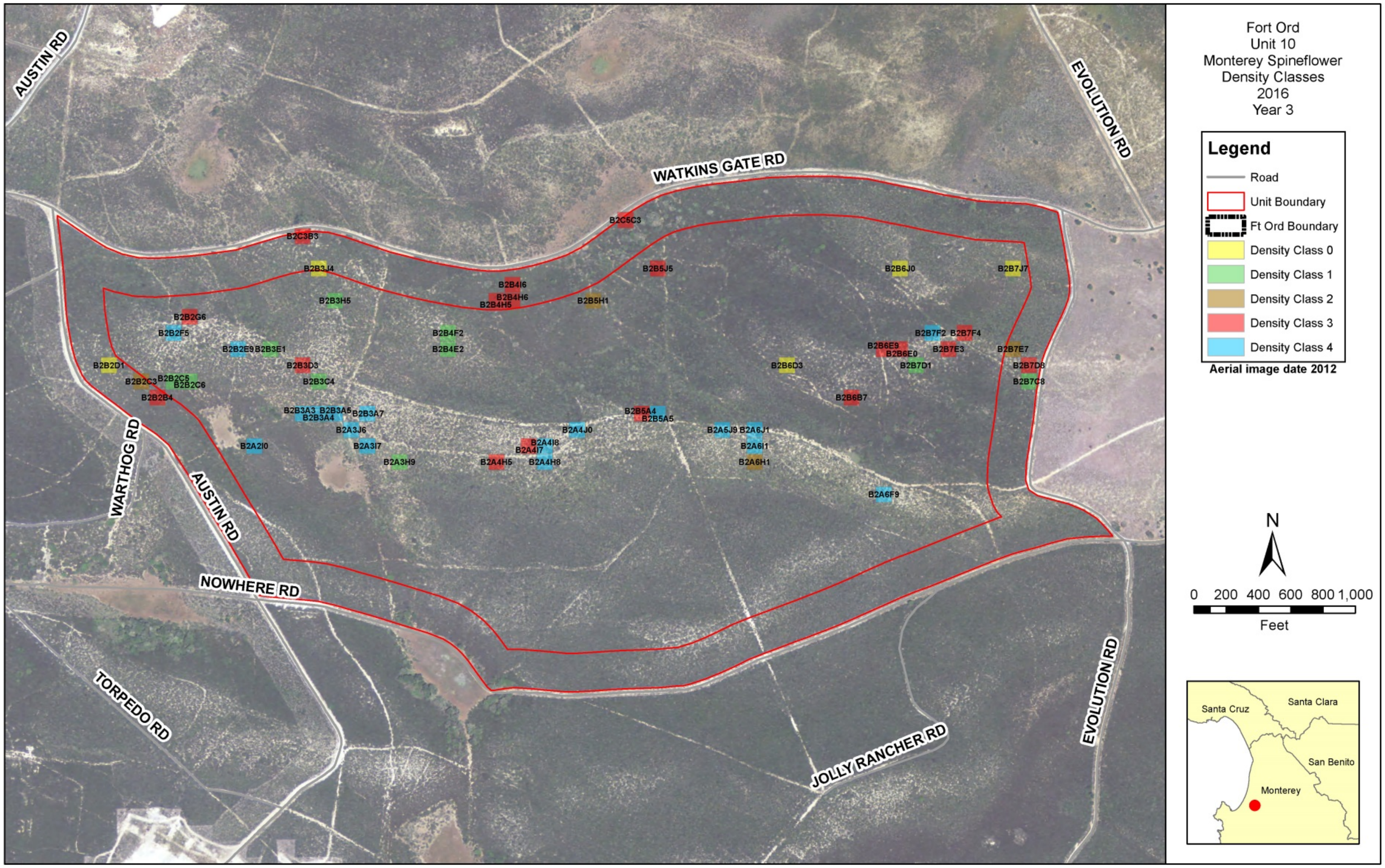

Figure B-24. Map of Monterey Spineflower Density, Unit 10

Figure B-25. Map of Shrub Transect Locations, Unit 10

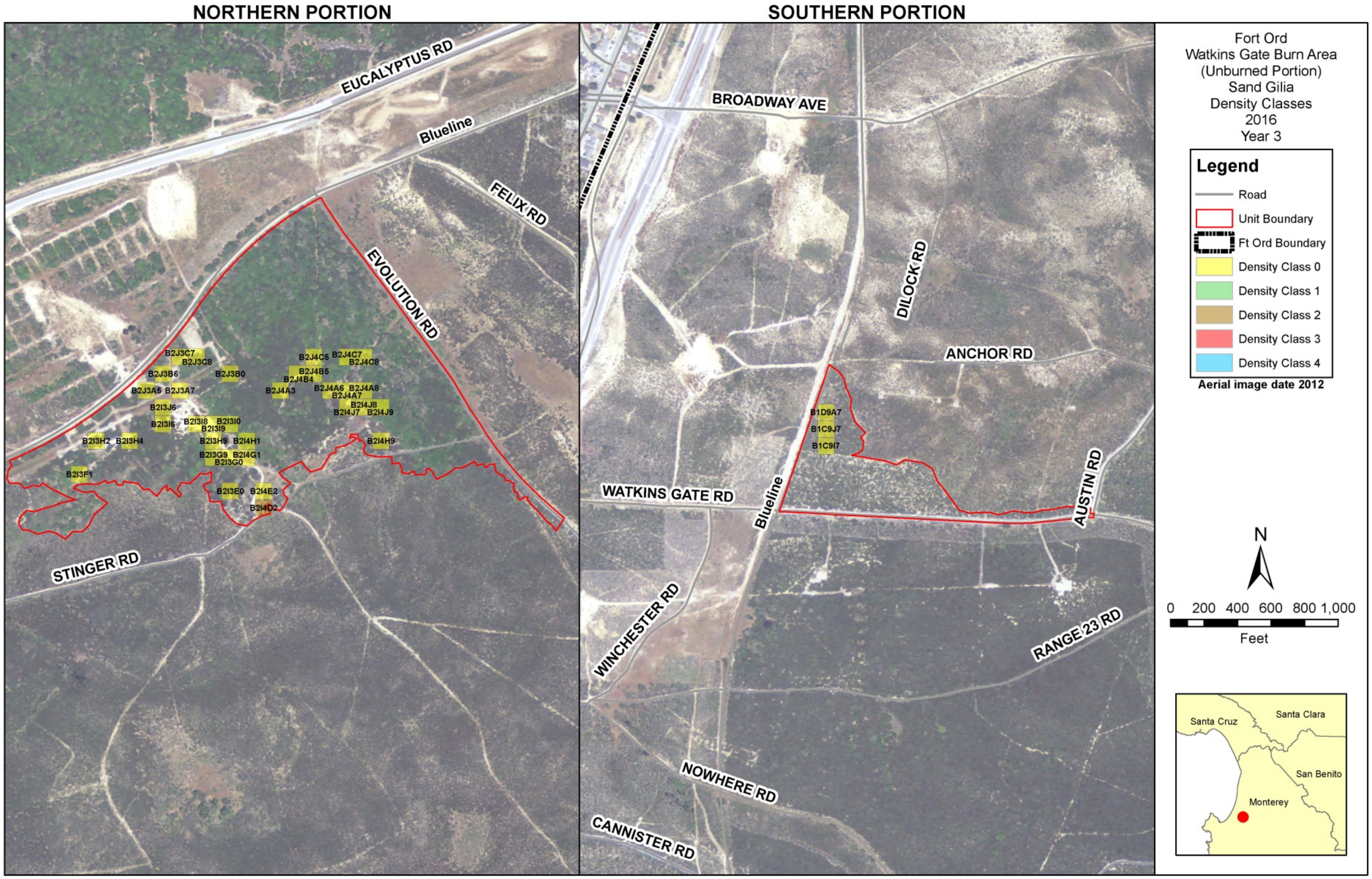

Figure B-26. Map of Sand Gilia Density, WGBA

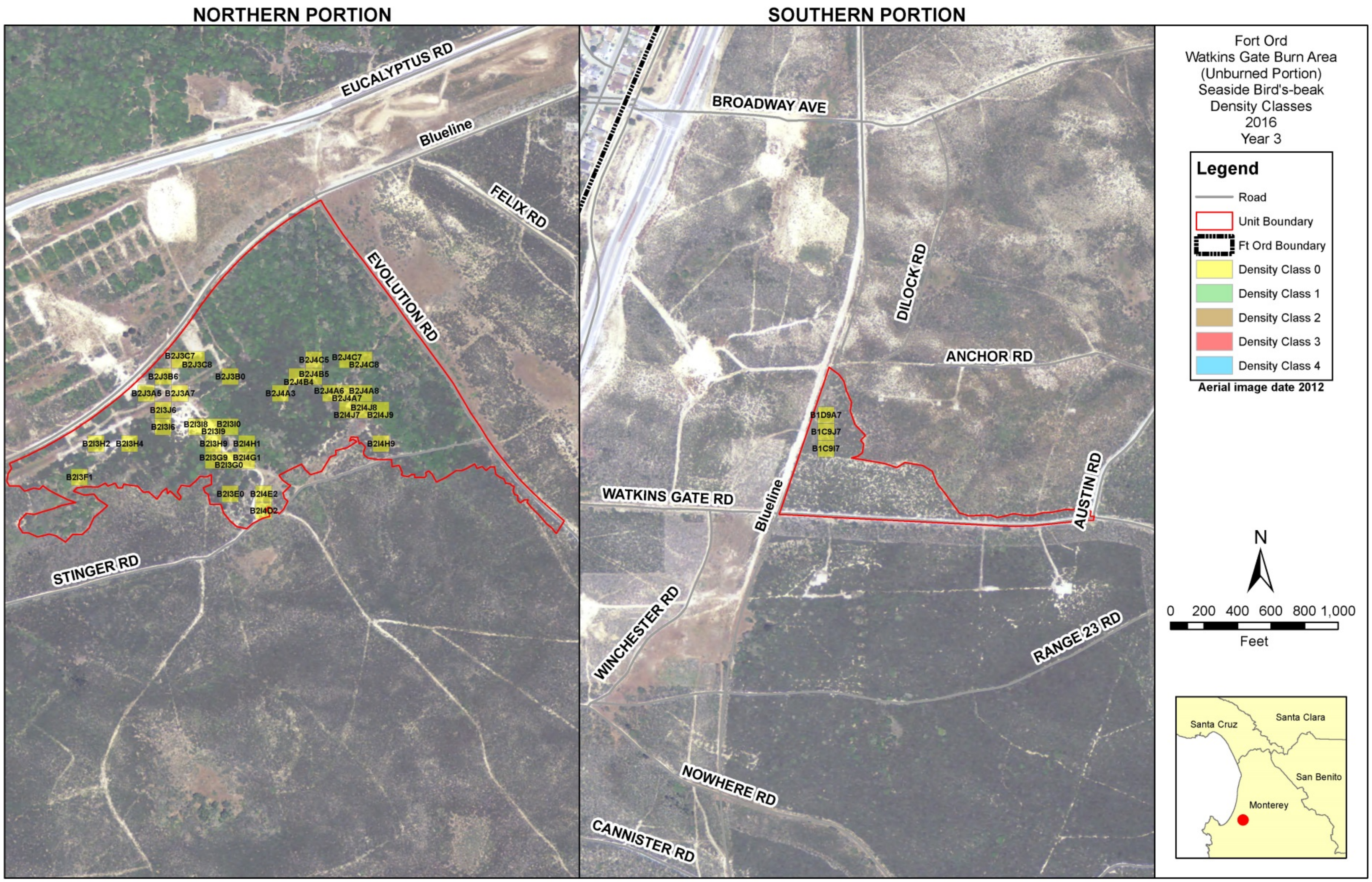

Figure B-27. Map of Seaside Bird's Beak Density, WGBA

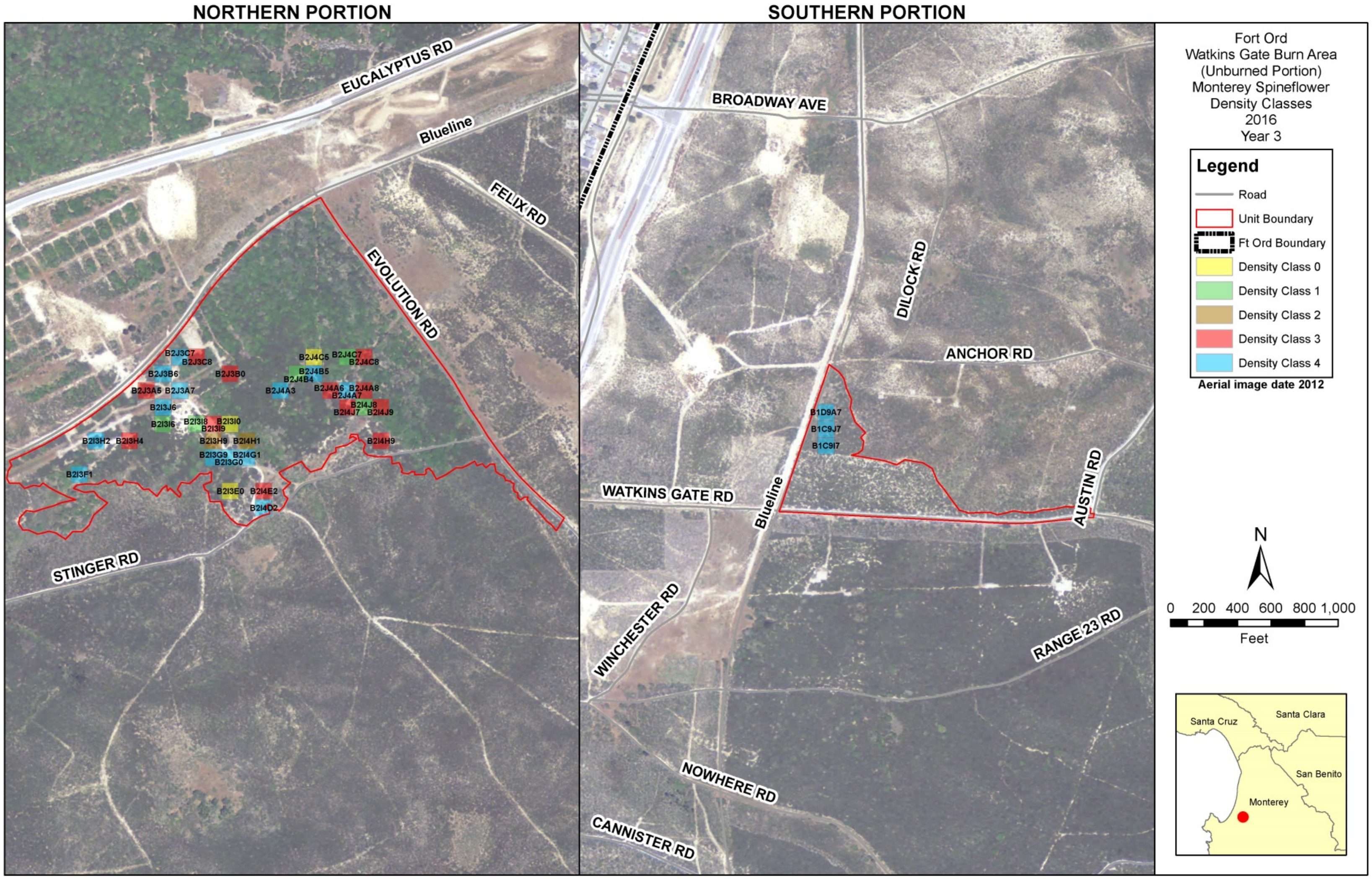

Figure B-28. Map of Monterey Spineflower Density, WGBA

Figure B-29. Map of Shrub Transect Locations, WGBA

Figure B-30. Map of Sand Gilia Density, MOUT

Figure B-31. Map of Seaside Bird's Beak Density, MOUT

Figure B-32. Map of Monterey Spineflower Density, MOUT

Figure B-33. Map of Shrub Transect Locations, MOUT

Figure B-34. Map of Sand Gilia Density, Unit 04

Figure B-35. Map of Seaside Bird's Beak Density, Unit 04

Figure B-36. Map of Monterey Spineflower Density, Unit 04

Figure B-37. Map of Shrub Transect Locations, Unit 04

Figure B-38. Map of Shrub Transect Locations, Unit 11

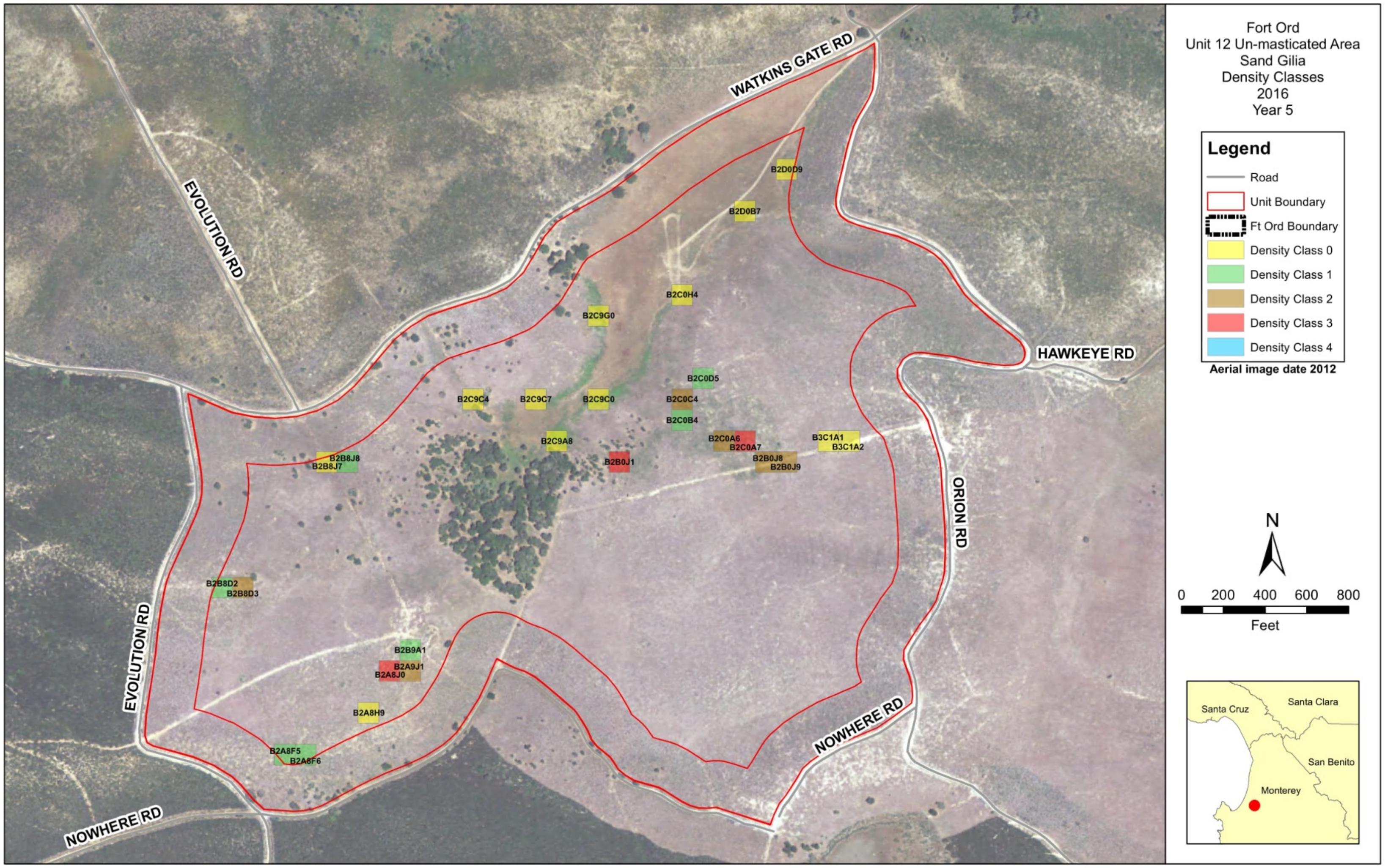

Figure B-39. Map of Sand Gilia Density, Unit 12

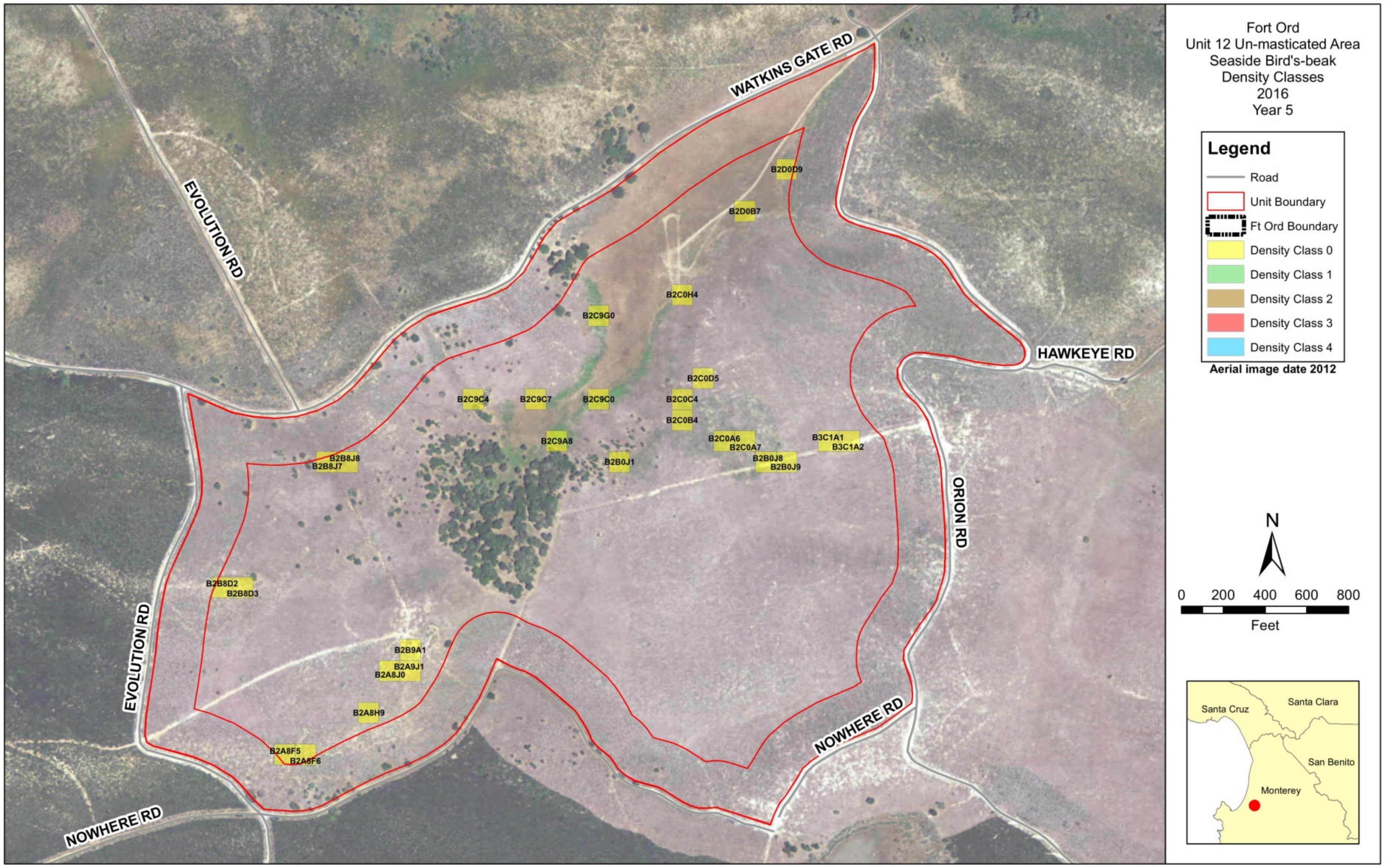

Figure B-40. Map of Seaside Bird's Beak Density, Unit 12

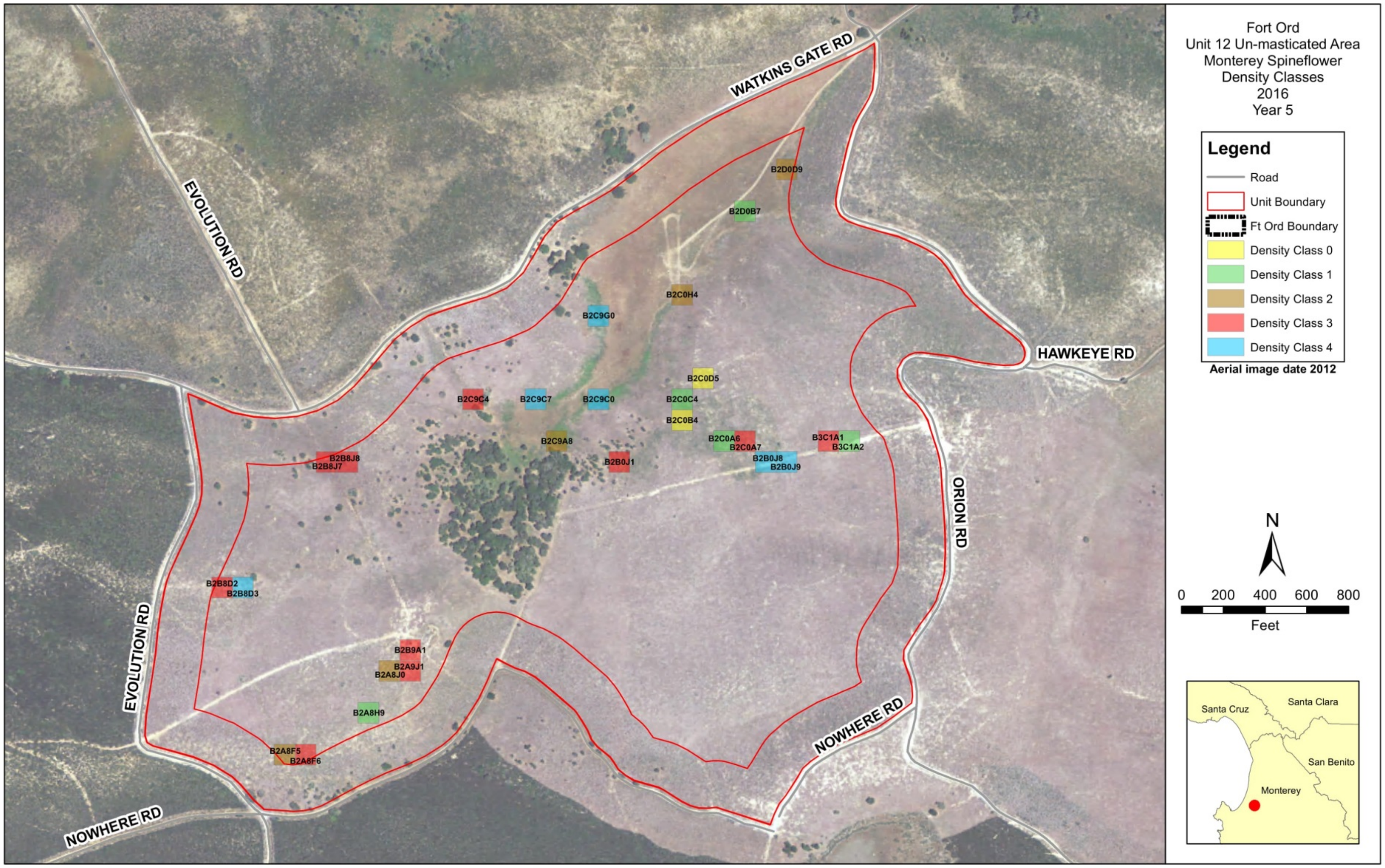

Figure B-41. Map of Monterey Spineflower Density, Unit 12

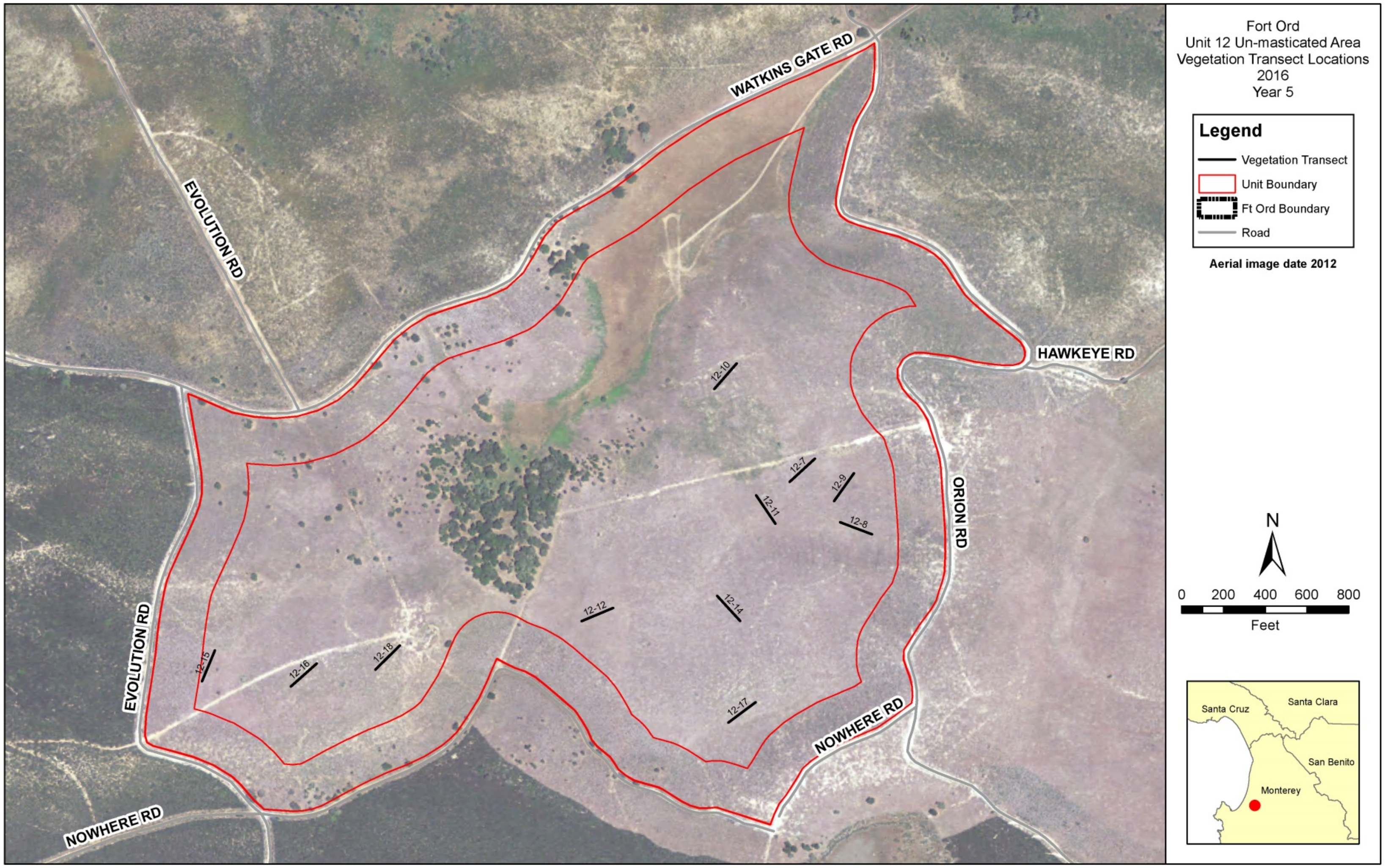

Figure B-42. Map of Shrub Transect Locations, Unit 12

Figure B-43. Map of Shrub Transect Locations, Unit 18

Figure B-44. Map of Shrub Transect Locations, Unit 22

APPENDIX C

GRASSES AND INVASIVE SPECIES

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Figure C-1. Map of Invasive Weed Locations, Unit 09

Figure C-2. Map of Annual Grass Distribution, Unit 11 Containment Line

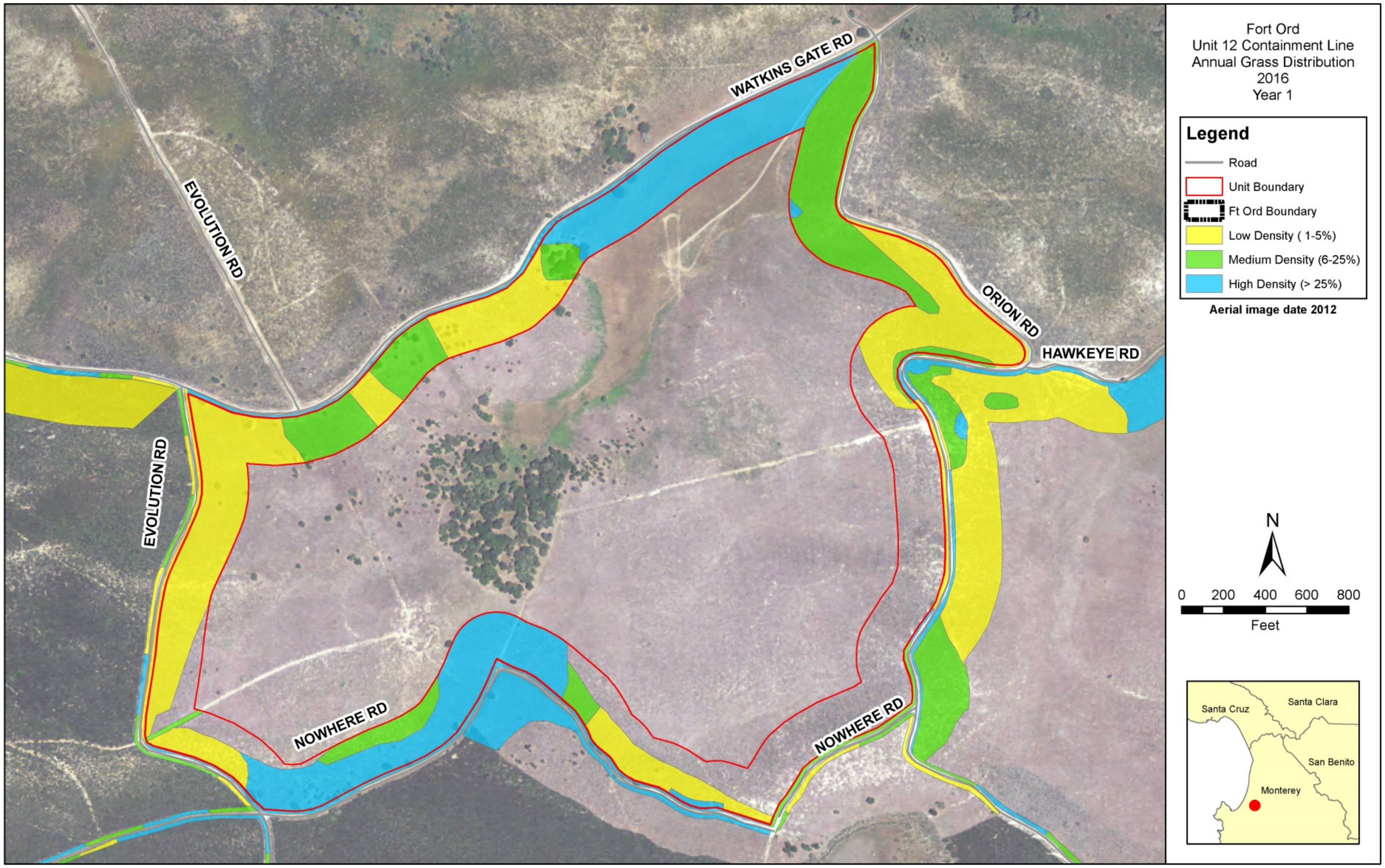

Figure C-3. Map of Annual Grass Distribution, Unit 12 Containment Line

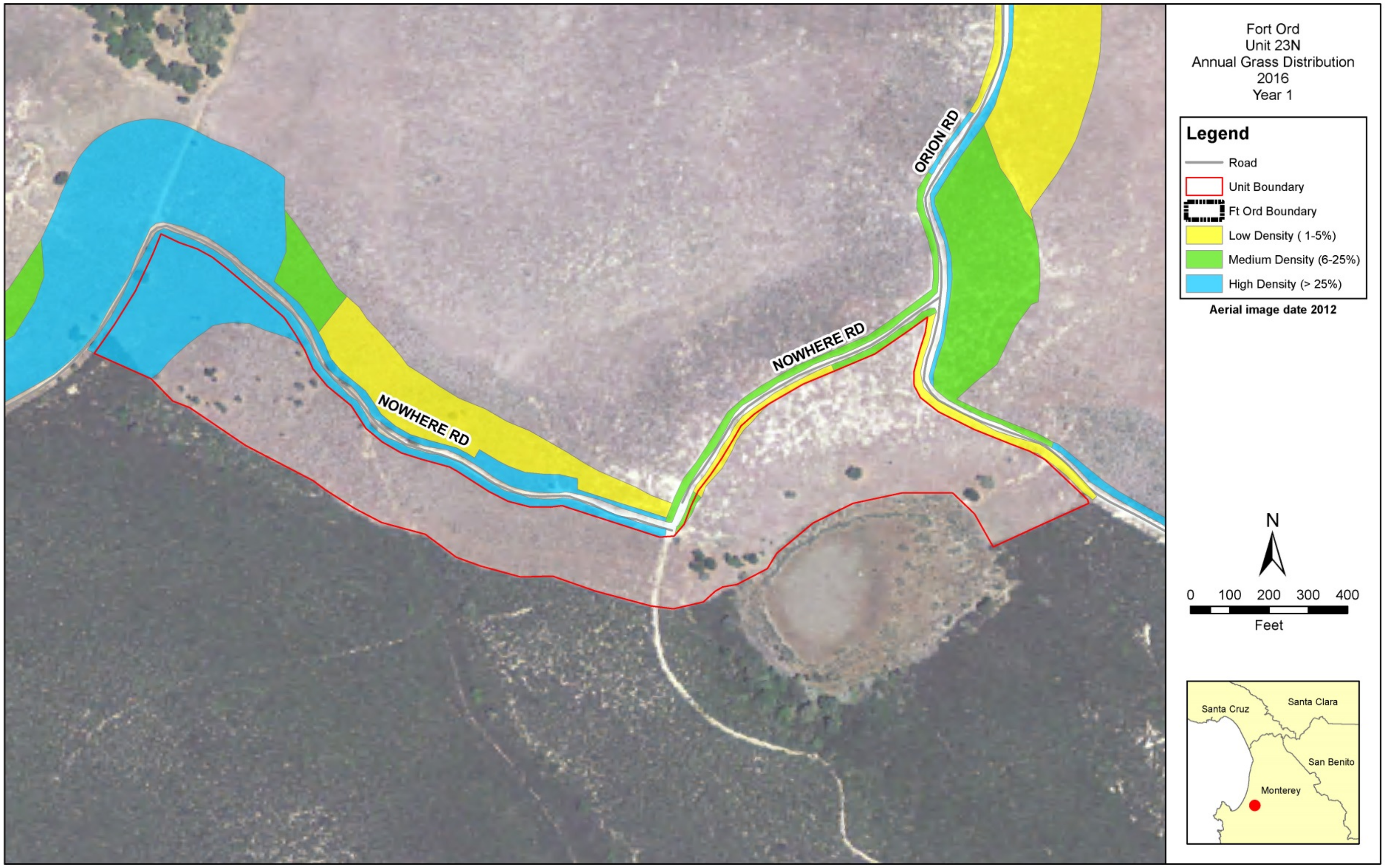

Figure C-4. Map of Annual Grass Distribution, Unit 23N

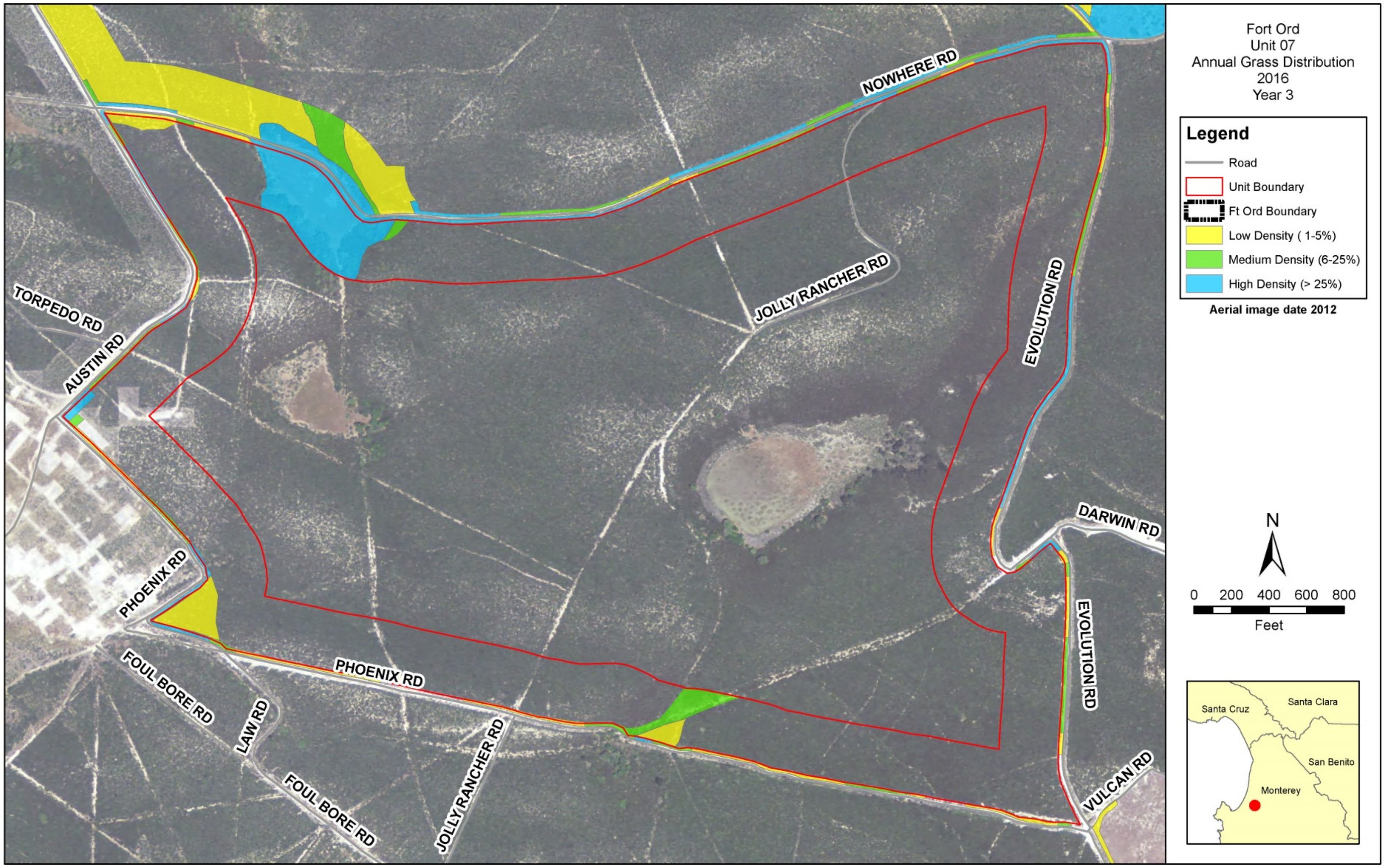

Figure C-5. Map of Annual Grass Distribution, Unit 07

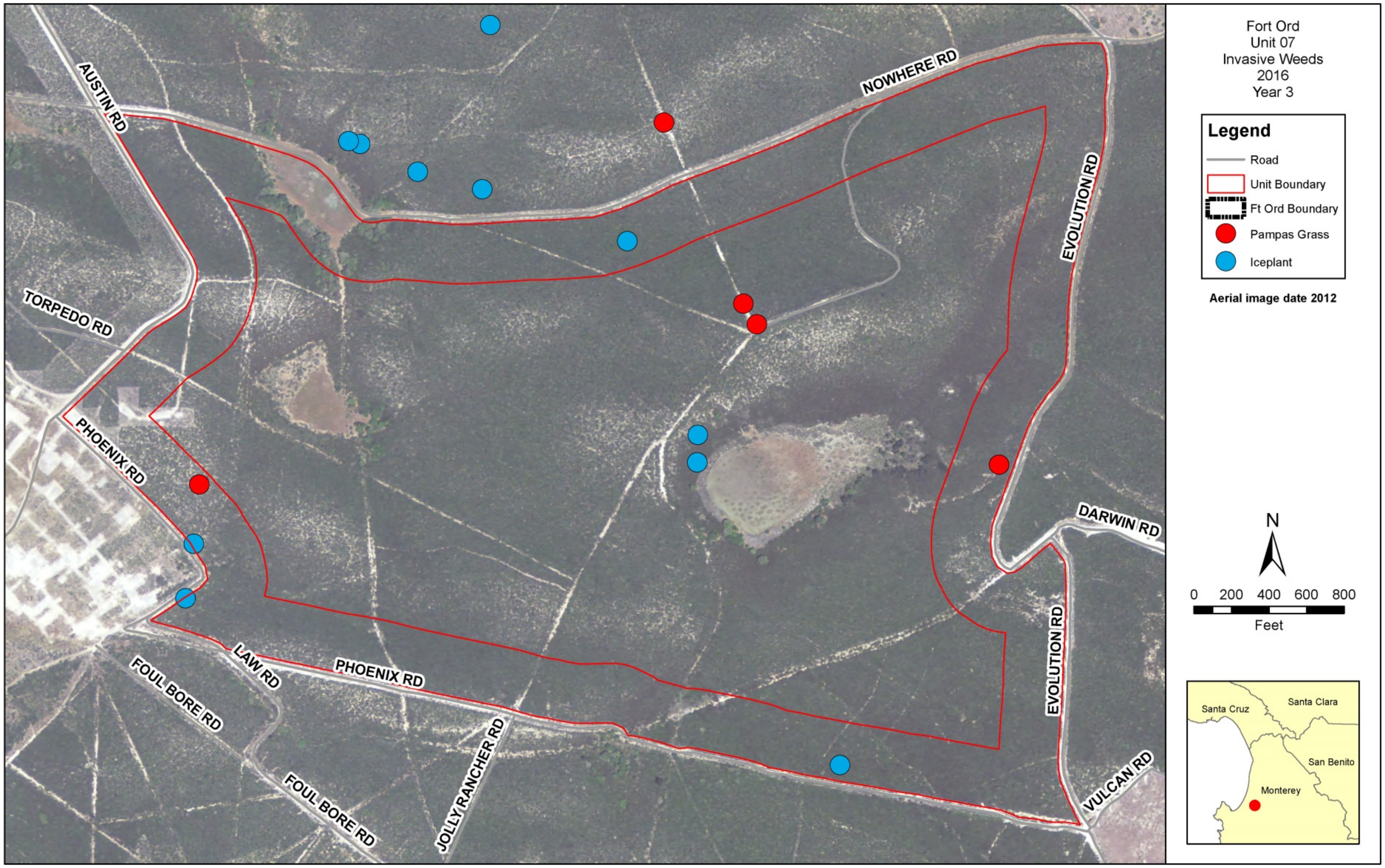

Figure C-6. Map of Invasive Weed Locations, Unit 07

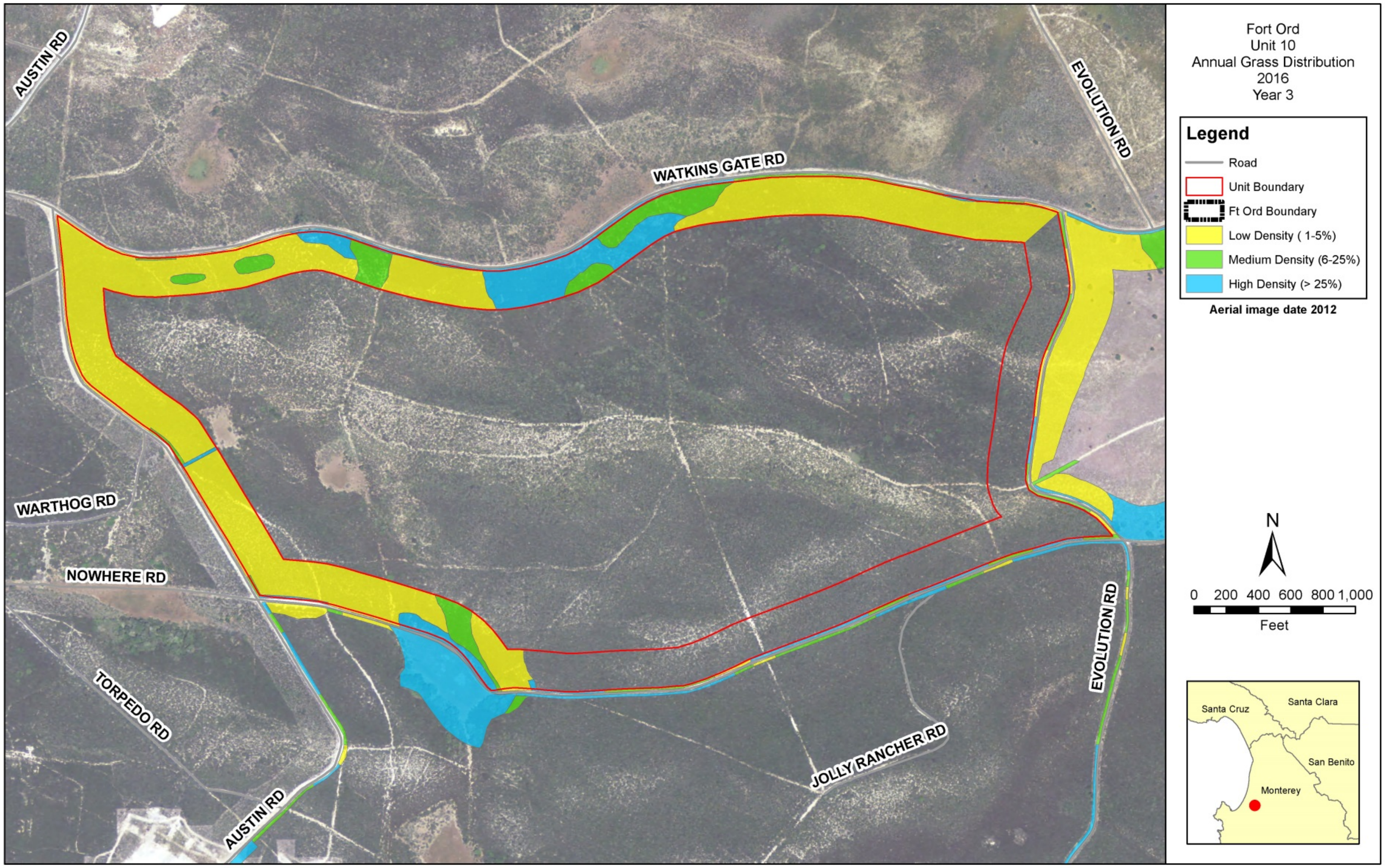

Figure C-7. Map of Annual Grass Distribution, Unit 10

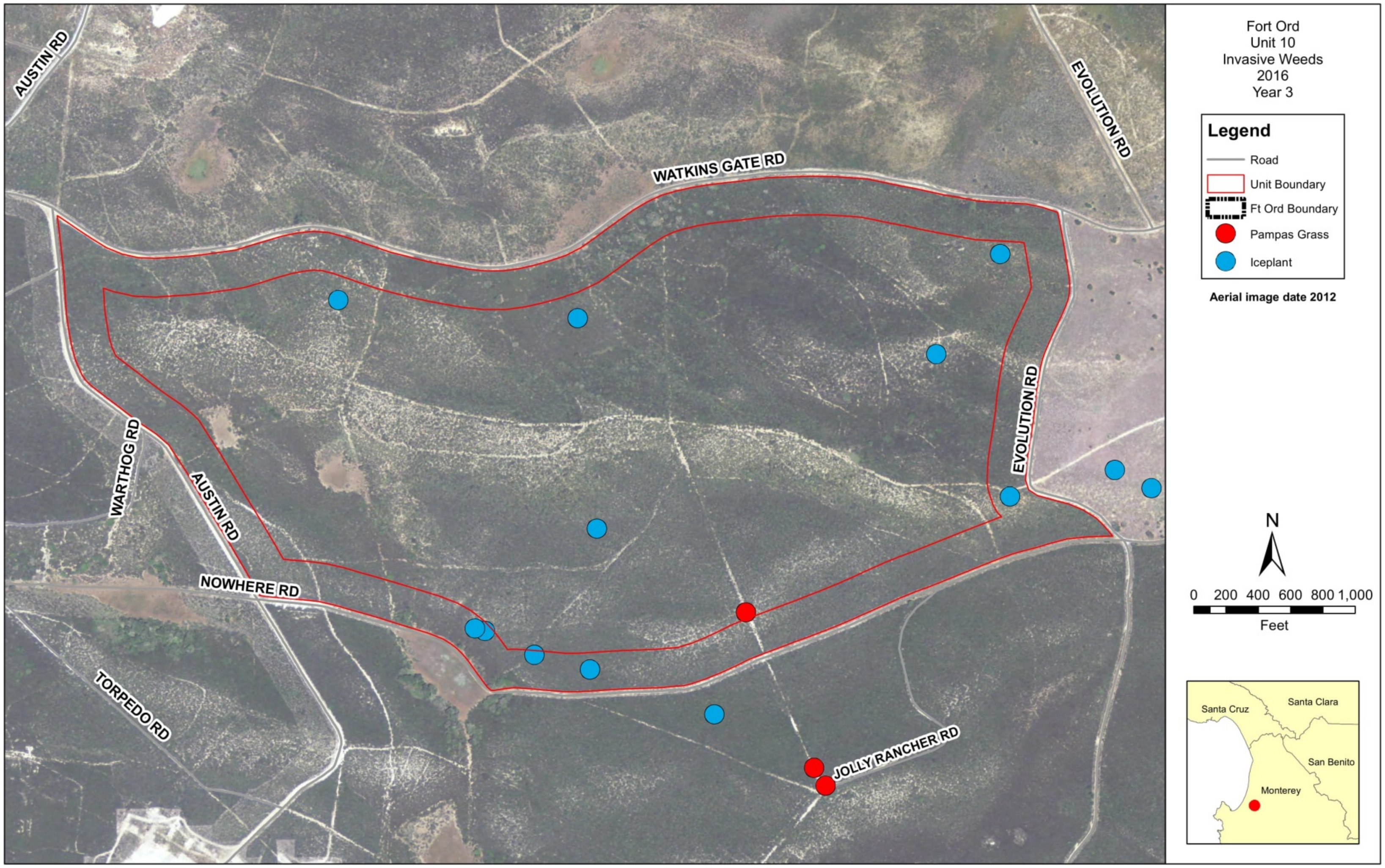

Figure C-8. Map of Invasive Weed Locations, Unit 10

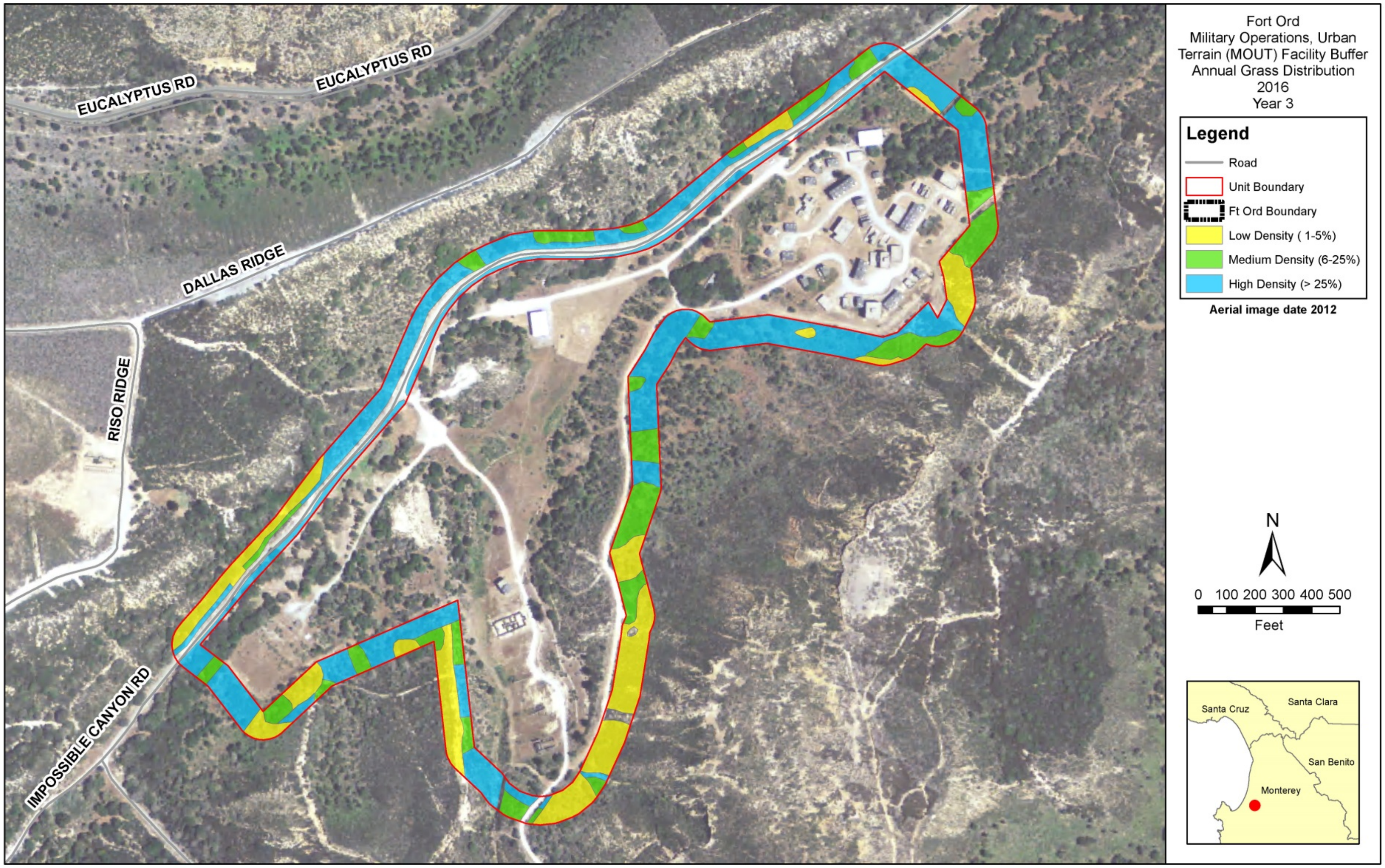

Figure C-9. Map of Annual Grass Distribution, MOUT

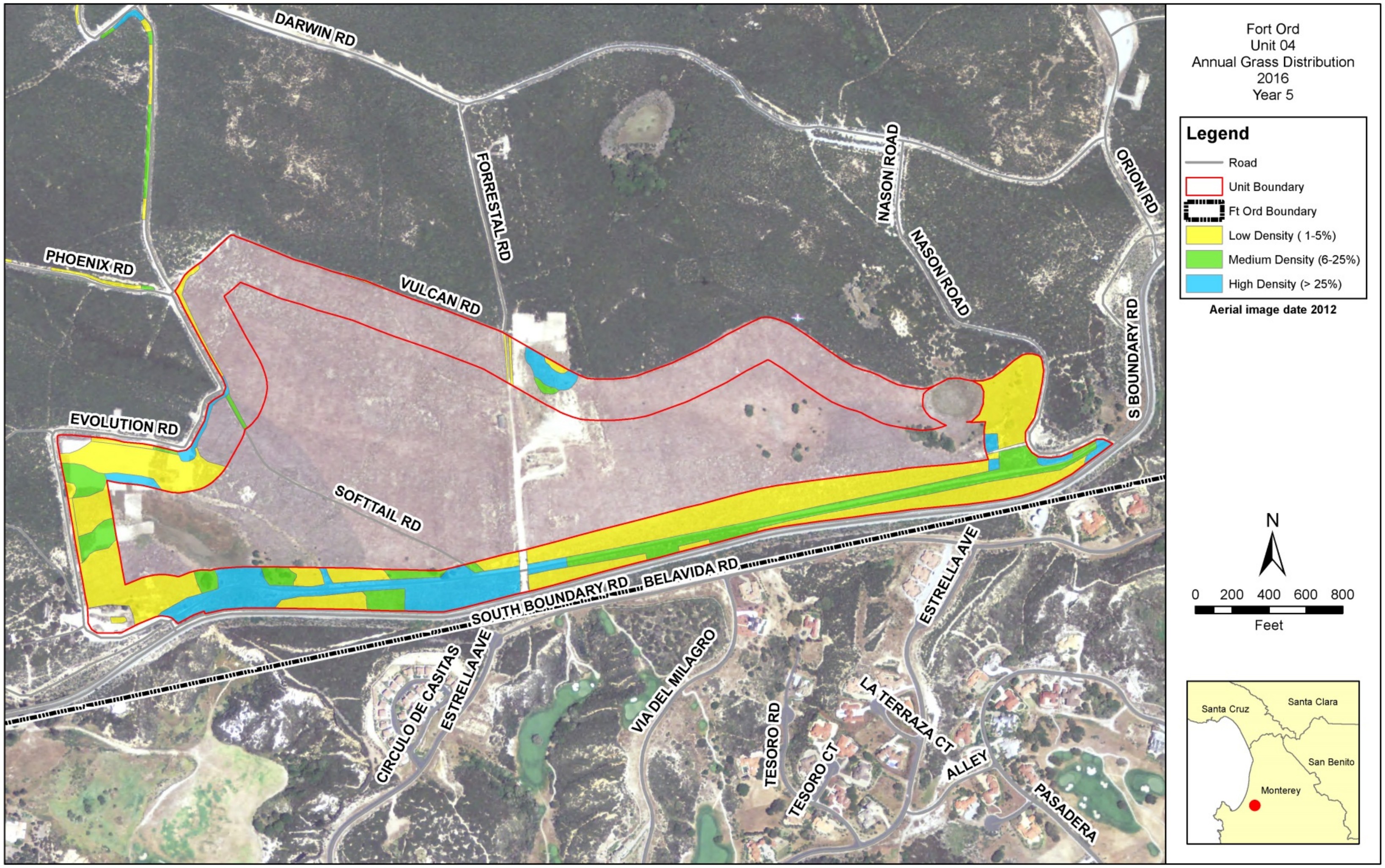

Figure C-10. Map of Annual Grass Distribution, Unit 04

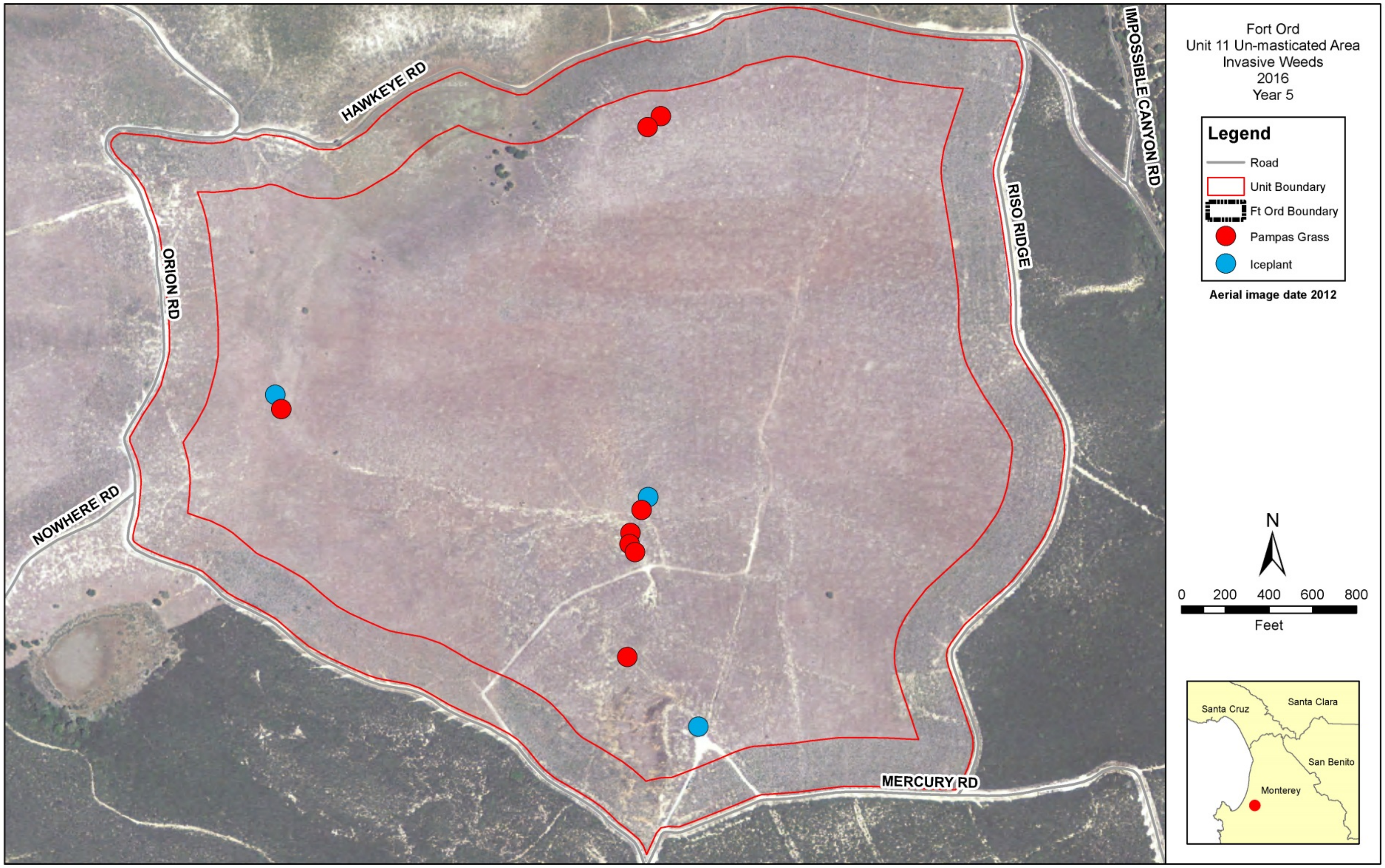

Figure C-11. Map of Invasive Weed Locations, Unit 11

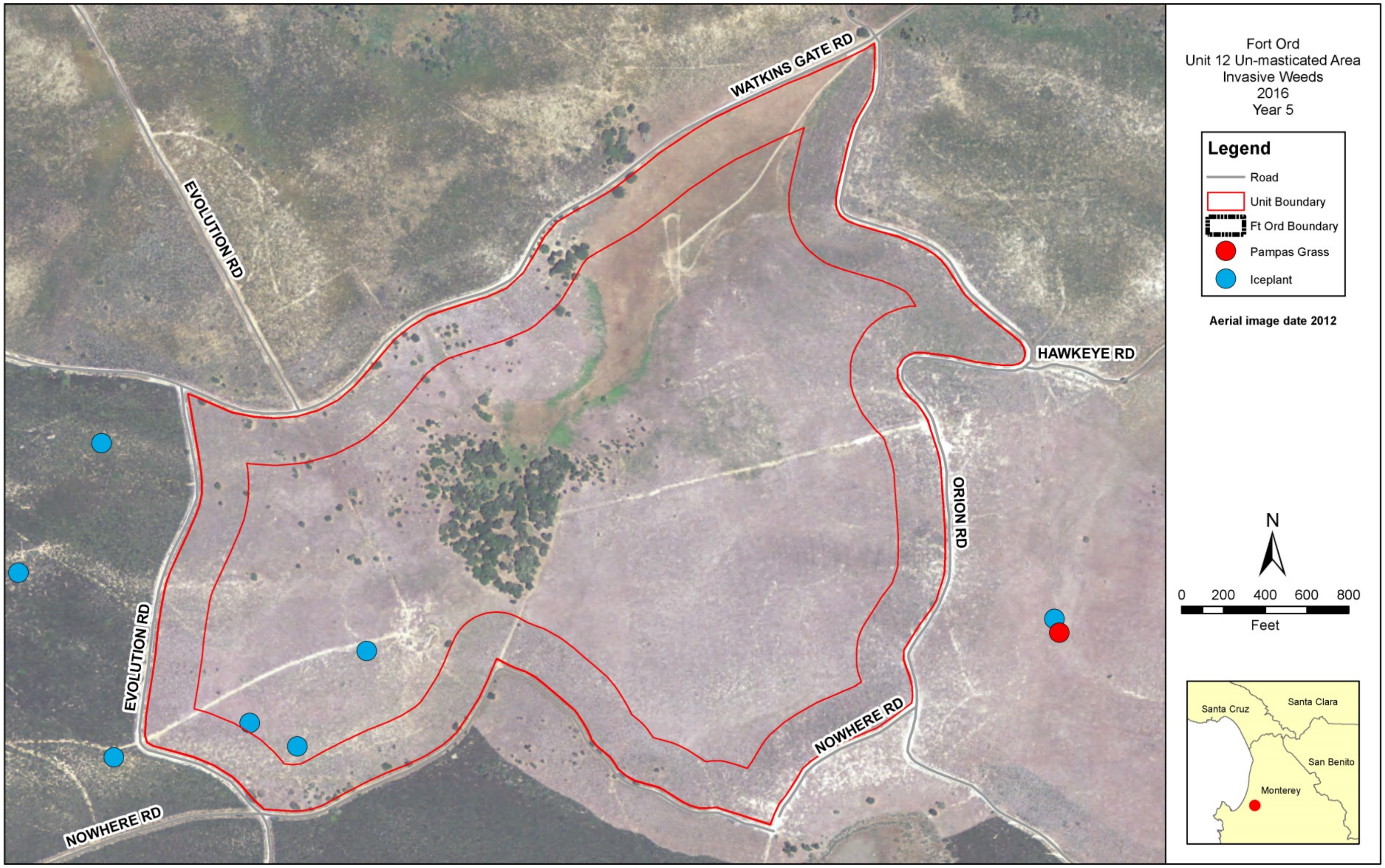

Figure C-12. Map of Invasive Weed Locations, Unit 12

Figure C-13. Map of Invasive Weed Locations, Unit 18

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APPENDIX D

MACROPLOT PRESENCE/ABSENCE MAPS

Figure D-1. Map of Monterey Spineflower Presence/Absence in Macroplots, Unit 09

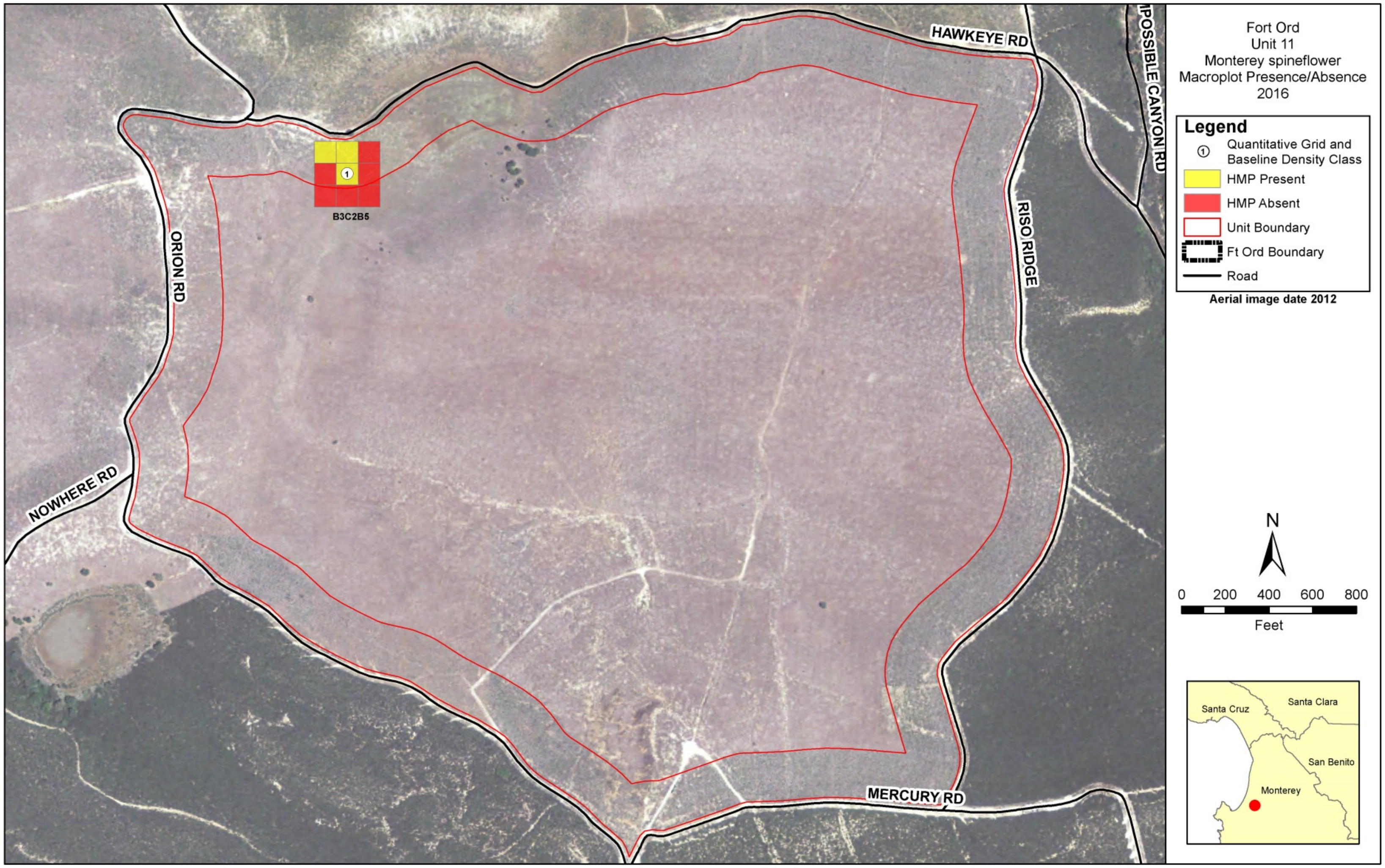

Figure D-2. Map of Monterey Spineflower Presence/Absence in Macroplots, Unit 11

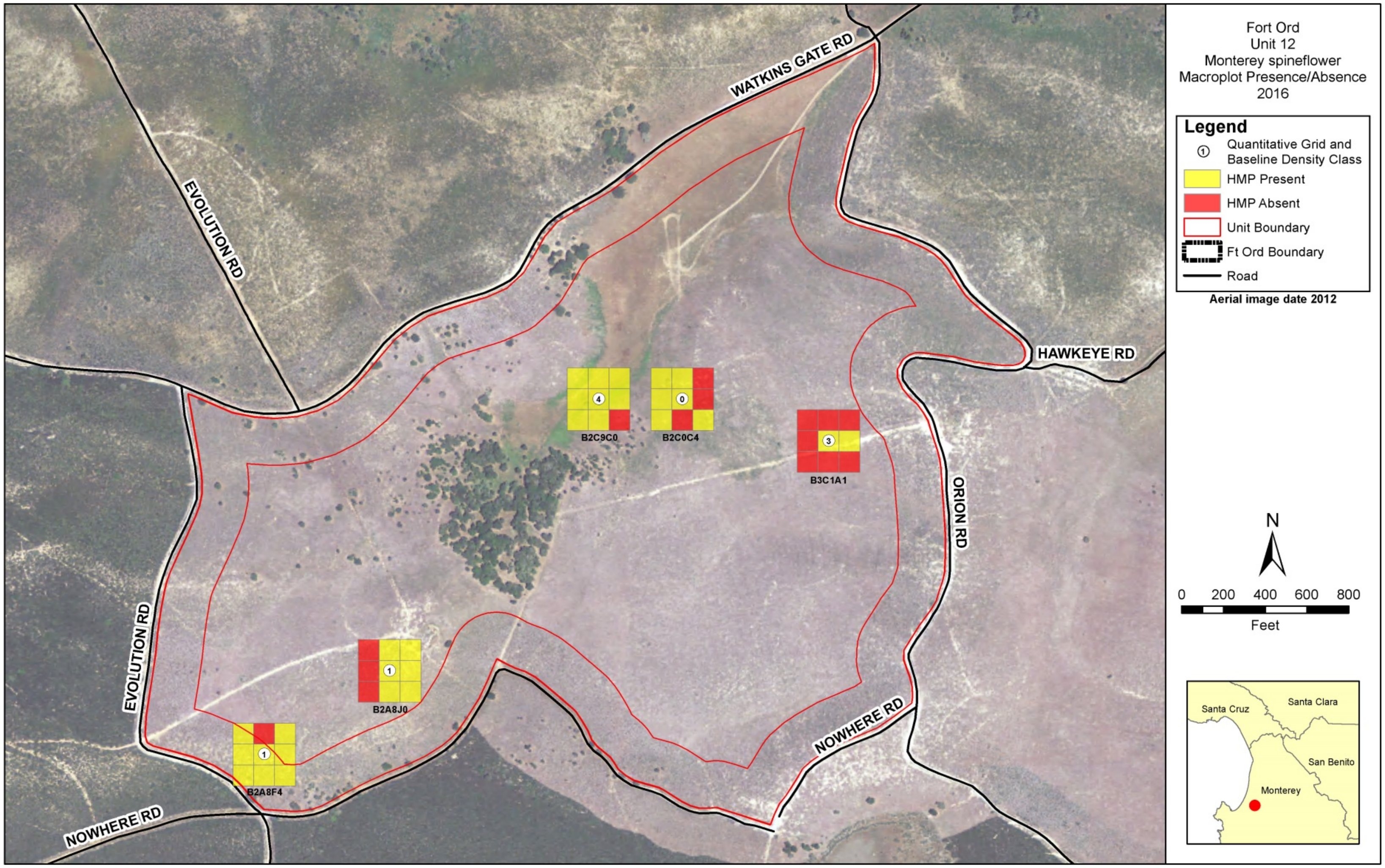

Figure D-3. Map of Monterey Spineflower Presence/Absence in Macroplots, Unit 12

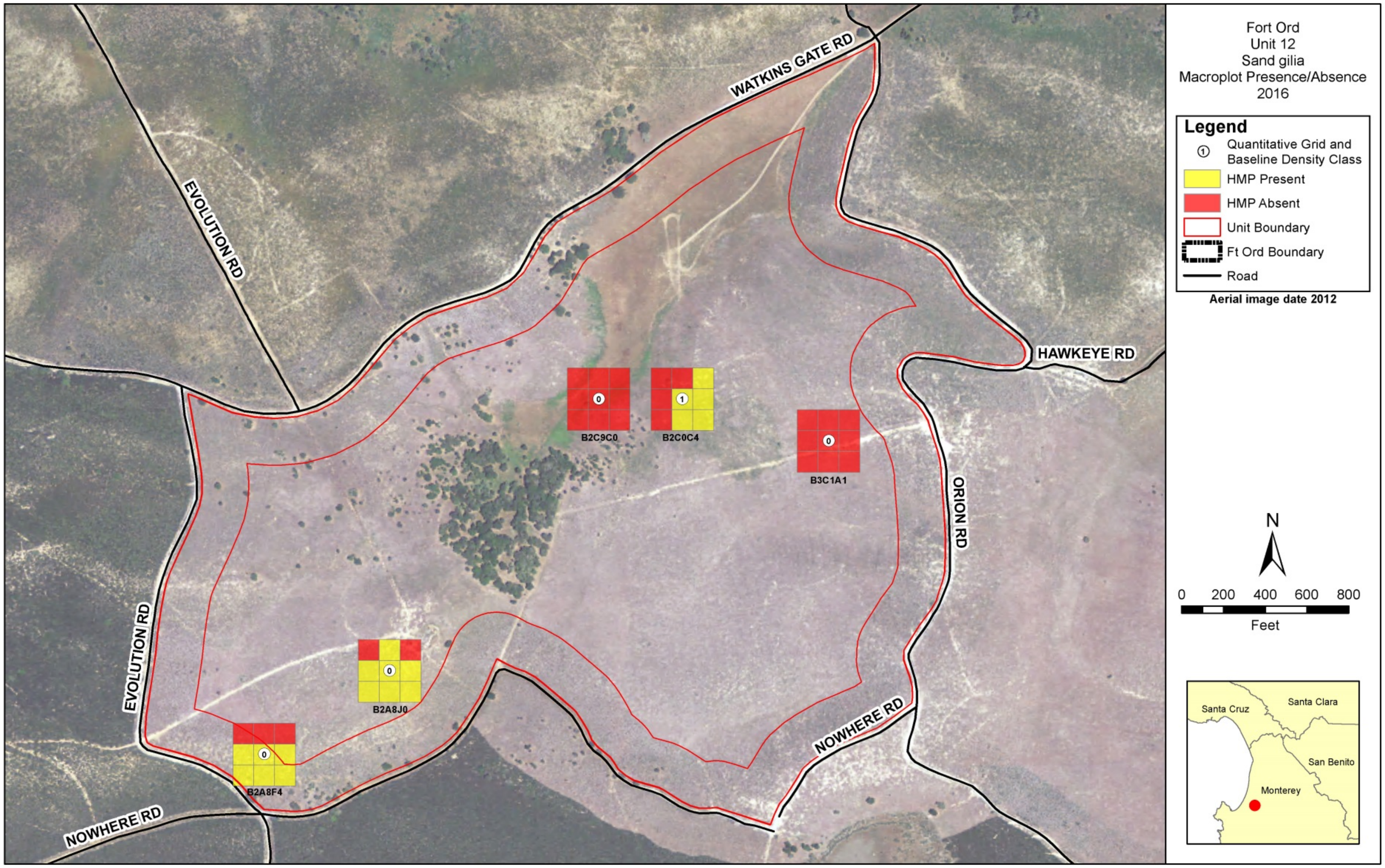

Figure D-4. Map of Sand Gilia Presence/Absence in Macroplots, Unit 12

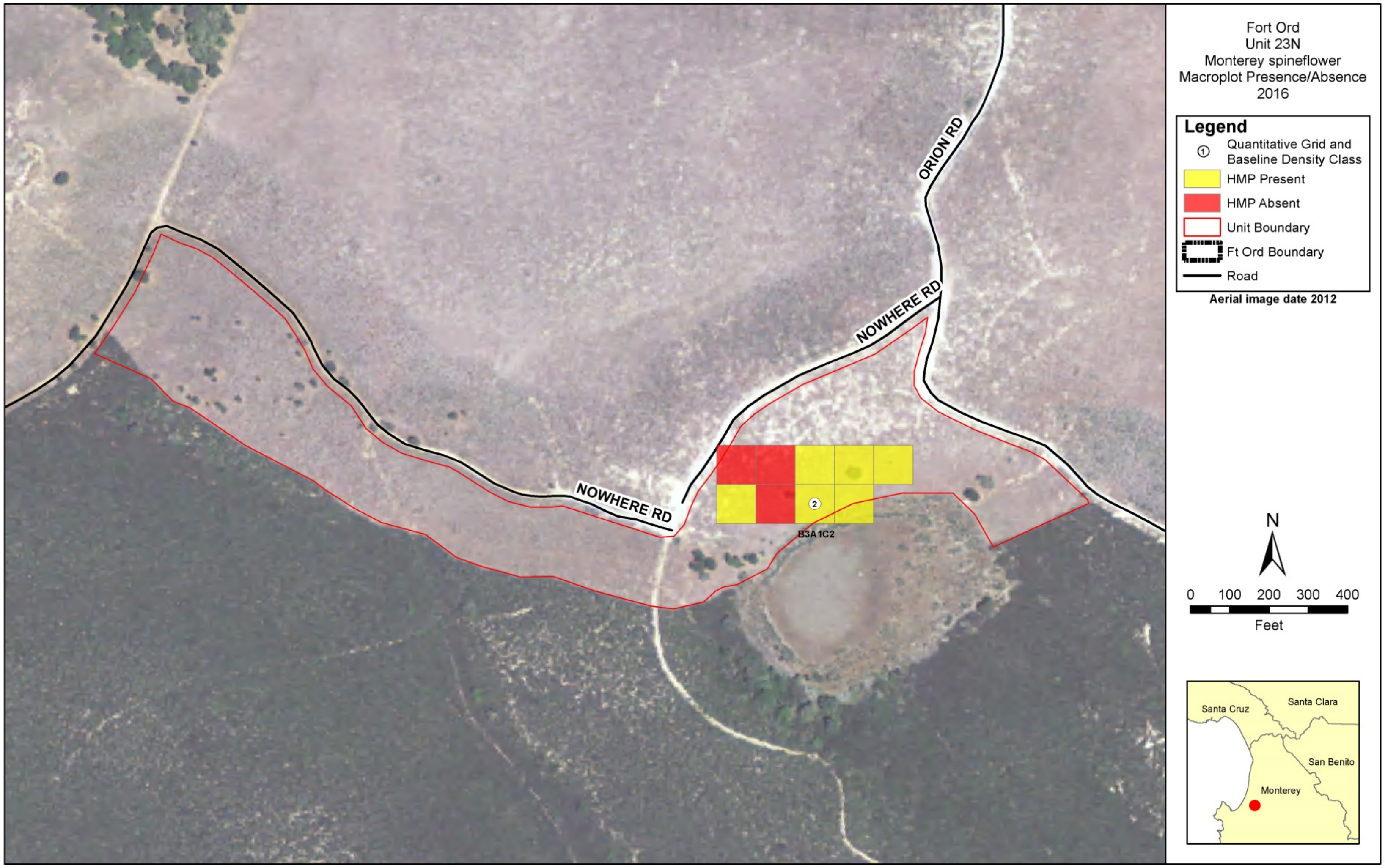

Figure D-5. Map of Monterey Spineflower Presence/Absence in Macroplots, Unit 23N

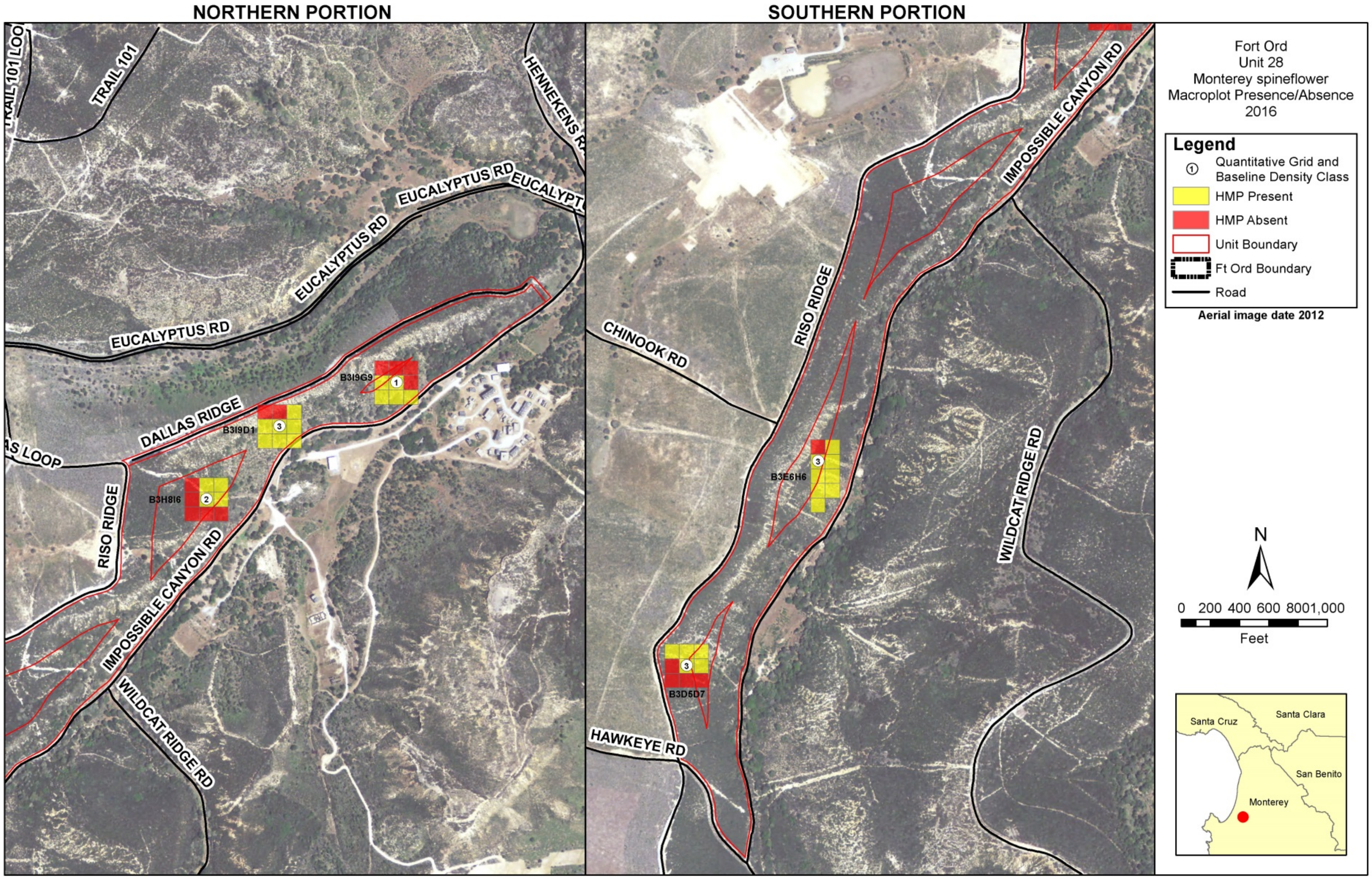

Figure D-6. Map of Monterey Spineflower Presence/Absence in Macroplots, Unit 28

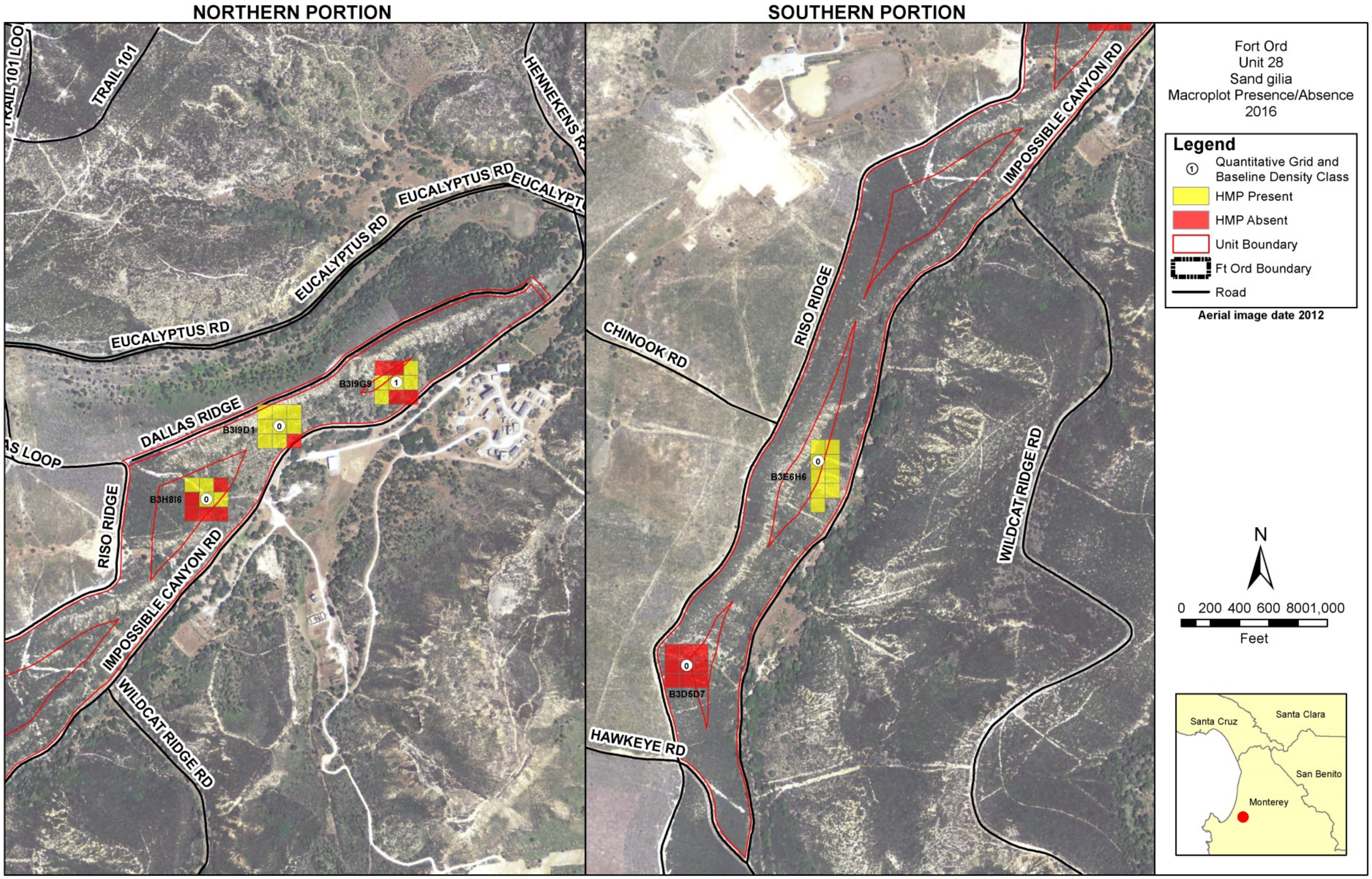

Figure D-7. Map of Sand Gilia Presence/Absence in Macroplots, Unit 28

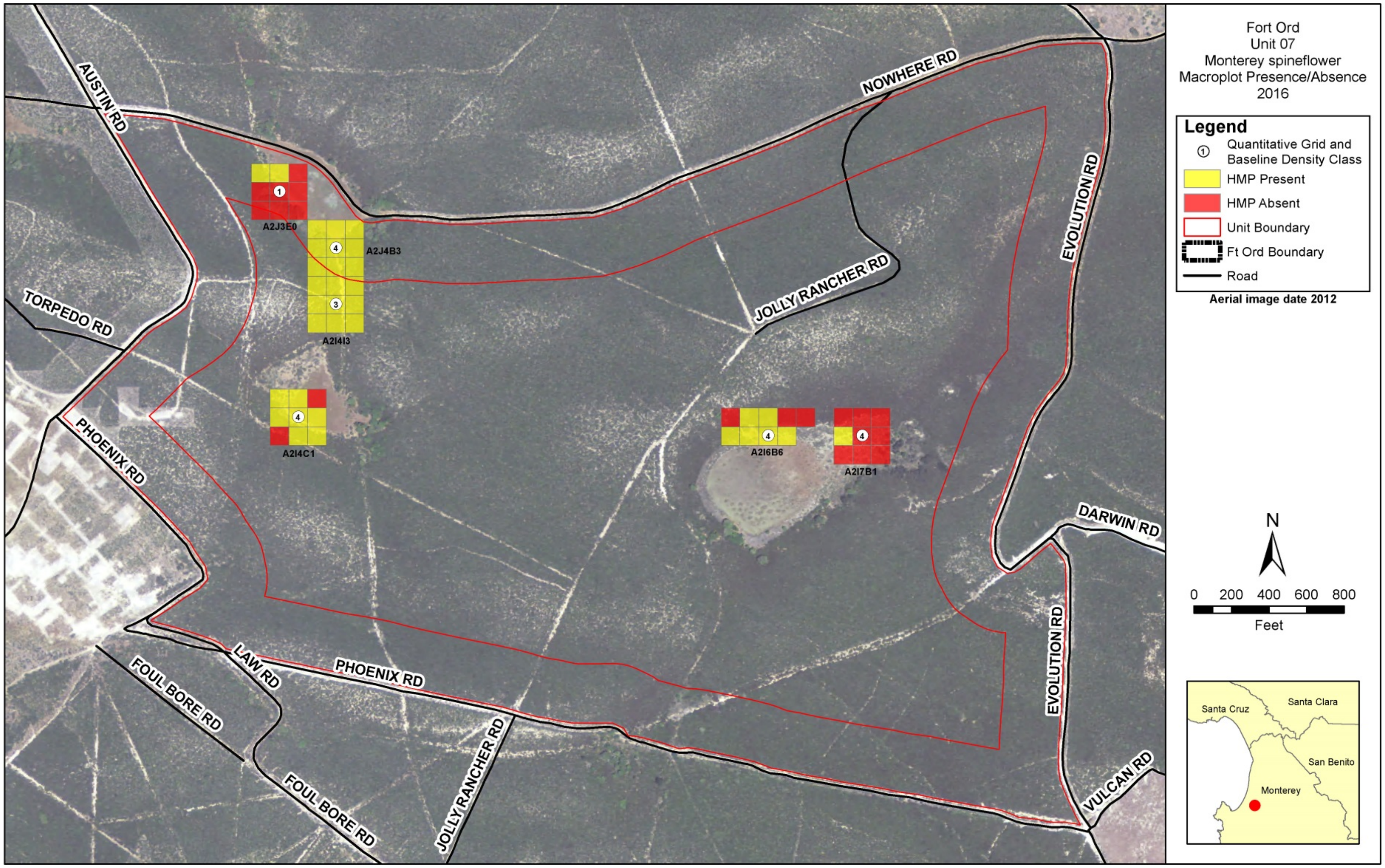

Figure D-8. Map of Monterey Spineflower Presence/Absence in Macroplots, Unit 07

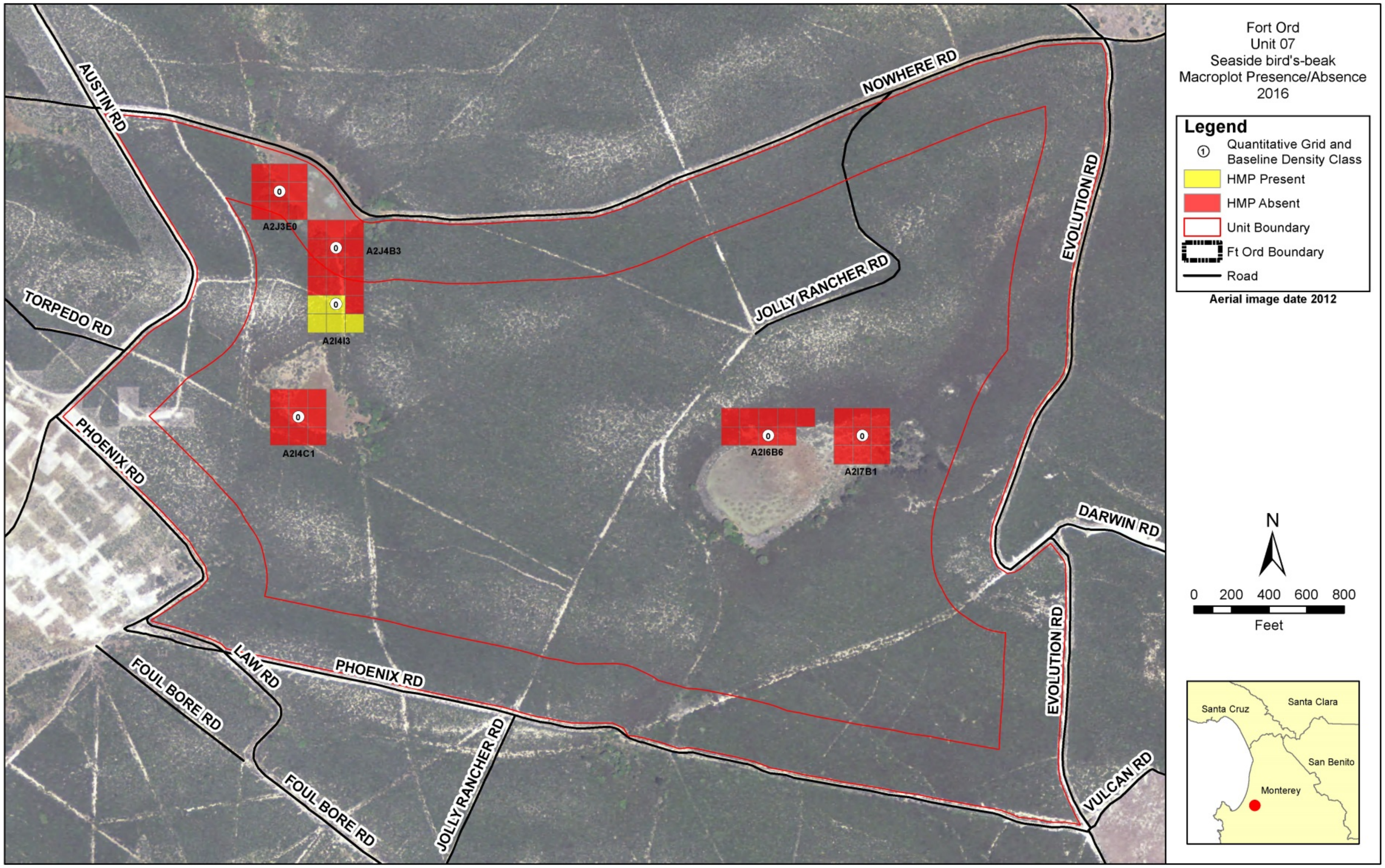

Figure D-9. Map of Seaside Bird's Beak Presence/Absence in Macroplots, Unit 07

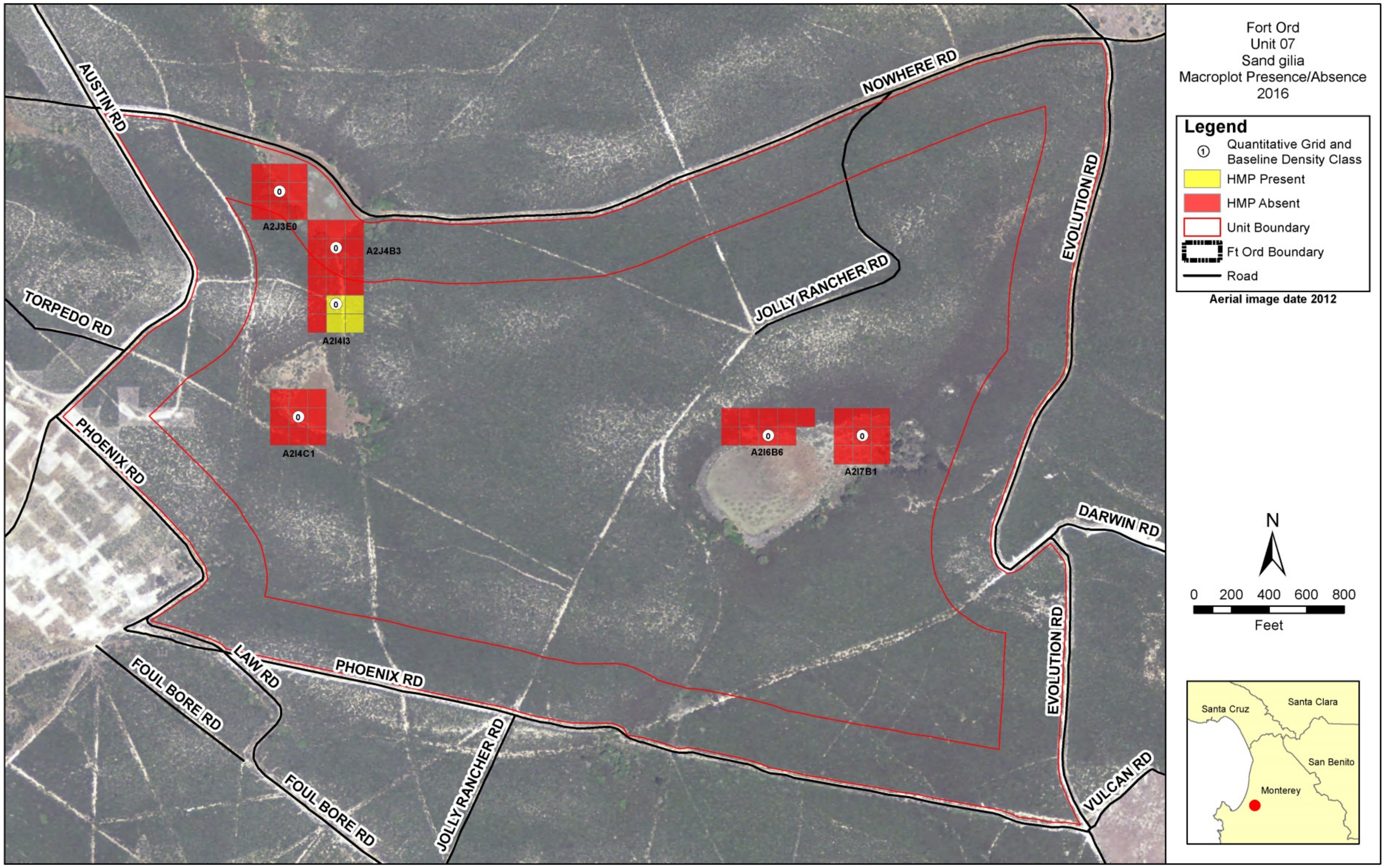

Figure D-10. Map of Sand Gilia Presence/Absence in Macroplots, Unit 07

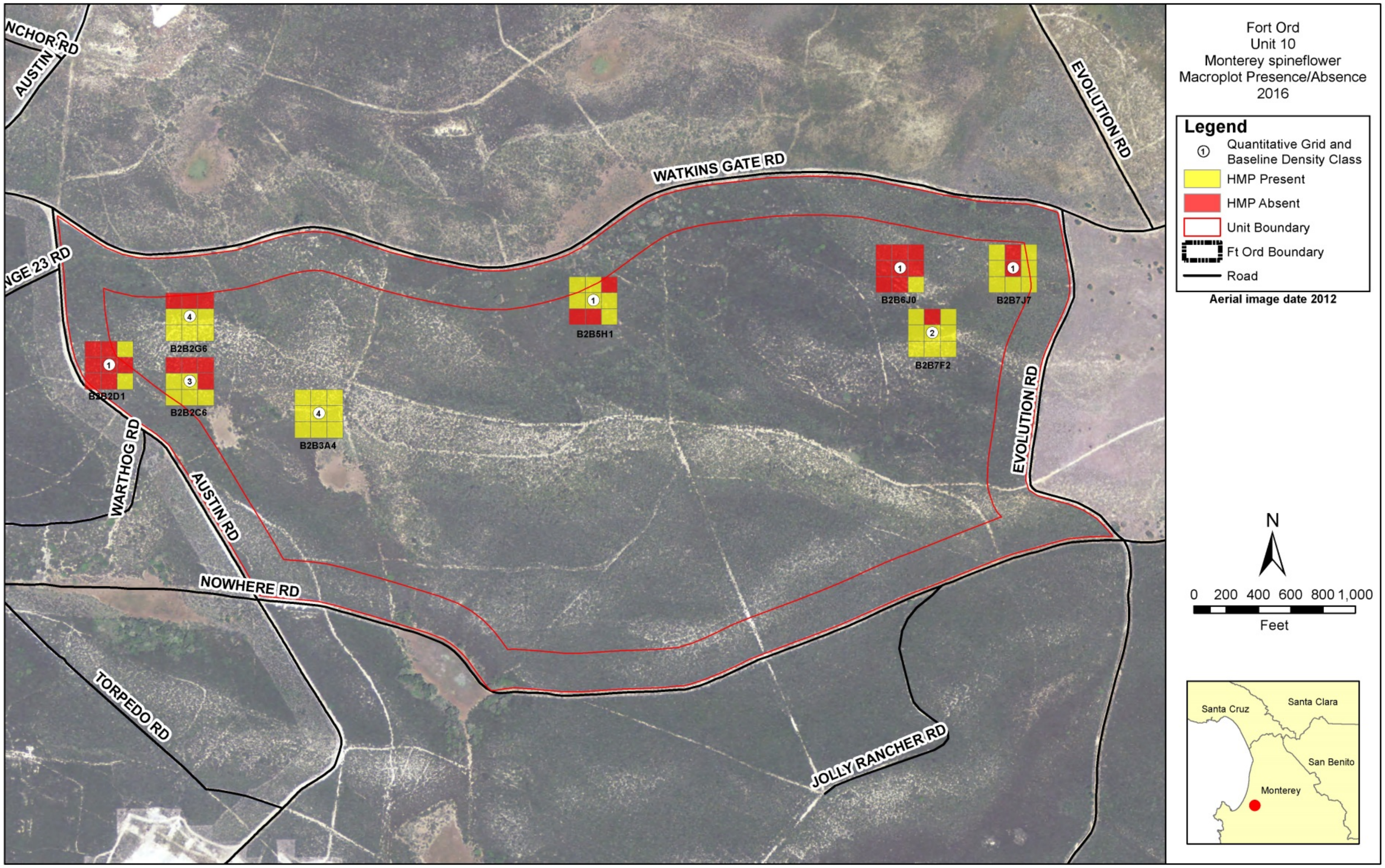

Figure D-11. Map of Monterey Spineflower Presence/Absence in Macroplots, Unit 10

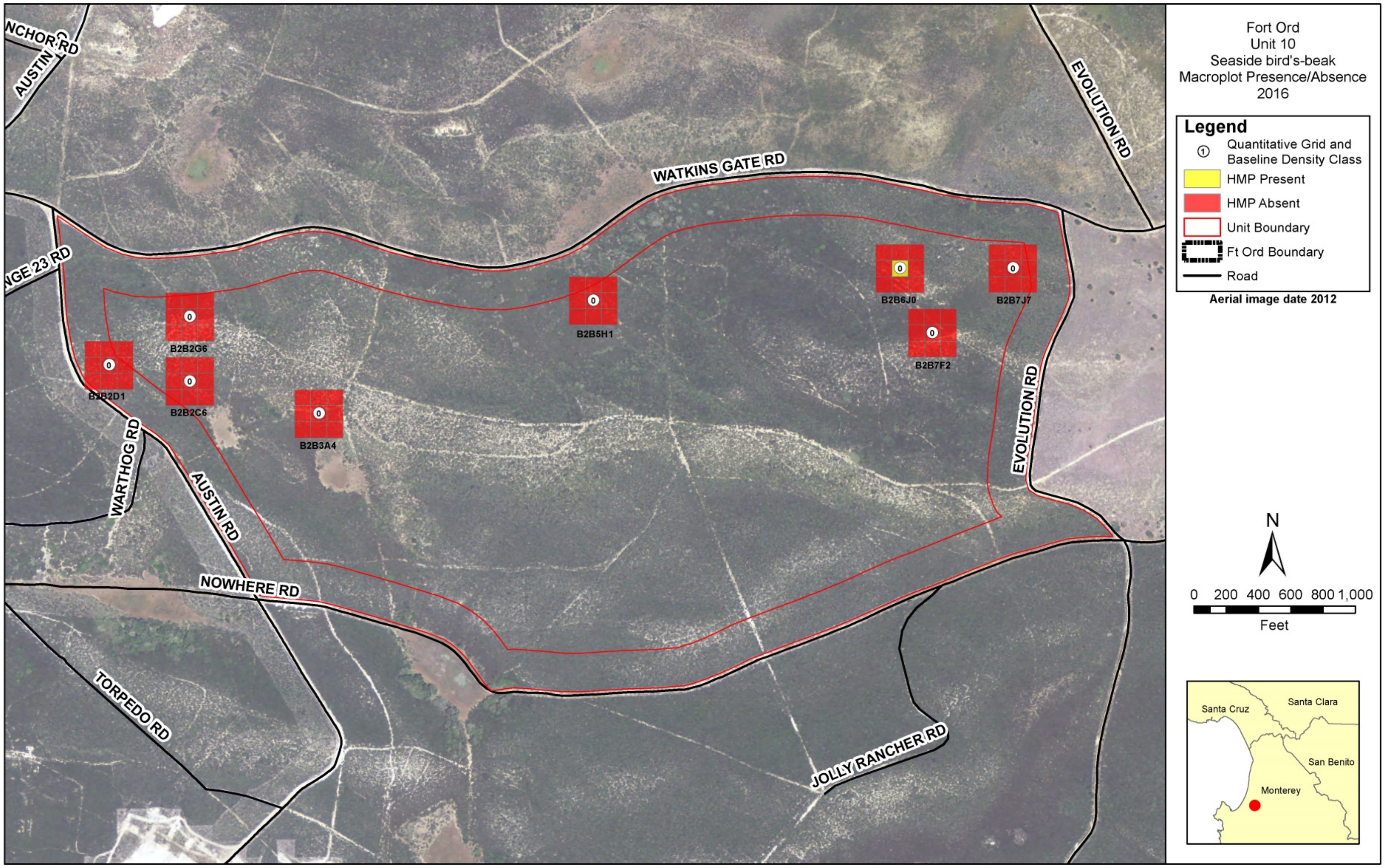

Figure D-12. Map of Seaside Bird's Beak Presence/Absence in Macroplots, Unit 10

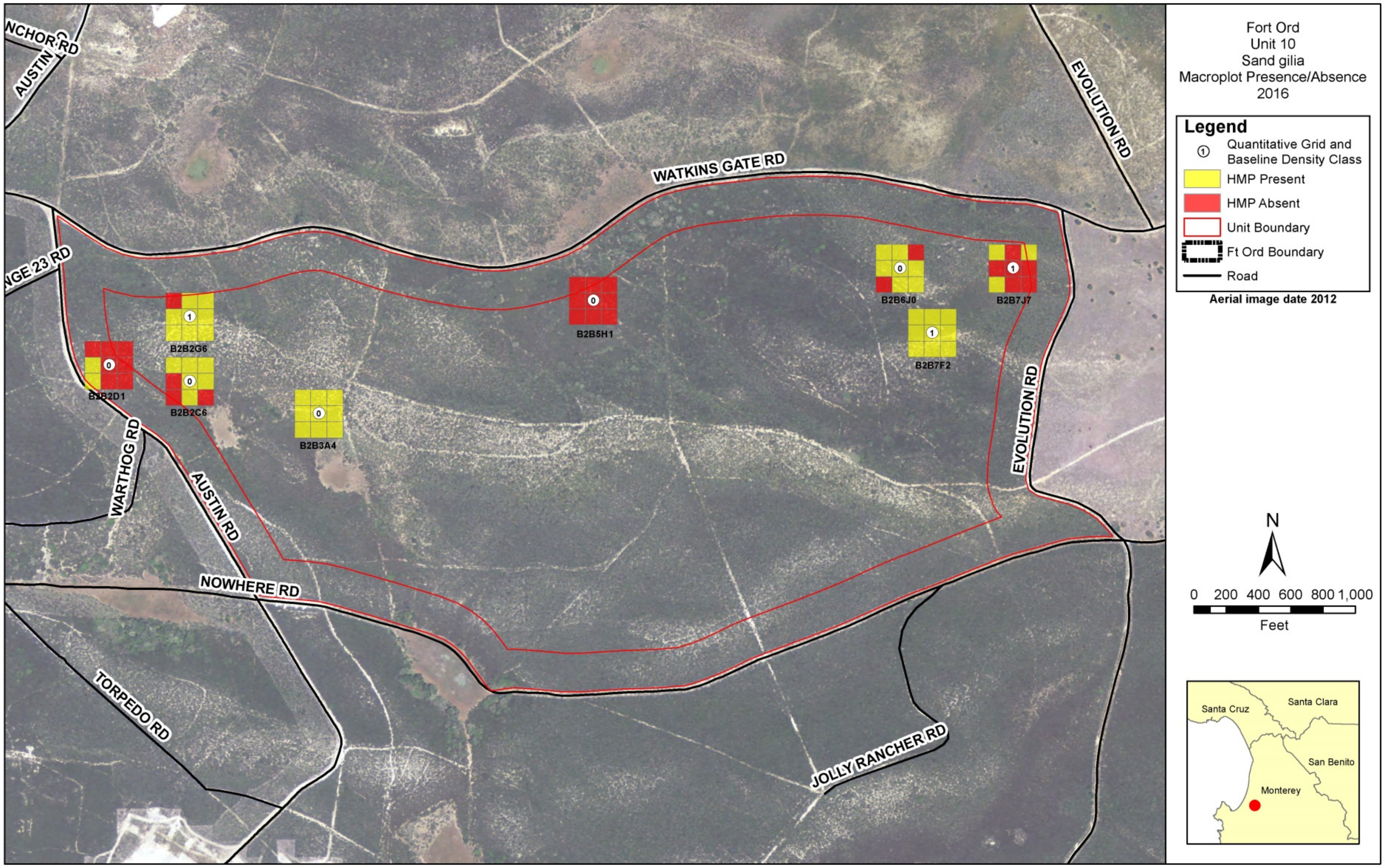

Figure D-13. Map of Sand Gilia Presence/Absence in Macroplots, Unit 10

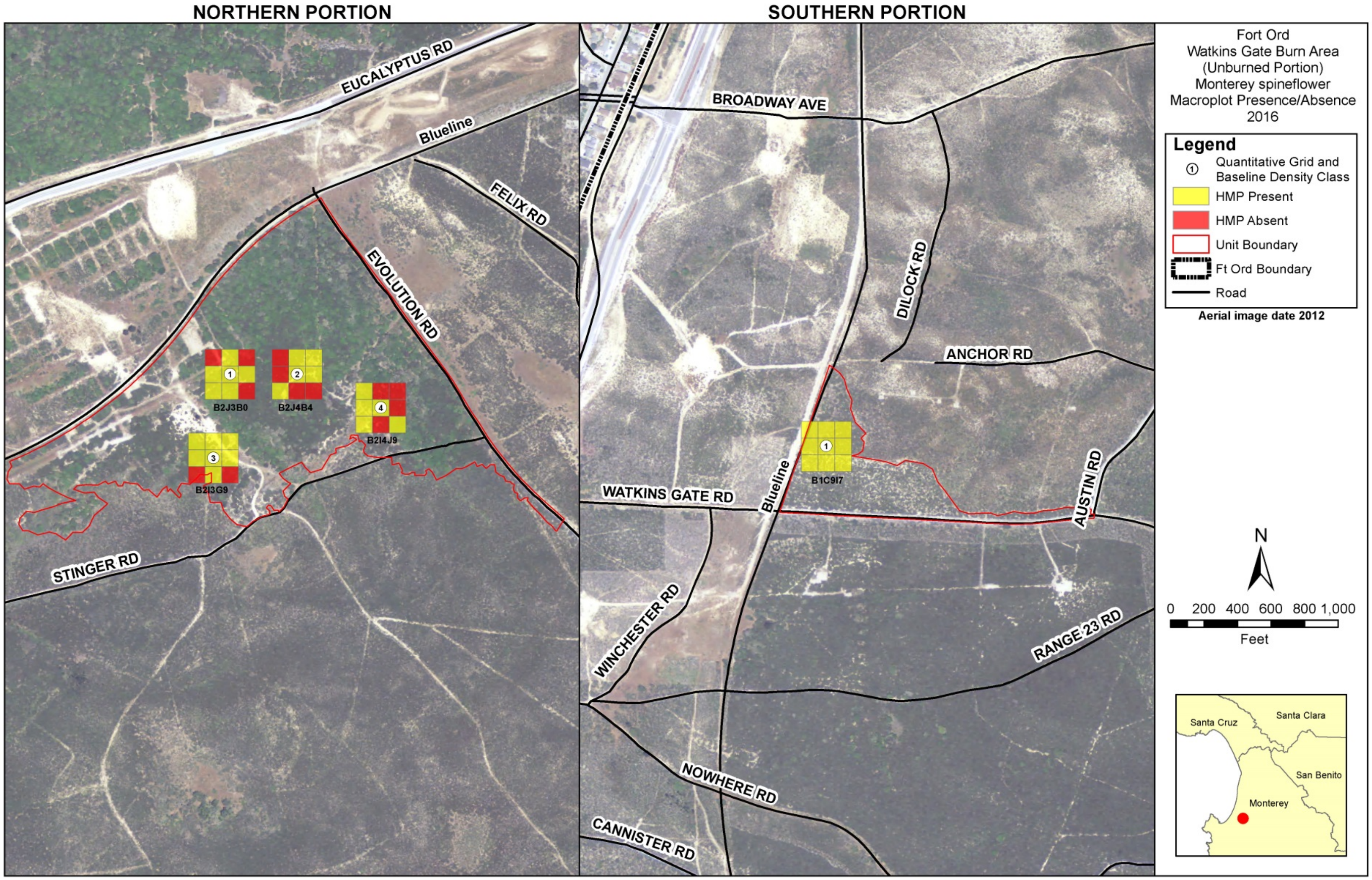

Figure D-14. Map of Monterey Spineflower Presence/Absence in Macroplots, WGBA

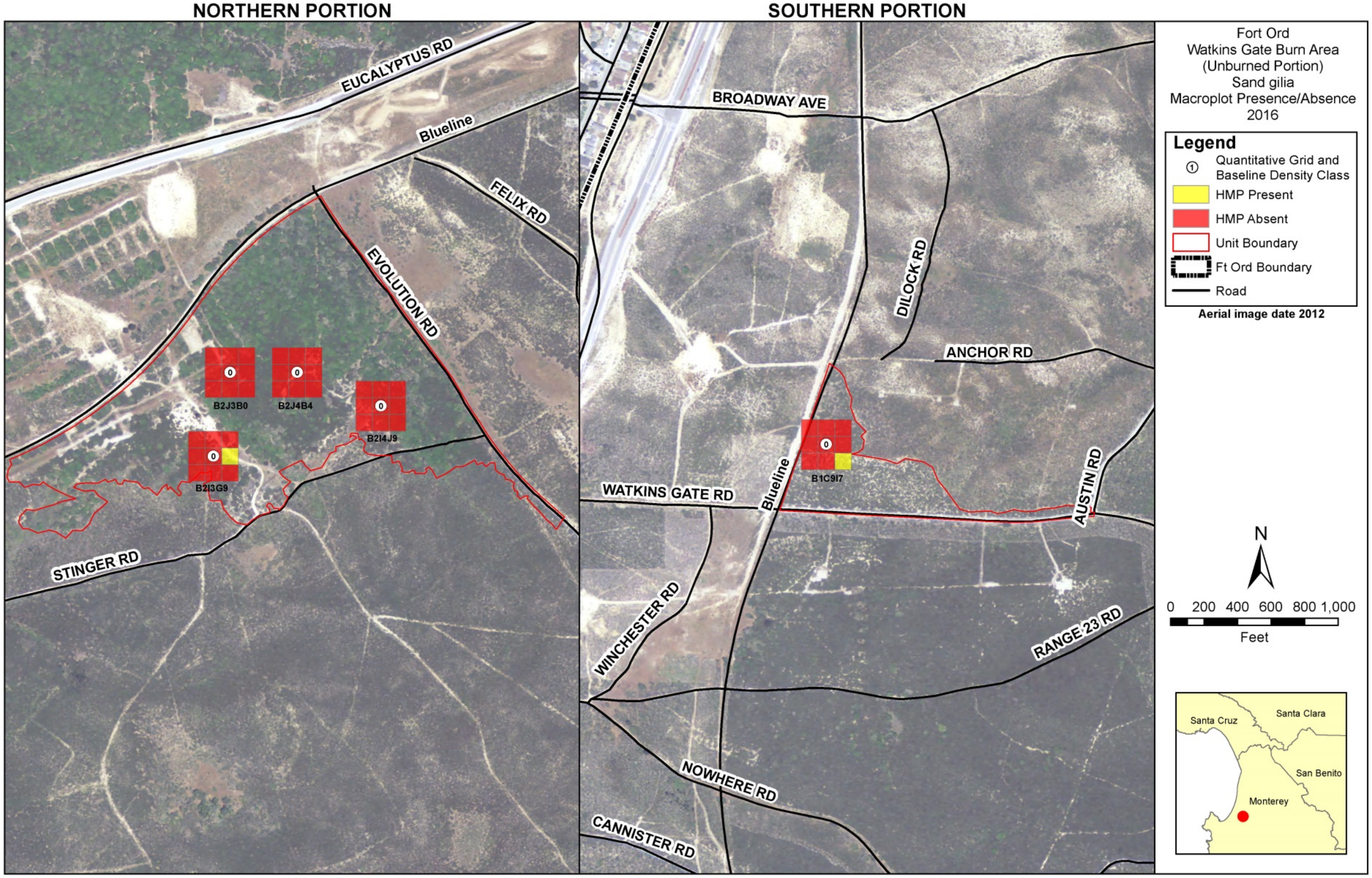

Figure D-15. Map of Sand Gilia Presence/Absence in Macroplots, WGBA

Figure D-16. Map of Monterey Spineflower Presence/Absence in Macroplots, Unit 04

APPENDIX E

SHRUB TRANSECT DATA

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Table E-1. Year 3 Shrub Transects, MOUT and Unit 01 East

		MOUT		Unit 01 East				
Code	**Species**	MOUT-1	MOUT-2	24A-1	26-2	27-3	T11	T12
ACME	*Acacia melanoxylon*	-	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	12.4	41.5	10.4	8.2	8.7	15.6	13.2
ARCA	*Artemisia californica*	-	-	-	-	-	2.4	-
ARPU	*Arctostaphylos pumila*	-	-	-	0.2	-	-	2.8
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	28	13.4	37.6	40.0	30.7	19.2	18.4
BAPI	*Baccharis pilularis*	4.2	-	-	-	-	4.2	-
CAED	*Carpobrotus edulis*	0.2	-	-	7.6	-	5.4	3.0
CEDE	*Ceanothus dentatus*	0.6	-	2.6	0.2	2.2	2.2	-
CERI	*Ceanothus rigidus*	0.8	1.1	-	-	-	-	-
COJU	*Cortaderia jubata*	4.2	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	0.8	-	0.6	2.8	-	1	6.6
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	-	-	-	2.8	-	0.2	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	2.6	0.4	3.6	0.6	5.4	5.4	5.4
LECA	*Lepechinia calycina*	-	-	2.0	-	5.7	1.2	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	-	1.8	17.4	55.4	14.2	41	20.2
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	1.4	-	-	-	0.7	-	-
QUAG	*Quercus agrifolia*	4.2	-	-	-	2.4	-	-
RUUR	*Rubus ursinus*	6.8	-	-	-	-	-	-
SAME	*Salvia mellifera*	-	6.9	3.0	-	9.4	18.8	2.6
SOUM	*Solanum umbelliferum*	0.2	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	13.6	-	-	-	-	2.4	-
TODI	*Toxicodendron diversilobum*	1.2	-	-	4.8	-	-	-
BG	Bare ground	13	26.0	36.8	16.4	32.2	12.6	36.8
HERB	Herbaceous vegetation	54.8	11.2	1.2	3.0	5.7	12.6	14.6

Table E-2. Year 3 Shrub Transects, Unit 10

		Unit 10							
Code	**Species**	10-1	10-2	10-3	10-4	10-5	10-6	10-7	10-8
ACME	*Acacia melanoxylon*	-	-	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	2.2	11.2	6	7	15.2	6.2	9	-
ARCA	*Artemisia californica*	-	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	0.4	-	-	-	0.4	0.6	2.4
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	9	7.8	6.2	6.2	17.2	7.2	40	16.6
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-	-
CAED	*Carpobrotus edulis*	4	-	-	5.8	-	6	-	-
CEDE	*Ceanothus dentatus*	44.4	13.2	45.6	18.4	5.2	4	2.8	-
CERI	*Ceanothus rigidus*	22.4	3.6	45.6	3	-	5.4	0.2	0.2
COJU	*Cortaderia jubata*	-	-	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	1.4	-	0.6	-	2.8	9.8	4.8	15.4
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	3	1.8	1.2	-	3.8	-	6	2.6
HEAR	*Heteromeles arbutifolia*	-	11.6	13	-	-	-	-	-
HESC	*Helianthemum scoparium*	20.2	17.8	8.2	31.4	4.4	21.6	3.4	3
LECA	*Lepechinia calycina*	1.8	-	-	0.4	-	-	-	0.2
LOSC	*Acmispon glaber (=Lotus scoparius)*	5.6	16.8	13.8	6.6	1.2	40	14.2	23.8
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	-	-	-	-	0.4	-	2	2
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	0.2
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	5.8	8	3	1.8	5.8	4.2	-	-
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	-	-	4.6
TODI	*Toxicodendron diversilobum*	-	-	-	-	-	-	10.6	30.2
BG	Bare ground	12	33.4	19	24.2	42.8	20.2	18	21.2
HERB	Herbaceous vegetation	1	6	1.6	17	8.8	5	12.4	17.2

Table E-3. Year 3 Shrub Transects, Unit 10 (Continued)

Code	Species	Unit 10							
		10-9	10-10	10-11	10-12	10-13	10-14	10-15	10-16
ACME	*Acacia melanoxylon*	-	-	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	22.4	6.8	15.2	12.6	14	1.4	10.8	25.6
ARCA	*Artemisia californica*	-	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	-	0.2	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	22	28.8	13.8	28	19.2	29	16	10.8
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-	-
CAED	*Carpobrotus edulis*	-	3.6	0.6	1.2	-	-	5	-
CEDE	*Ceanothus dentatus*	25.4	0.8	2	18.8	17.8	42.6	11.2	13.2
CERI	*Ceanothus rigidus*	15.2	2	0.8	4.2	4.4	4.2	6.8	5
COJU	*Cortaderia jubata*	-	-	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	3.4	-	2.4	-	1.4	-	3	3.4
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	1	-
GAEL	*Garrya elliptica*	-	-	-	-	-	-	-	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	17.6	0.8	29	7.8	14.6	12.6	23.8	33.8
LECA	*Lepechinia calycina*	-	-	0.2	3.2	-	-	-	15.6
LOSC	*Acmispon glaber (=Lotus scoparius)*	50	46	12.6	3.8	9	22.8	23.6	50.6
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	-	-	1.6	-	-	-	-	0.6
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	7.4	-	2	1.6	1	-	4	7.2
SOUM	*Solanum umbelliferum*	-	0.4	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	-	3.4	-	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	-	-	-	-	3.2	2.4	6.8	-
BG	Bare ground	7.6	20	34.4	36	32	12.8		9.8
HERB	Herbaceous vegetation	1.6	12.4	3.4	2.6		3	3	0.2

Table E-4. Year 3 Shrub Transects, Unit 10 (Continued)

		Unit 10							
Code	**Species**	10-17	10-18	10-19	10-20	10-21	10-22	10-23	10-24
ACME	*Acacia melanoxylon*	-	-	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	5.8	41.8	3	11.6	2	8.4	8.2	1
ARCA	*Artemisia californica*	-	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	25	8.4	8	20	19.2	24.6	16.8	6.8
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-	-
CAED	*Carpobrotus edulis*	0.2	1.8	4.8	1.8	0.4	-	-	-
CEDE	*Ceanothus dentatus*	7.6	46.6	-	-	67	17.2	35.8	25
CERI	*Ceanothus rigidus*	5.6	7.2	-	0.6	1.4	6.4	2.8	0.8
COJU	*Cortaderia jubata*	-	-	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	1.2	0.2	-	3.8	0.2	-	-	0.2
ERER	*Ericameria ericoides*	3.2	-	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-	2.8	1.2	1.6	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	14.6	5.2	38.6	32.6	25.8	25.2	22.4	25.8
LECA	*Lepechinia calycina*	-	-	-	0.2	1.8	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	23	-	37.2	72.6	-	30.4	23.6	31.2
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	-	-	-	-	-	-	-	-
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	1.2	-	-	0.6	1	5	0.6	3.6
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	2.2	-	-	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	6	-	-	0.4	-	-	-	-
BG	Bare ground	25.8	12	30.4	9.6	13.8	19.4	19.6	25.4
HERB	Herbaceous vegetation	3.8	9.2	7		0.4	1.6	1.2	4.2

Table E-5. Year 3 Shrub Transects, Unit 10 (Continued)

Code	Species	Unit 10					
		10-25	10-26	10-27	10-28	10-29	10-30
ACME	*Acacia melanoxylon*	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	7.2	5.4	4.2	4.2	2.4	4
ARCA	*Artemisia californica*	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	-	-	0.2	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	20.6	23	21.2	31	18	28
BAPI	*Baccharis pilularis*	-	-	-	-	-	-
CAED	*Carpobrotus edulis*	0.8	2.8	-	0.4	-	5
CEDE	*Ceanothus dentatus*	3	17.6	40.6	14.2	20	5.2
CERI	*Ceanothus rigidus*	-	8	1.2	1.8	2	3.4
COJU	*Cortaderia jubata*	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	1.2	-	0.2	-	-	-
ERER	*Ericameria ericoides*	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-
GAEL	*Garrya elliptica*	-	-	7.8	0.8	7	2.2
HEAR	*Heteromeles arbutifolia*	0.4	-	6.8	-	-	-
HESC	*Helianthemum scoparium*	9.8	24.4	16.6	5.2	4.4	2.8
LECA	*Lepechinia calycina*	-	-	-	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	33.6	50	19.6	19	2.6	18.6
LUAR	*Lupinus arboreus*	0.6	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	1.4	0.8	-	-	-	-
QUAG	*Quercus agrifolia*	-	-	-	-	-	0.6
RUUR	*Rubus ursinus*	-	-	-	-	-	-
SAME	*Salvia mellifera*	0.2	4.4	1	-	-	2
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	17.6	-	-	1.4	3.2	-
BG	Bare ground	26	5.6	15.6	32.2	45.4	36.2
HERB	Herbaceous vegetation	4.8	5.4	0.8	4.2	5.2	5.2

Table E-6. Year 3 Shrub Transects, Unit 06 and Unit 07

		Unit 6						Unit 7	
Code	**Species**	6-2	6-3	6-5	6-6	27B-1	28-2	7-1	7-2
ACME	*Acacia melanoxylon*	-	-	-	11.2	-	-	-	-
ADFA	*Adenostoma fasciculatum*	15.2	22.2	8	9	19.8	12.4	5.6	17.6
ARCA	*Artemisia californica*	-	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	1	-	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	29.6	16.4	21.4	38.8	20.8	28	32.4	20
BAPI	*Baccharis pilularis*	-	-	-	0.4	-	-	1.4	-
CAED	*Carpobrotus edulis*	0.2	-	-	11.6	1.2	0.2	2.4	0.4
CEDE	*Ceanothus dentatus*	1.4	-	-	-	-	1.8	2.8	24.2
CERI	*Ceanothus rigidus*	-	-	-	-	-	-	1.6	1.4
COJU	*Cortaderia jubata*	-	-	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	9.6	5.2	4	0.2	-	5.8	-	16.8
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	0.8	-	-	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-	-	-	-	-
HEAR	*Heteromeles arbutifolia*	-	3	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	5.4	2.4	5	2.8	0.6	4.8	9.8	14.4
LECA	*Lepechinia calycina*	-	-	-	-	-	-	1.8	1
LOSC	*Acmispon glaber (=Lotus scoparius)*	15	11.8	32.8	14.4	70.8	11.2	67.2	3
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	-	-	-	0.6	-	-	-	-
QUAG	*Quercus agrifolia*	-	-	-	-	6.6	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	3	2.6	2.2	1.4	-	-	5.2	2.8
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	-	-	-	-	-	-	-	-
BG	Bare ground	34.6	43.6	35.8	28.2	5.6	40.6	12.2	22.6
HERB	Herbaceous vegetation	1.4	1.6	2.8	3.6	0.4	0.8		2

Table E-7. Year 3 Shrub Transects, Unit 07 (Continued)

		Unit 7							
Code	**Species**	7-3	7-4	7-5	7-6	7-7	7-8	7-9	7-10
ACME	*Acacia melanoxylon*	-	-	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	0.6	-	7.4	4.8	33	22.2	6.6	18.6
ARCA	*Artemisia californica*	-	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	22.6	13.8	9.8	8.4	24.6	13.2	30.8	10.8
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-	-
CAED	*Carpobrotus edulis*	0.2	21	2	1.4	-	3.4	-	0.6
CEDE	*Ceanothus dentatus*	37.2	7.8	50	9.2	6.8	19.8	39.4	13.8
CERI	*Ceanothus rigidus*	3.6	1.2	6.8	2.8	2.4	4.4	0.8	-
COJU	*Cortaderia jubata*	-	-	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	1	-	0.4	0.2	3.8	2	0.2	0.2
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-	0.4
GAEL	*Garrya elliptica*	3.8	-	3	-	-	-	2.2	-
HEAR	*Heteromeles arbutifolia*	-	-	11.8	-	-	-	-	-
HESC	*Helianthemum scoparium*	16.4	3.4	5	25.6	0.6	14.4	11.6	23.2
LECA	*Lepechinia calycina*	0.4	4.8	1.4	0.2	-	-	0.8	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	-	33.4	-	71.4	34.2	17.6	28	15.4
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	-	-	-	-	-	-	-	-
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	-	6.8	0.2	4.6	6.2	-	-	-
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	0.2	-	0.4	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	1.8	-	0.4	-	-	-	0.4	-
BG	Bare ground	31.6	36.8	22.2	16.8	21.2	21.4	19	31.8
HERB	Herbaceous vegetation	0.8		2		1	2.8		1

Table E-8. Year 3 Shrub Transects, Unit 07 (Continued)

		Unit 7							
Code	**Species**	7-11	7-12	7-13	7-14	7-15	7-16	7-17	7-18
ACME	*Acacia melanoxylon*	-	-	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	0.4	46.8	12.4	19.2	26.6	10.6	5.8	22.6
ARCA	*Artemisia californica*	-	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	39.2	3.6	17.8	7.2	7.2	20	16.2	4.2
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-	-
CAED	*Carpobrotus edulis*	-	-	-	0.2	0.4	0.6	0.2	1
CEDE	*Ceanothus dentatus*	38.4	18.6	51	-	10.4	30.2	34.6	2.6
CERI	*Ceanothus rigidus*	0.2	9	2	2.8	7.2	0.4	1	0.2
COJU	*Cortaderia jubata*	-	-	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	-	-	2.2	-	0.2	0.8	4.4	-
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-	-	-	-	-
HEAR	*Heteromeles arbutifolia*	-	-	4.2	-	-	-	3	-
HESC	*Helianthemum scoparium*	16.2	8	20.8	3.4	13.6	25.8	37.2	41.2
LECA	*Lepechinia calycina*	0.4	-	1	0.8	-	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	24.4	18.8	4.2	97.8	24.2	37.8	31.2	54.4
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	-	-	-	-	-	-	-	-
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	-	-	0.4	-	2.8	1.2	1.2	0.6
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	-	-	-	0.6	-	-	-	-
TODI	*Toxicodendron diversilobum*	-	-	2.6	1	-	0.4	-	-
BG	Bare ground	12.4	20.2	11.6		30.2	14	15.6	19.8
HERB	Herbaceous vegetation	1.8	1	2.2	2.8		0.2		0.4

Table E-9. Year 3 Shrub Transects, Unit 07 (Continued)

		Unit 7							
Code	**Species**	7-19	7-20	7-21	7-22	7-23	7-24	7-25	7-26
ACME	*Acacia melanoxylon*	-	-	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	6.4	12.8	6.4	20.8	6.6	17	4.6	5.8
ARCA	*Artemisia californica*	-	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	19.4	11	28.2	7.4	23.6	25.6	32.4	20.8
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-	-
CAED	*Carpobrotus edulis*	-	0.2	1.8	0.6	-	-	-	0.8
CEDE	*Ceanothus dentatus*	23.6	28.2	27.6	20.2	24.8	21	19.4	23.2
CERI	*Ceanothus rigidus*	12.8	0.4	0.6	3.2	-	1	1.4	0.4
COJU	*Cortaderia jubata*	-	-	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	-	0.2	-	0.4	1.4	-	-	0.4
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	13.4	3.6	0.8	6.4	-	-	7	-
HEAR	*Heteromeles arbutifolia*	9.2	4.2	-	2.8	8	-	-	-
HESC	*Helianthemum scoparium*	3.2	7.2	32.4	15	16.6	14.4	16.6	22.8
LECA	*Lepechinia calycina*	1.8	-	-	-	-	-	0.4	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	1.2	36	22.2	46.8	20.8	50	30.6	21.6
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	-	-	-	-	-	-	-	-
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	-	2.2	0.2	2.6	-	-	0.8	0.2
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	0.6	-	-	-	0.2	-	-	-
TODI	*Toxicodendron diversilobum*	-	-	-	-	-	-	0.6	-
BG	Bare ground	26	22	14	16.4	28	12	16	29
HERB	Herbaceous vegetation	2.6	0.2		0.2	1			0.4

Table E-10. Year 3 Shrub Transects, Unit 07 (Continued) and WGBA

		Unit 7					Watkins Gate Burn Area		
Code	**Species**	7-27	7-T2	7-T26-1	7-T26-2	7-T26-3	12-1	12-3	13-1
ACME	*Acacia melanoxylon*	-	-	-	-	-	-	-	-
ADFA	*Adenostoma fasciculatum*	9	12	21.4	1.6	4	4.8	4.2	-
ARCA	*Artemisia californica*	-	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	-	2.6	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	11.8	25.6	14.4	10.2	12	12.8	29.4	16.2
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-	-
CAED	*Carpobrotus edulis*	0.8	-	0.4	4.8	0.4	10.8	7.2	4.2
CEDE	*Ceanothus dentatus*	41.4	2.4	3.8	48.2	33.8	-	-	-
CERI	*Ceanothus rigidus*	2	-	1.2	0.2	3.4	-	-	-
COJU	*Cortaderia jubata*	-	-	-	-	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	-	4.8	0.2	2.8	2.8	-	-	-
ERER	*Ericameria ericoides*	-	-	-	-	-	1.4	-	1.4
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	-	1.6	-	-	-	-	-	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	13.6	2.8	5.6	34.6	20.4	1	-	1.8
LECA	*Lepechinia calycina*	3.6	1.6	-	-	2	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	42.6	0.8	1	3.4	3	37.2	27	10.2
LUAR	*Lupinus arboreus*	-	-	-	-	-	-	-	-
MIAU	*Mimulus aurantiacus*	-	-	0.4	-	-	3.8	-	0.6
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	-	3.6	-	3.8	3	0.6	-	0.4
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	2	-	-	-	-	-	-	-
BG	Bare ground	12.2	41.6	47.8	21.2	27.2	32.8	36.8	58.6
HERB	Herbaceous vegetation		7.4	14	4.6	3.8	4	5.8	13.2

Table E-11. Year 3 Shrub Transects, WGBA

Code	Species	Watkins Gate Burn Area 13-3	14-1	15-1	9A-1
ACME	*Acacia melanoxylon*	-	-	-	-
ADFA	*Adenostoma fasciculatum*	6	-	-	-
ARCA	*Artemisia californica*	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	1.4	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	28.4	33.6	39.8	5.6
BAPI	*Baccharis pilularis*	-	-	-	-
CAED	*Carpobrotus edulis*	33.6	15.6	2.6	3.4
CEDE	*Ceanothus dentatus*	-	-	-	-
CERI	*Ceanothus rigidus*	-	-	-	-
COJU	*Cortaderia jubata*	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	-	-	-	-
ERER	*Ericameria ericoides*	-	-	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-
HESC	*Helianthemum scoparium*	-	-	-	6.4
LECA	*Lepechinia calycina*	-	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	28.6	63.6	44.4	56.4
LUAR	*Lupinus arboreus*	-	0.6	-	-
MIAU	*Mimulus aurantiacus*	1	-	-	1.4
QUAG	*Quercus agrifolia*	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-
SAME	*Salvia mellifera*	-	-	-	1.4
SOUM	*Solanum umbelliferum*	-	-	-	-
SYMO	*Symphoricarpos mollis*	-	-	-	-
TODI	*Toxicodendron diversilobum*	0.4	0.2	6.2	-
BG	Bare ground	18.2	14.6	28.4	19.4
HERB	Herbaceous vegetation	10	2.4		

Table E-12. Year 5 Shrub Transects, Unit 11

		Unit 11							
Code	**Species**	11-7	11-8	11-9	11-10	11-11	11-12	11-13	11-14
ADFA	*Adenostoma fasciculatum*	20	23.4	7.4	15	16.4	47	43	18.4
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	22.2	44.4	52.2	36.2	27.2	26.6	13	22.4
BAPI	*Baccharis pilularis*	-	-	-	1.6	-	-	6.4	2
CAED	*Carpobrotus edulis*	-	-	-	-	-	-	-	-
CEDE	*Ceanothus dentatus*	0.8	-	-	0.2	0.6	0.6	-	1.6
CERI	*Ceanothus rigidus*	-	0.2	-	0.2	2.4	1	0.2	-
ERCO	*Eriophyllum confertiflorum*	0.6	-	0.2	7.6	11	-	2.4	8.2
ERFA	*Ericameria fasciculata*	1.6	-	-	0.2	-	-	-	-
GAEL	*Garrya elliptica*	-	6.4	1.4	-	-	-	-	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	2	0.6	-	2.8	2.4	-	1	1.6
LECA	*Lepechinia calycina*	-	1	2.4	-	1.8	2.6	0.6	1.8
LOSC	*Acmispon glaber (=Lotus scoparius)*	-	1.4	-	-	5.4	1.2	15.2	-
MIAU	*Mimulus aurantiacus*	-	0.2	-	-	-	-	2	0.4
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RISA	*Ribes sanguineum*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	3.8	0.8	-	-	8.2	17.2	3	0.2
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	-	-	1
TODI	*Toxicodendron diversilobum*	-	2.8	2.2	-	1.6	6.2	8.6	1.2
BG	Bare Ground	49.8	32	37.8	40.4	28.4	16.8	22.2	41.2
HERB	Herbaceous vegetation	4.4	0.8	1.2	4.8	9.4		19.6	13

Table E-13. Year 5 Shrub Transects, Unit 11 (Continued)

Code	Species	Unit 11							
		11-15	11-16	11-17	11-18	11-19	11-20	11-21	11-22
ADFA	*Adenostoma fasciculatum*	27	19.8	21.2	33.6	15.4	15	53.2	8.2
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	16.8	45.6	26.4	19.4	36.8	61	19.2	46.8
BAPI	*Baccharis pilularis*	14.6	-	-	-	3.2	6.8	2.4	0.2
CAED	*Carpobrotus edulis*	2.2	-	-	-	-	-	-	-
CEDE	*Ceanothus dentatus*	-	3	2	-	0.8	2.6	2.4	-
CERI	*Ceanothus rigidus*	0.4	0.4	0.6	2	0.4	0.2	-	-
ERCO	*Eriophyllum confertiflorum*	-	1.6	1	14.6	10.4	1.8	1.2	6
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-	4.2	-	-	-
HEAR	*Heteromeles arbutifolia*	2.2	-	-	-	0.4	0.8	-	4.4
HESC	*Helianthemum scoparium*	-	1.6	1.2	-	1	-	-	-
LECA	*Lepechinia calycina*	-	2.4	-	1	0.4	0.8	1	11.6
LOSC	*Acmispon glaber (=Lotus scoparius)*	4.6	0.4	-	1.2	-	-	-	1.8
MIAU	*Mimulus aurantiacus*	12	1	-	-	-	0.2	-	1.4
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RISA	*Ribes sanguineum*	0.8	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	-	5.4	4.4	2	-	-	-	7
SYMO	*Symphoricarpos mollis*	12	-	-	-	4.4	1	0.6	4.4
TODI	*Toxicodendron diversilobum*	14.2	0.2	1	6.8	0.8	1	20.4	-
BG	Bare Ground	18.6	26.4	36.4	27.8	26	25.6	25.6	30.2
HERB	Herbaceous vegetation	9.8	7.2	13.2	4	7.4	1	4.2	0.2

Table E-14. Year 5 Shrub Transects, Unit 11 (Continued) and Unit 12

		Unit 11		Unit 12					
Code	**Species**	11-23	11-24	12-7	12-8	12-9	12-10	12-11	12-12
ADFA	*Adenostoma fasciculatum*	8.4	23.8	30.4	42.2	28.8	19.6	40.6	42.2
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	44.4	38	41	26.2	45.2	34.8	36.2	43.8
BAPI	*Baccharis pilularis*	2.4	8	-	2.4	1.2	-	-	3
CAED	*Carpobrotus edulis*	-	-	-	-	-	-	-	-
CEDE	*Ceanothus dentatus*	-	-	1.4	0.2	1.4	2.6	0.2	-
CERI	*Ceanothus rigidus*	-	-	1.4	1	1	-	1.4	1.4
ERCO	*Eriophyllum confertiflorum*	2.8	0.4	-	0.4	1.4	0.8	-	-
ERFA	*Ericameria fasciculata*	-	-	-	-	-	2.4	-	-
GAEL	*Garrya elliptica*	1.8	0.6	-	-	-	0.8	3	-
HEAR	*Heteromeles arbutifolia*	-	10.2	3.4	-	9.8	-	-	-
HESC	*Helianthemum scoparium*	-	-	0.6	1	-	1	-	-
LECA	*Lepechinia calycina*	2.2	4.4	2	-	9.8	-	1.4	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	0.4	-	-	-	1	-	-	-
MIAU	*Mimulus aurantiacus*	0.4	0.8	-	-	-	-	-	-
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-	-
RISA	*Ribes sanguineum*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	1.2	-	-
SAME	*Salvia mellifera*	-	-	13.2	8.2	3.8	8.2	-	-
SYMO	*Symphoricarpos mollis*	1.4	0.8	-	6.2	-	-	1.4	-
TODI	*Toxicodendron diversilobum*	-	0.2	-	10.4	12	0.4	7	-
BG	Bare Ground	34.2	24.6	23.8	31.6	17.4	34.8	23.4	21.6
HERB	Herbaceous vegetation	12.2			0.6		2.8		

Table E-15. Year 5 Shrub Transects, Unit 12 (Continued) and Unit 04

		Unit 12					Unit 4		
Code	**Species**	12-14	12-15	12-16	12-17	12-18	4-1	4-5	4-6
ADFA	*Adenostoma fasciculatum*	25.6	24	3.6	17	24.2	14.2	3.8	2.2
ARPU	*Arctostaphylos pumila*	-	-	-	-	-	3.4	0.6	5.8
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	42.4	43.4	44.2	33.8	15.2	55	45.6	39.8
BAPI	*Baccharis pilularis*	-	-	-	-	-	0.2	-	-
CAED	*Carpobrotus edulis*	-	3.4	-	-	-	-	-	-
CEDE	*Ceanothus dentatus*	-	-	4	3.8	-	-	-	1.6
CERI	*Ceanothus rigidus*	0.4	1.6	-	1.6	-	-	-	-
ERCO	*Eriophyllum confertiflorum*	-	-	-	0.2	0.6	-	-	0.2
ERFA	*Ericameria fasciculata*	-	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-	-	2	-	-
HEAR	*Heteromeles arbutifolia*	-	8.4	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	-	-	1.8	0.4	1.6	-	0.8	0.6
LECA	*Lepechinia calycina*	15.6	-	-	4.8	-	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	-	0.8	4.6	-	13.4	2.4	0.4	7.2
MIAU	*Mimulus aurantiacus*	-	-	-	-	2.2	-	-	1.4
QUAG	*Quercus agrifolia*	-	9	-	-	-	-	-	-
RISA	*Ribes sanguineum*	-	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	12.2	1.4	9.6	16.2	10.6	9.4	-	2.4
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	1	12.4	-	-	-	-	0.4	-
BG	Bare Ground	20.4	15.4	35.4	33.2	38.2	23.6	49.2	44.8
HERB	Herbaceous vegetation	0.2	1.8	3	2	2.4	0.2	0.4	2

Table E-16. Year 5 Shrub Transects, Unit 04 (Continued)

		Unit 4						
Code	**Species**	4-7	4-8	4-9	4-10	4-11	SB-T2	SB-T8
ADFA	*Adenostoma fasciculatum*	14.4	15	11.4	23.6	14.0	0.5	17.6
ARPU	*Arctostaphylos pumila*	1	1.2	12.4	15.9	5.0	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	48.4	31.8	25.2	11.0	40.4	11.5	33
BAPI	*Baccharis pilularis*	-	-	-	-	-	21.7	-
CAED	*Carpobrotus edulis*	-	-	-	1.6	4.0	-	-
CEDE	*Ceanothus dentatus*	-	0.6	-	-	-	-	0.8
CERI	*Ceanothus rigidus*	-	-	-	-	1.0	-	0.2
ERCO	*Eriophyllum confertiflorum*	-	1.2	11	-	-	-	0.4
ERFA	*Ericameria fasciculata*	-	-	0.4	3.9	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-	-	-	-
HEAR	*Heteromeles arbutifolia*	0.6	-	-	2.6	-	5.5	-
HESC	*Helianthemum scoparium*	0.4	1.6	1.4	1.3	1.4	3.1	2.8
LECA	*Lepechinia calycina*	-	-	-	-	-	-	0.2
LOSC	*Acmispon glaber (=Lotus scoparius)*	54.6	15	14.4	44.7	40.4	-	-
MIAU	*Mimulus aurantiacus*	-	-	0.6	-	1.6	-	1
QUAG	*Quercus agrifolia*	-	-	1.4	-	-	3.8	-
RISA	*Ribes sanguineum*	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	10.8	0.2	-	9.4	5.4	4.5	-
SYMO	*Symphoricarpos mollis*	-	-	0.4	-	-	-	-
TODI	*Toxicodendron diversilobum*	-	-	1	-	-	1.0	-
BG	Bare Ground	7.8	40.8	31.2	8.1	13.0	9.5	44.8
HERB	Herbaceous vegetation	2.2	1	2.8	1.6	0.8	56.1	1.6

Table E-17. Year 8 Shrub Transects, Unit 18

		Unit 18						
Code	**Species**	T1	T10	T11	T19	T2	T20	T21
ADFA	*Adenostoma fasciculatum*	8.6	19.2	12	26.2	-	1	1.8
ARMO	*Arctostaphylos montereyensis*	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	0.2	-	21.8	-	24.6	10.4	18.2
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	13.6	-	22	-	5	28.2	26.4
BAPI	*Baccharis pilularis*	-	-	1.6	-	-	-	-
CEDE	*Ceanothus dentatus*	-	-	-	0.2	0.2	13	-
CERI	*Ceanothus rigidus*	0.6	-	3.6	2	-	-	1.2
ERCO	*Eriophyllum confertiflorum*	-	0.2	-	4.6	0.2	0.2	-
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	1.4	1.4	-	0.2	-	-	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	-	-	2.4	3.6	0.4	17.4	0.6
LECA	*Lepechinia calycina*	-	-	-	-	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	1.6	0.2	-	2	4.2	0.2	-
LUAL	*Lupinus albifrons (var. albifrons?)*	2.6	2.8	-	-	-	-	2.4
MIAU	*Mimulus aurantiacus*	-	1	-	2	0.6	3	0.4
QUAG	*Quercus agrifolia*	-	4.6	14.2	-	-	-	-
RHCA	*Frangula californica (= Rhamnus californica ssp. californica)*	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	-	2.4	9	0.8	-	-	-
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	1	-	2.8	-	-	-	1.2
TODI	*Toxicodendron diversilobum*	8.4	0.4	-	8.6	-	-	0.4
BG	Bare Ground	38	21.8	18	43.6	57.8	29	21
HERB	Herbaceous vegetation	36.2	54.4	4	11.8	2.4	13.4	41

Table E-18. Year 8 Shrub Transects, Unit 18 (Continued)

		Unit 18						
Code	**Species**	T22	T23	T24	T25	T3	T32	T33
ADFA	*Adenostoma fasciculatum*	16.8	20.4	40.4	29	9	3.6	12.6
ARMO	*Arctostaphylos montereyensis*	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	20	0.6	18.6	12.6	7	13.8	15.8
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	6.6	4.8	2.2	-	16.2	19.8	18.6
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-
CEDE	*Ceanothus dentatus*	0.4	-	-	-	14.4	-	-
CERI	*Ceanothus rigidus*	7.4	2.8	24.2	6.2	6.8	0.6	8.2
ERCO	*Eriophyllum confertiflorum*	0.2	0.4	-	1.4	0.2	-	0.4
ERER	*Ericameria ericoides*	-	-	0.2	-	-	-	0.2
GAEL	*Garrya elliptica*	-	-	-	-	-	-	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	3.2	-	-	2.8	0.2	-	1.6
LECA	*Lepechinia calycina*	-	-	-	-	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	7.4	3.2	0.2	3.4	-	-	3.6
LUAL	*Lupinus albifrons (var. albifrons?)*	-	-	-	-	0.4	3	0.4
MIAU	*Mimulus aurantiacus*	-	4.4	-	0.2	1.6	-	-
QUAG	*Quercus agrifolia*	-	8	-	5	-	-	-
RHCA	*Frangula californica (= Rhamnus californica ssp. californica)*	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	6.2	6	-	-	1.4	-	-
SOUM	*Solanum umbelliferum*	-	-	-	-	-	0.2	-
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	0.6	-
TODI	*Toxicodendron diversilobum*	1.4	-	-	-	-	7.8	2
BG	Bare Ground	36.2	42.2	14.6	40.6	43.8	20.8	43.4
HERB	Herbaceous vegetation	6.4	19.8	16.6	4.4	6.4	50	7.6

Table E-19. Year 8 Shrub Transects, Unit 18 (Continued)

		Unit 18						
Code	**Species**	T34	T35	T36	T4	T6	T7	T8
ADFA	*Adenostoma fasciculatum*	44.8	18.6	14	-	16.4	21.2	18.4
ARMO	*Arctostaphylos montereyensis*	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	8.8	-	0.4	19.2	3.8	6	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	7.6	3.4	2.8	-	40.2	33	17.2
BAPI	*Baccharis pilularis*	-	-	-	-	-	-	-
CEDE	*Ceanothus dentatus*	-	4.6	-	-	5.4	4.6	-
CERI	*Ceanothus rigidus*	14.4	2.2	11.4	8.8	-	3.4	9.2
ERCO	*Eriophyllum confertiflorum*	0.2	0.4	1.4	-	0.2	1	0.4
ERER	*Ericameria ericoides*	0.8	-	-	5	-	-	-
GAEL	*Garrya elliptica*	-	1.8	-	-	-	2.6	-
HEAR	*Heteromeles arbutifolia*	-	-	8.2	-	-	-	-
HESC	*Helianthemum scoparium*	-	7.6	3.2	-	-	2.4	-
LECA	*Lepechinia calycina*	-	-	-	-	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	1.2	1.4	2.4	-	10.4	-	0.8
LUAL	*Lupinus albifrons (var. albifrons?)*	-	-	-	-	0.6	-	0.4
MIAU	*Mimulus aurantiacus*	-	-	1	-	-	-	-
QUAG	*Quercus agrifolia*	-	-	1.2	-	-	-	-
RHCA	*Frangula californica (= Rhamnus californica ssp. californica)*	-	0.2	-	4.4	-	-	5
RUUR	*Rubus ursinus*	-	-	-	0.6	-	-	-
SAME	*Salvia mellifera*	-	10	2	-	-	3	-
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	3.6	-	2	-	15.6	-	-
BG	Bare Ground	37.2	46.8	49.6	50.2	28.8	32.2	46
HERB	Herbaceous vegetation	4	7.4	8.8	17.6	6.2	1.4	9.4

Table E-20. Year 8 Shrub Transects, Unit 22

		Unit 22						
Code	**Species**	T12	T13	T14	T15	T16	T17	T18
ADFA	*Adenostoma fasciculatum*	3.6	22	17.4	8.8	63.4	10.4	52.6
ARMO	*Arctostaphylos montereyensis*	-	-	-	-	-	-	0.6
ARPU	*Arctostaphylos pumila*	14	0.8	19.2	16.8	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	25.4	17.2	13.2	27.8	2.4	42.8	8.2
BAPI	*Baccharis pilularis*	-	-	-	-	0.8	-	-
CEDE	*Ceanothus dentatus*	-	-	-	-	-	-	-
CERI	*Ceanothus rigidus*	1.2	-	-	-	35.2	14.2	32.8
ERCO	*Eriophyllum confertiflorum*	-	-	3	2.2	-	0.2	-
ERER	*Ericameria ericoides*	-	-	-	-	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-	0.8	-	-
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	1.6	0.4	0.8	4	-	-	-
LECA	*Lepechinia calycina*	-	-	-	-	1	0.2	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	6.6	0.6	7.8	1.8	1.8	-	0.4
LUAL	*Lupinus albifrons (var. albifrons?)*	2.2	-	1.2	5	-	-	-
MIAU	*Mimulus aurantiacus*	-	4.6	-	3	-	-	0.2
QUAG	*Quercus agrifolia*	-	4.6	-	-	-	-	-
RHCA	*Frangula californica (= Rhamnus californica ssp. californica)*	-	-	0.2	-	-	-	-
RUUR	*Rubus ursinus*	0.4	-	-	-	-	-	-
SAME	*Salvia mellifera*	-	34.4	-	-	-	28.2	0.2
SOUM	*Solanum umbelliferum*	-	2	-	-	1.2	-	-
SYMO	*Symphoricarpos mollis*	-	-	-	-	-	-	-
TODI	*Toxicodendron diversilobum*	3.6	5.6	-	-	-	-	-
BG	Bare Ground	29.4	14.4	40.6	30.6	11.4	14.8	20.2
HERB	Herbaceous vegetation	23.2	4.6	8	9.8	12.4	6.6	5.2

Table E-21. Year 8 Shrub Transects, Unit 22 (Continued)

		Unit 22						
Code	**Species**	T26	T27	T28	T29	T30	T31	T9
ADFA	*Adenostoma fasciculatum*	35.2	48.2	55.2	4.4	8.4	20.4	29.6
ARMO	*Arctostaphylos montereyensis*	-	-	-	-	-	-	-
ARPU	*Arctostaphylos pumila*	-	-	-	5.6	8.2	4	1.2
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	28.8	15.6	24.8	37.6	25.6	35	43.0
BAPI	*Baccharis pilularis*	0.6	-	-	-	-	-	-
CEDE	*Ceanothus dentatus*	-	-	-	1	-	-	-
CERI	*Ceanothus rigidus*	34.4	25.4	35.6	8.2	-	-	-
ERCO	*Eriophyllum confertiflorum*	0.4	0.6	-	0.4	1.8	0.2	2.2
ERER	*Ericameria ericoides*	-	-	-	0.6	-	-	-
GAEL	*Garrya elliptica*	-	-	-	-	0.6	2.8	0.6
HEAR	*Heteromeles arbutifolia*	-	-	-	-	-	-	-
HESC	*Helianthemum scoparium*	-	-	1.4	3.2	2.4	0.6	0.2
LECA	*Lepechinia calycina*	1.6	-	3	-	-	-	-
LOSC	*Acmispon glaber (=Lotus scoparius)*	0.6	-	-	1.8	8.4	1	4.6
LUAL	*Lupinus albifrons (var. albifrons?)*	-	-	-	-	3.6	0.2	3.4
MIAU	*Mimulus aurantiacus*	-	-	-	1	-	-	0.8
QUAG	*Quercus agrifolia*	-	-	-	-	-	-	-
RHCA	*Frangula californica (= Rhamnus californica ssp. californica)*	-	-	-	-	-	-	-
RUUR	*Rubus ursinus*	-	-	-	-	-	-	-
SAME	*Salvia mellifera*	0.8	-	0.2	6.8	-	-	1.0
SOUM	*Solanum umbelliferum*	-	-	-	-	0.2	-	-
SYMO	*Symphoricarpos mollis*	8.8	-	-	-	-	3.6	0.2
TODI	*Toxicodendron diversilobum*	-	-	-	0.6	3.8	8.8	2.6
BG	Bare Ground	9.8	19.4	12.6	32.8	40	32.2	23.6
HERB	Herbaceous vegetation	13.6	4.2	1.2	8.4	7	9.2	1.2

Table E-22. Year 8 Quadrat Data on Shrub Transects, MOUT, Unit 04, Unit 18 and Unit 22

Code	Species	MOUT MOUT-1 Year 3	Unit 4 SB-T2 Year 5	Unit 18 T1 Year 8	Unit 18 T10 Year 8	Unit 18 T21 Year 8	Unit 18 T32 Year 8	Unit 22 T12 Year 8
ADFA	*Adenostoma fasciculatum*	5.83	-	5.83	3.33	3.33	1.17	17.50
AICA	*Aira caryophyllea*	10.00	-	-	0.17	-	-	0.50
ANAR	*Anagallis arvensis*	-	1.00	-	-	-	-	-
AMMEI	*Amsinckia menziesii var. intermedia*	-	-	-	-	-	0.17	-
ARPU	*Arctostaphylos pumila*	-	6.67	0.50	-	16.67	10.83	19.50
ARPY3	*Artemisia pycnocephala*	-	-	5.83	-	-	-	-
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	30.83	6.83	33.33	-	24.17	25.17	-
ASXX	*Asteraceae*	-	-	-	-	0.83	0.33	-
AVBA	*Avena barbata*	-	1.17	-	-	-	-	0.17
BAPI	*Baccharis pilularis*	-	4.17	-	-	-	-	-
BRDI	*Bromus diandrus*	-	12.83	0.83	8.67	7.00	6.17	-
BRHO	*Bromus hordeaceus*	-	0.33	0.17	-	-	-	0.17
BRMA	*Briza maxima*	-	0.33	-	-	-	-	-
BRMAR	*Bromus madritensis ssp. rubens*	-	0.33	0.33	0.83	0.33	0.33	2.67
BRMI2	*Briza minor*	-	0.83	-	-	-	-	-
CAEX	*Castilleja exserta*	-	-	0.50	-	-	-	-
CEME2	*Centaurea melitensis*	-	0.83	-	-	-	-	-
CERI	*Ceanothus rigidus*	0.50	-	-	-	-	0.83	-
CHDI	*Chorizanthe diffusa*	-	-	-	0.33	0.50	-	0.17
CHPUP	*Chorizanthe pungens var. pungens*	-	-	0.83	0.33	4.17	1.67	0.17
CLPE	*Claytonia perfoliata*	-	-	-	-	-	0.17	-
COFI	*Corethrogyne (Lessingia) filaginifolia*	-	-	-	0.33	-	-	2.17
COJU	*Cortaderia jubata*	10.83	-	-	-	-	-	-
CORIL	*Cordylanthus rigidus ssp. littoralis*	-	-	-	1.00	-	-	-
CRXX	*Cryptantha sp.*	-	-	-	0.17	-	-	-
DAPU	*Daucus pusillus*	-	-	0.67	-	-	-	-
ERCI	*Erodium cicutarium*	-	-	-	-	-	0.17	-
ERCO	*Eriophyllum confertiflorum*	-	-	-	4.33	-	-	0.50
ERNU3	*Eriogonum nudum*	-	-	-	0.50	-	-	-
ERVI	*Eriastrum virgatum*	-	-	0.33	0.17	-	0.17	-
FEOC3	*Festuca (Vulpia) octoflora*	-	-	-	0.17	-	-	-

Table E-23. Year 8 Quadrat Data on Shrub Transects, MOUT, Unit 04, Unit 18 and Unit 22 (Continued)

Code	Species	MOUT MOUT-1 Year 3	Unit 4 SB-T2 Year 5	Unit 18 T1 Year 8	Unit 18 T10 Year 8	Unit 18 T21 Year 8	Unit 18 T32 Year 8	Unit 22 T12 Year 8
GACA	*Galium californicum*	0.17	-	0.33	-	6.67	-	-
GAPA5	*Galium parisiense*	-	0.33	-	-	-	-	-
GAPH2	*Gastridium phleoides*	-	3.33	-	-	-	-	-
GAPO	*Galium porrigens*	-	0.17	0.50	-	0.50	-	-
GITEA	*Gilia tenuiflora ssp. arenaria*	-	-	-	-	-	0.17	-
HECO	*Deinandra (Hemizonia) corymbosa*	-	-	0.33	-	-	0.33	-
HEGR	*Heterotheca grandiflora*	-	1.83	-	0.17	-	-	-
HESC	*Helianthemum scoparium*	5.00	-	-	-	-	-	1.33
HOCU	*Horkelia cuneata*	-	-	-	0.17	-	-	0.83
HYGL	*Hypocharis glabra*	-	0.67	5.33	1.50	4.17	2.00	0.50
HYRA	*Hypochaeris radicata*	-	2.83	-	-	-	-	-
KOMA	*Koeleria macrantha*	6.67	-	-	-	-	-	-
LAPL	*Layia platyglossa*	-	-	0.67	-	-	-	-
LECA	*Lepechinia calycina*	2.00	-	1.83	-	-	-	-
LEPA51	*Leptosiphon parviflorus*	-	-	0.17	-	-	-	-
LOGA2	*Lessingia pectinata (var. pectinata?)*	0.33	0.17	-	0.17	-	-	-
LOMAT	*Lomatium sp.*	-	-	-	-	-	-	0.17
LOSC	*Acmispon glaber (=Lotus scoparius)*	0.50	-	1.67	0.83	-	-	4.50
LOST	*Lotus strigosus*	-	-	0.33	0.33	0.17	0.33	-
LUAL	*Lupinus albifrons (var. albifrons?)*	-	-	-	0.50	6.50	-	-
LUBI	*Lupinus bicolor*	-	-	0.50	-	-	-	-
LUNA	*Lupinus nanus*	-	-	-	-	1.33	14.33	-
MAEX	*Madia exigua*	-	-	-	-	0.50	-	0.17
MAFA3	*Marah fabaceus*	-	-	-	-	3.33	-	-
MAGR3	*Madia gracilis*	0.17	0.67	-	-	-	0.83	-
MEIM	*Melica imperfecta*	-	-	0.17	-	-	-	-
MIAU	*Mimulus aurantiacus*	1.67	-	-	0.17	1.67	-	-
NAHA2	*Navarretia hamata*	-	-	-	0.17	-	-	0.33
PHRA2	*Phacelia ramosissima*	-	-	-	-	-	0.83	-
PLER	*Plantago erecta*	-	-	0.33	0.17	-	-	0.17
PTAQP	*Pteridium aquilinum var. pubescens*	-	-	14.50	0.33	-	-	-

Table E-24. Year 8 Quadrat Data on Shrub Transects, MOUT, Unit 04, Unit 18 and Unit 22 (Continued)

Code	Species	MOUT MOUT-1 Year 3	Unit 4 SB-T2 Year 5	Unit 18 T1 Year 8	Unit 18 T10 Year 8	Unit 18 T21 Year 8	Unit 18 T32 Year 8	Unit 22 T12 Year 8
QUAG	*Quercus agrifolia*	-	16.67	-	-	-	-	-
RISP	*Ribes speciosum*	-	-	-	-	6.67	-	-
RUAC	*Rumex acetosella*	0.33	-	-	-	-	-	-
RUUR	*Rubus ursinus*	4.83	-	-	-	-	-	-
SACR2	*Sanicula crassicaulis*	-	-	-	-	0.33	-	-
SAME	*Salvia mellifera*	-	9.17	-	3.17	-	-	-
SESY	*Senecio sylvaticus*	0.83	-	0.17	-	-	1.17	-
SIGA	*Silene gallica*	-	0.17	-	-	-	-	-
SOUM	*Solanum umbelliferum*	-	-	-	-	-	-	-
SYMO	*Symphoricarpos mollis*	7.33	-	1.33	-	0.83	-	-
TODI	*Toxicodendron diversilobum*	-	-	-	-	8.50	12.50	-
URLI	*Uropappus lindleyi*	-	-	-	0.67	4.17	-	-
VUBR	*Vulpia bromoides*	-	-	1.00	-	-	1.67	-
VUMY	*Vulpia myuros*	24.17	11.67	-	6.50	-	-	0.67

APPENDIX F

POWER ANALYSIS

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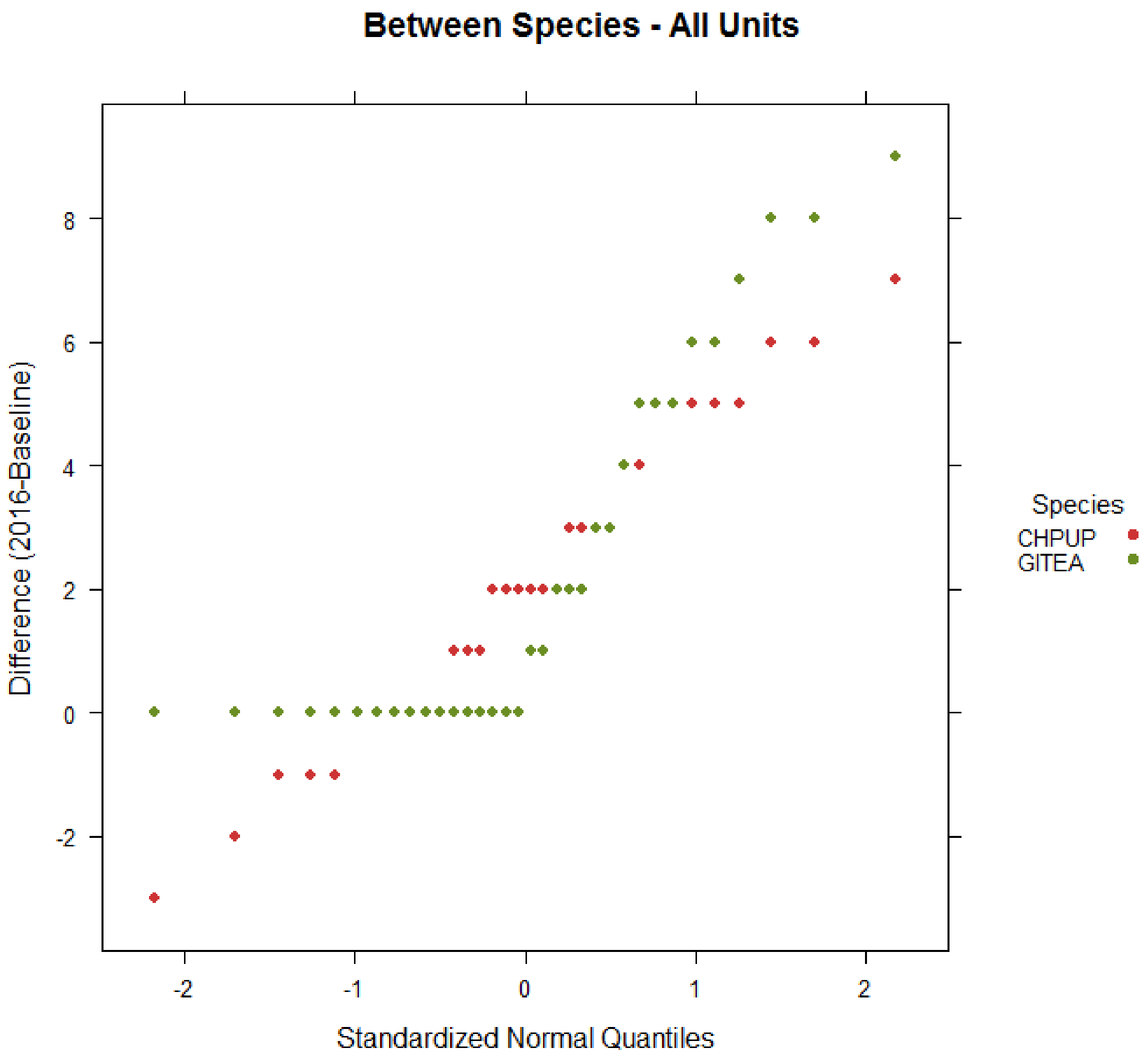

Figure F-1. Deviations from the mean change in the number of occupied grids were evaluated using a Q-Q plot to assess agreement with the normal distribution and to allow comparison of the variances of the distributions