2013 Biological Monitoring Report for Units 7, 5E, and 23E; Units 15, 21, 32, and 34; Units 18 and 22; and Ranges 43–48 Former Fort Ord

Prepared for

Department of the Army
U.S. Army Corps of Engineers

Sacramento District
1325 J Street
Sacramento, CA 95814-2922

February 2014

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SECTION 1

Introduction

This report presents the results of biological monitoring conducted in Units 7, 5E, and 23E (baseline pre-burn areas); Units 15, 21, 32, and 34 (Year 3 monitoring areas); Units 18 and 22 (Year 5 monitoring areas), and Ranges 43–48 (Year 10 monitoring areas) (Figure 1-1). 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* (VMP) (Burleson 2009a), with modifications as discussed in Sections 2.3, 3.3, 4.3, and 5.3.

The 2013 biological monitoring program was conducted to satisfy the monitoring requirements of the *Installation-Wide Multispecies Habitat Management Plan for Former Fort Ord* (HMP) (United States Army Corps of Engineers 1997) and biological opinions (BO) issued by the United States Fish and Wildlife Service (USFWS) (1999, 2002, 2005, and 2011). This annual monitoring report presents the results of monitoring for HMP annuals, shrubs, grasses, and exotic plants. Before the completion of vegetation clearance, munitions 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. 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 VMP. Density of the annual HMP plants is monitored at 1, 3, 5, and 8 years after completion of vegetation clearance. Shrub communities are monitored at 3, 5, 8, and 13 years after completion of vegetation clearance.

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. A periodic fire regime is a key management tool for establishing a diverse dynamic chaparral community.

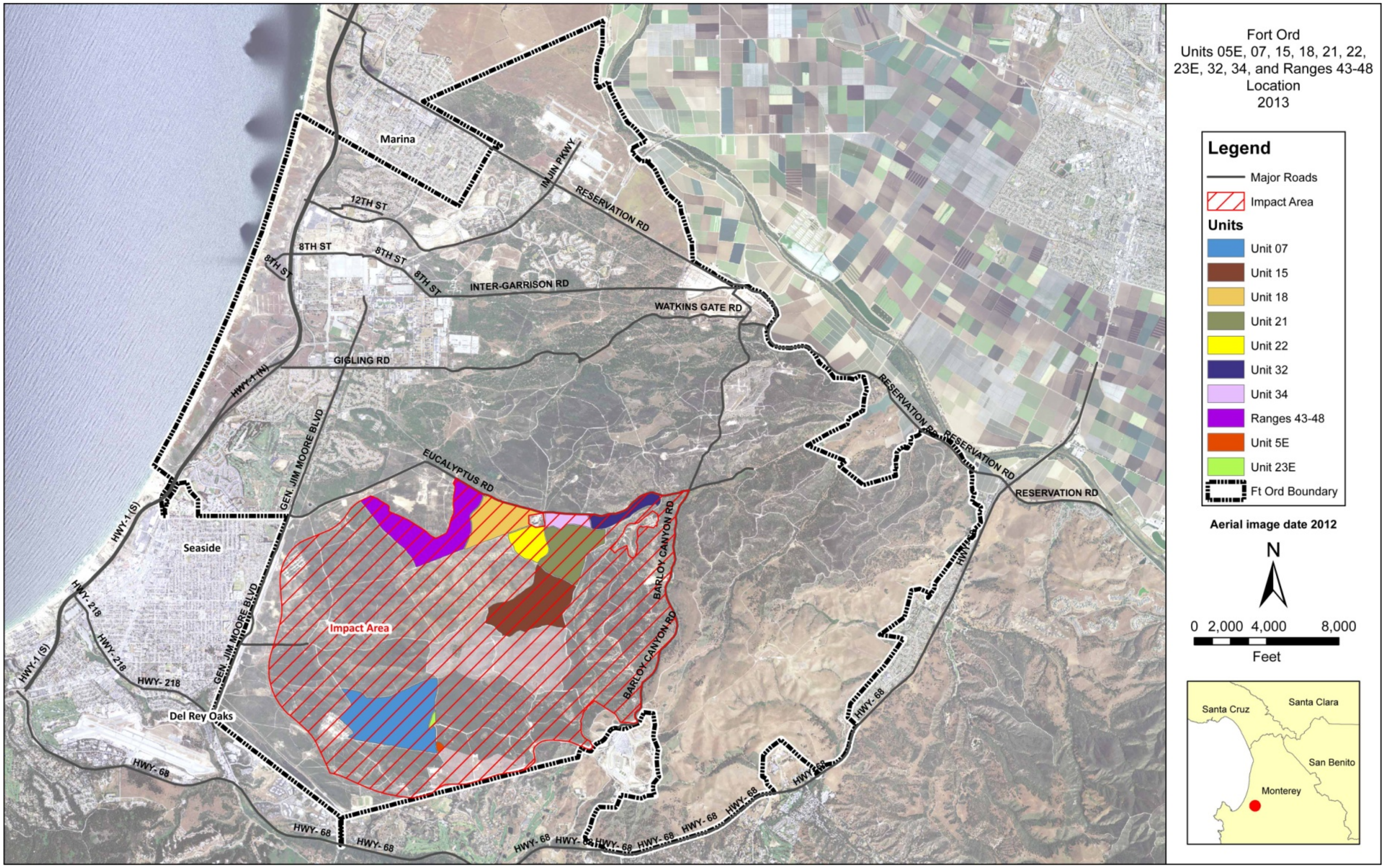

Figure 1-1 Map of former Fort Ord, Monterey California showing locations of Units sampled in 2013.

1.1. Species Included in 2012 Habitat and Rare Species Monitoring

The primary habitat type within the Army'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 (Table 1-1). 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. The shrub species of concern (HMP shrubs) include sandmat manzanita (*Arctostaphylos pumila*), 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 sand gilia (*Gilia tenuiflora* ssp. *arenaria*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), and seaside bird's-beak (*Cordylanthus rigidus* ssp. *littoralis*).

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, for code has been changed back to CERI.

1.2. Previous Surveys Conducted on the Sites

The previous surveys conducted at the specific Fort Ord sites monitored in 2013 are referenced in Table 1-2. The Year 3 units (15, 21, 32, and 34) were sampled by Tetra Tech and EcoSystems West (2011; 2012). Baseline sampling on the Year 5 Units (18 and 22) was conducted by Shaw Environmental (2009), with Year 1 sampling conducted by Burleson (2009b), and Year 3 sampling by Tetra Tech and Ecosystems-West (2011). Multiple teams surveyed the Year 10 site (Ranges 43–48) including Harding Lawson (2001), MACTEC (2005), Parsons (2004, 2005), Shaw (2008), and Tetra Tech and EcoSystems West (2011).

Data from previous surveys for HMP annuals and shrub line transects were obtained from GIS shapefiles and associated metadata provided by the Army), and from the results of previous surveys in 2010, and 2011 (Tetra Tech and EcoSystems West 2011, 2012).

Data were also 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 vegetation monitoring data table to correspond to the density classes defined by Burleson (2009a).

Table 1-1
Common and Scientific Names of Plant Species Included in the 2013 and Previous Vegetation Surveys[1]

Acronym	Scientific Name	Common Name	Life Form
CHPUP	***Chorizanthe pungens var. pungens***	**Monterey spineflower**	**HMP annual**
CORIL	***Cordylanthus rigidus ssp. littoralis***	**Seaside bird's-beak**	**HMP annual**
GITEA	***Gilia tenuiflora ssp. arenaria***	**Sand gilia**	**HMP annual**
ADFA	*Adenostoma fasciculatum*	Chamise	shrub
ARHO	***Arctostaphylos hookeri ssp. hookeri***	**Hooker's manzanita**	**shrub**
ARMO	***Arctostaphylos montereyensis***	**Monterey manzanita**	**shrub**
ARPU	***Arctostaphylos pumila***	**Sandmat manzanita**	**shrub**
ARTO	*Arctostaphylos tomentosa ssp. tomentosa*	Shaggy-barked manzanita	shrub
BAPI	*Baccharis pilularis*	Coyote brush	shrub
CAED	*Carpobrotus edulis*	Iceplant	Perennial succulent herb
CERI	***Ceanothus rigidus (=Ceanothus cuneatus var. rigidus)***	**Monterey ceanothus**	**shrub**
CEDE	*Ceanothus dentatus*	Dwarf ceanothus	shrub
CETH	*Ceanothus thyrsiflorus*	Blue blossom	shrub
COJU	*Cortaderia jubata*	Jubata grass	large, robust perennial grass
COXX	*Cortaderia sp. (C. jubata or C. selloana)*	Jubata grass, pampas grass	large, robust perennial grass
ERAM4	*Erysimum ammophilum*	Coast wallflower	Biennial to perennial herb
ERCA	*Eriodictyon californicum*	Yerba santa	shrub
ERCO	*Eriophyllum confertiflorum*	Golden yarrow	subshrub

[1] **Bolded** species are identified as species of concern in the HMP.

Table 1-1 (continued)
Common and Scientific Names of Plant Species Included in the 2013 and Previous Vegetation Surveys[1]

Acronym	Scientific Name	Common Name	Life Form
ERER	*Ericameria ericoides*	Mock-heather	shrub
ERFA	***Ericameria fasciculata***	**Eastwood's goldenbush**	**shrub**
GAEL	*Garrya elliptica*	Coast silk-tassel bush	shrub
GEMO	*Genista monspessulana*	French broom	Invasive grass
HEAR	*Heteromeles arbutifolia*	Toyon	shrub
HESC	*Helianthemum scoparium*	Peak rush-rose	subshrub
LACO6	*Lasthenia conjugens*	Contra Costa goldfields	Annual herb
LECA	*Lepechinia calycina*	Pitcher sage, woodbalm	shrub
LOSC	*Acmispon glaber (=Lotus scoparius)*	Deerweed	subshrub
LUAL	*Lupinus albifrons (var. albifrons?)*	Silver bush lupine	shrub
LUAR	*Lupinus arboreus*	Bush lupine	shrub
MIAU	*Mimulus aurantiacus*	Sticky monkeyflower	shrub
QUAG	*Quercus agrifolia*	Coast live oak	tree
QUPAS	*Quercus parvula var. shrevei*	Shreve oak	tree or shrub
QUWIF	*Quercus wislizenii var. frutescens*	Interior live oak	shrub
RHCA	*Frangula californica (= Rhamnus californica ssp. californica)*	California coffeeberry	shrub
ROCA	*Rosa californica*	California wild rose	shrub
ROGY	*Rosa gymnocarpa*	Wood rose	shrub
RUUR	*Rubus ursinus*	Pacific blackberry	woody vine
SALA	*Salix lasiolepsis*	Arroyo willow	shrub
SAME	*Salvia mellifera*	Black sage	shrub

[1] **Bolded** species are identified as species of concern in the HMP.

Table 1-1 (continued)
Common and Scientific Names of Plant Species Included in the 2013 and Previous Vegetation Surveys[1]

Acronym	Scientific Name	Common Name	Life Form
SOUM	*Solanum umbelliferum*	Blue witch	shrub
SYMO	*Symphoricarpos mollis*	Creeping snowberry	subshrub
TODI	*Toxicodendron diversilobum*	Poison-oak	shrub
VAOV	*Vaccinium ovatum*	Huckleberry	shrub
BG		Bare ground	
HERB		Herbaceous vegetation	

[1] **Bolded** species are identified as species of concern in the HMP.

Nomenclature conforms to *The Jepson Manual, Second Edition* (Baldwin et al. 2012); names used in previous monitoring reports and in the first edition of *The Jepson Manual* (Hickman 1993) are given in parentheses.

Table 1-2
Previous Monitoring Surveys at 2013 Study Sites on Fort Ord

Year	Survey
1999–2000	Harding Lawson Associates (2001) completed an Annual Monitoring Report, Biological Baseline Studies and Follow-Up Monitoring on Ranges 43–48.
2003–2004	Parsons (2005) conducted a study of effects of fire retardant and foam on maritime chaparral in Ranges 43–48.
2004	MACTEC (2005) conducted annual monitoring, biological baseline studies, and follow-up monitoring
2005	Parson Inc. prepared the Annual Biological Monitoring Report for Ranges 43–48.
2008	Shaw Environmental (2009) performed baseline sampling of Units 18 and 22, and Year 5 monitoring on Ranges 43–48
2009	Burleson (2009a) revised the monitoring program approach.
2009	Burleson (2009b) performed Year 1 monitoring of HMP annual plants in Units 18 and 22
2010	Tetra Tech and Ecosystems-West (2011) performed baseline HMP annual plants and shrub surveys on Units 15, 21, 32, and 34, and Year 7 monitoring on Ranges 43–48.
2011	Tetra Tech and Ecosystems-West (2012) performed Year 1 HMP annual plant surveys on Units 15, 21, 32, and 34, and Year 3 monitoring on Units 18 and 22.

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; 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 ransects 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.
- Unspecified – This class was applied to those grid cells that were cleared prior to 2010 and which could not be assigned a treatment type.

Treatments were identified based on the activities reported in previous reports and using data from the “flora_fire_area” shapefile obtained from the Army. The 2013 baseline survey locations were classified based on the anticipated position relative to the primary containment area.

SECTION 2

Baseline Vegetation Surveys – Units 7, 5E, and 23E

2.1. Unit 7 and Portions of Units 5E and 23E – Introduction

Unit 7 and portions of Units 5E and 23E are located in the southern portion of the Impact Area (Figure 1-1), and were burned or mechanically cleared (masticated) of existing shrub cover in October 2013 (after completion of the survey) as part of environmental cleanup operations involving munitions and explosives removal (Figure 2-1). In Unit 7, the prescription was for mastication prior to burning within 316 foot-wide primary containment lines (fuel breaks) around the entire perimeter of the unit, followed by prescribed burning of the entire unit including the masticated perimeter. Clearance of existing vegetation in the portions of Units 23E and 5E (the areas included in 2013 vegetation monitoring) included only mastication in areas of mature maritime chaparral, with prescribed burning planned in the future. The Army plans to burn or terra-torch all mastication-only areas within three to five years after cleanup operations (W. Collins, pers. com; USFWS 2011). In mastication areas shrub cover is mowed to a height of approximately 6 inches.

2.2. Unit 7 and Portions of Units 5aE and 23E – Setting

Unit 7 is located south of Nowhere Road and north of Phoenix Road in the southwest portion of the area of former Fort Ord within which munitions and explosives removal are currently being conducted. Unit 7 encompasses an area of 340 acres, of which 124 acres are within the 316-foot-wide primary containment mastication area and the remaining 216 acres are in the interior of the unit. In general, Unit 7 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.

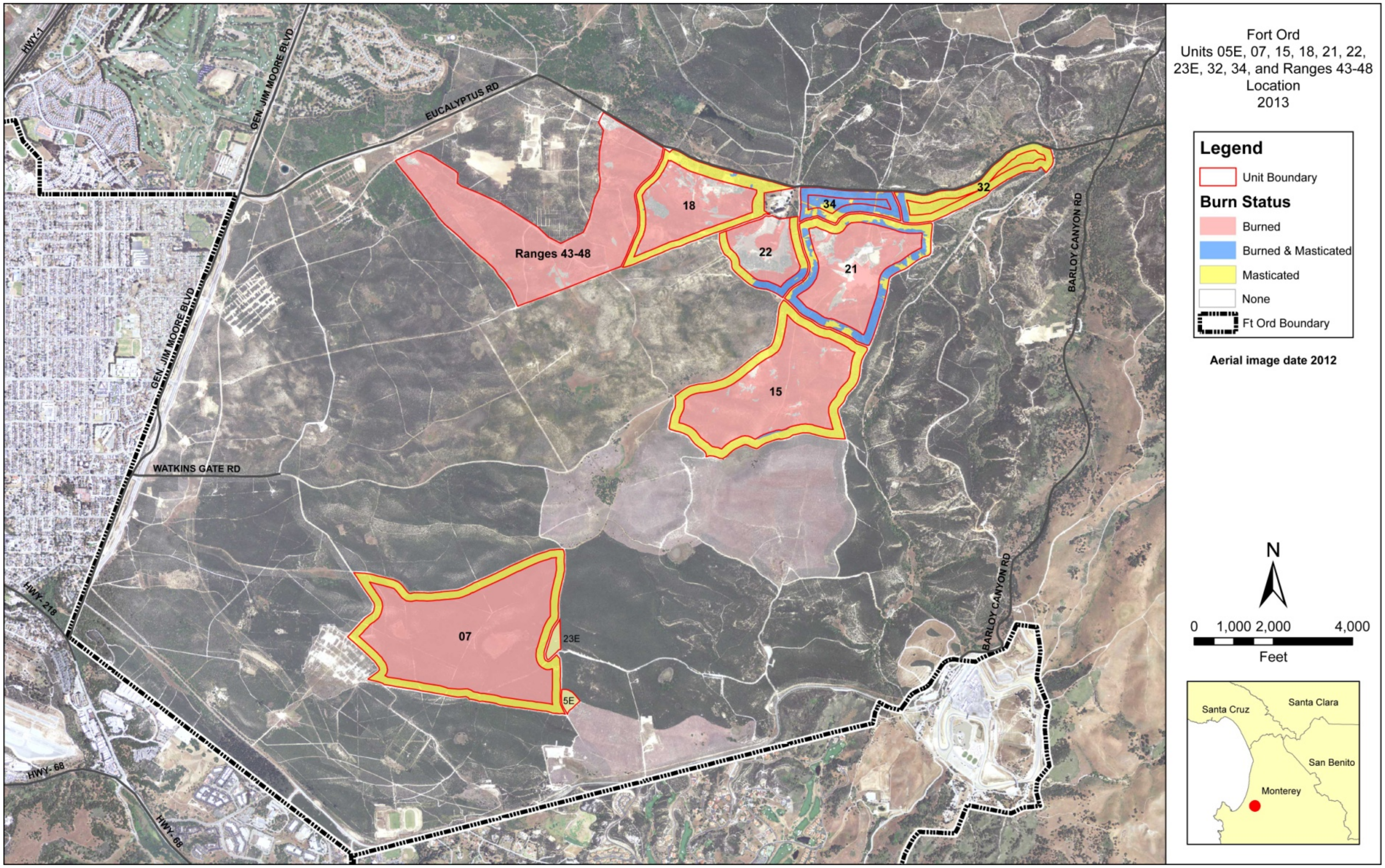

Figure 2-1 **Burn units surveyed in 2013 showing actual burn status for those units. Status for Units 7, 5E, and 23E is based on the proposed burn plan.**

In 2013, Unit 7 was almost entirely vegetated with mature maritime chaparral varying considerably in physiognomy and species composition. A few meadow grasslands were located in lowland basins throughout the unit. The chaparral shrubs range from low (3–4 feet) to tall (12–15 feet), and shrub density ranges from relatively open, with numerous openings of various sizes, to essentially 100 percent areal cover. Relatively open chaparral is most extensive in the southeast on ridgelines and south facing slopes in areas that appeared to be more recently disturbed, possibly by accidental fire, during active use of the range by the military. As in maritime chaparral throughout Fort Ord, shaggy-barked manzanita is the characteristic dominant, and is generally overwhelmingly dominant where the shrub cover is tall and dense. Other characteristic shrubs that are often dominant or co-dominant include chamise, black sage, sandmat manzanita, Monterey ceanothus, and poison-oak. 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; however, due to below average precipitation, this feature was completely dry during 2013 monitoring. 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 7 near the intersection of Austin Road and Phoenix Road. This area is largely denuded of vegetation and topsoil and is undergoing restoration activities.

Units 5E and 23E included in 2013 monitoring are immediately east of Unit 7 along Evolution Road. The included portions of Units 5E and 23E encompass 4 acres and 5 acres, respectively. The topography is moderately sloped. In pre-treatment condition, the included portions of the two units were mostly vegetated with mature maritime chaparral similar to that in Unit 7. This chaparral is mostly dense with few openings in Unit 23E and more variable in physiognomy in Unit 5E with evidence of disturbance, possibly fire, in the recent past. Unit 5E had areas co-dominated by huckleberry which is relatively rare at former Fort Ord in the ranges undergoing munitions clearance. Neither unit supported oaks or any habitat type other than maritime chaparral.

The U.S. Department of Agriculture (USDA 2013) maps show one soil type as occurring in the baseline areas. Arnold-Santa Ynez complex is mapped as occurring in all of Unit 7 and the entire portions of Unit 5E and 23E included in the 2013 monitoring. The characteristics of this soil type are presented in Table 2-1.

It is apparent from field observations that at least two distinct types of soil occur in the areas where the soil is mapped as Arnold-Santa Ynez complex as well as elsewhere in the portion of the base in which munitions and explosives removal are currently being conducted. One type of soil consists primarily of relatively coarse, loose sand, generally without gravel. The other soil type consists of dense, hard-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 Unit 7, this soil variant is located almost entirely in and along the margins of three distinct herbaceous meadows of varying levels of seasonal hydrology.

Table 2-1
Distribution of Soil Types in the 2013 Fort Ord Biological Monitoring Areas

Soil Type	Description	Units Where Found
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	Baseline: Unit 7; Unit 5E and 23E (portions included in 2013 monitoring) Year 3: Unit 15, 21 and 34; Unit 32 in west and south portions near Rizzo Ridge Road. Year 5: Unit 18 and 22 Year 8: Ranges 43–48 except northern portion of Range 48
Arnold loamy sand, 9–15 percent slopes	Loamy fine sand; somewhat excessively drained; derived from residuum weathered from sandstone.	Year 3: Unit 32, northern and eastern portions
Baywood sand, 2 to 15 percent slopes	Sand; somewhat excessively drained; derived from stabilized sandy eolian sands	Year 8: Ranges 43–48 in northern portion of Range 48
Source: USDA (2013)		

2.3. Units 7, 5E, and 23E – Methods

Baseline vegetation monitoring surveys were conducted in these units in spring 2013, prior to any remediation activities being conducted. The 2013 baseline monitoring surveys consisted of the following components:

- Meandering transect surveys to locate and map herbaceous HMP species.
- Density monitoring for three HMP annual species: Monterey spineflower, sand gilia, and seaside bird's-beak.
- Line intercept transect sampling to sample shrub species composition in the mature maritime chaparral.
- Mapping of non-native annual grasses within the primary containment areas.
- Mapping of invasive species, including iceplant, pampas grass, and French broom, where encountered.

2.3.1. Meandering Transects

Meandering transect surveys were conducted on 10 and 15 April 2013. Species surveyed for included five HMP herbaceous species: the biennial to perennial species coast wallflower and the annual species Monterey spineflower, sand gilia, seaside bird's-beak, and Contra Costa goldfields. 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 had not yet flowered when the meandering transect survey was conducted but the species could be readily identified by its vegetative characteristics.

When an HMP herbaceous species was observed during meandering transect surveying, a recreational-grade Global Positioning System (GPS) unit (Garmin 62S or 72H) 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 foot 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. This list formed the basis for selection of grids for density sampling. The monitoring protocol (Burleson 2009a) indicates that 20 percent of occupied grids or a minimum of 38 grids, whichever is greater, are to be monitored for density of HMP annuals.

2.3.2. HMP Annuals Density Monitoring

Density monitoring for three HMP annual species, Monterey spineflower, sand gilia, and seaside bird's-beak, was conducted on 6 and 15 May 2013.

The pre-selected 100×100 foot grids were used as sample grids for the density monitoring. In Unit 7 a random sample of 100×100 foot grids consisting of 38 grids of the 44 identified during meandering transect surveying as occupied by one or more HMP annual species were selected for sampling. Sampling was stratified by species, to ensure adequate representation of both Monterey spineflower and sand gilia (the only HMP annual species mapped in the unit), and by peripheral mastication area and interior burn area. No HMP annual species were identified during meandering surveys in Units 5E or 23E and therefore no grids were selected for density monitoring. Since the baseline grids were not marked in any way in the field, the survey team used a resource grade Trimble GeoXH GPS receiver with the grid boundaries loaded as a map layer to determine the boundaries of the grids to be sampled. 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 protocol (Burleson 2009a) were followed for the density monitoring, with the exception that a complete census of the entire grid was conducted rather than subsampling as described below. Upon arrival at the grid, the surveyors conducted an initial reconnaissance of the 100×100 foot sample grid to determine which HMP annual species were present and their distribution within the grid. When feasible given the numbers and distribution of individuals of the 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 all 100×100 foot 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 foot sample grid when a circular subsample grid was used, including habitat subjectively judged to be “suitable”, but not occupied, the estimates of suitable habitat would have resulted in upwardly biased estimates of numbers of individuals present in subsampled 100×100 foot grids.

In previous monitoring years, when it was not feasible to conduct a complete census of a given species in a given grid, the grid was subsampled using a 2.5-meter radius circular plot. This technique was not used in 2013 but the methodology is presented to demonstrate the alternative method for estimating density in previous monitoring years as these figures are used for inter-annual comparisons. 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 meter radius plot.

When circular plots were used for subsampling, estimates of the total number of plants present in the 100×100 foot sample grid were calculated. Since the area of a 2.5 meter radius circular plot is approximately 211.34 square feet, and the area of a 100×100 foot grid is 10,000 square feet, the estimated number of individuals in the 100×100 foot 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 foot grid;

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

b = the estimated percent suitable habitat in the 100×100 foot grid

For each HMP annual species, each 100×100 foot 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 foot 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, the surveyors assigned the grid to this density class without attempting to count or estimate numbers of plants. This was done because, for all HMP annual species, it is difficult to get accurate counts, even within a 2.5 meter 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 foot 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 foot sample grid.

2.3.3. Shrub Transect Monitoring

Shrub transect monitoring in the baseline areas was conducted in areas supporting maritime chaparral without obvious recent or large-scale disturbance. One baseline transect was allocated for each approximately 11 acres. 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 and excluded from transect sampling. In Unit 7, four pre-existing transects were re-occupied. In Units 5E and 23E, no transects had been sampled previously.

Locations for all newly established transects were selected by randomly selecting 100×100 foot grids within the areas of maritime chaparral vegetation in each baseline unit as a starting point, and a 50-m transect was laid out. For previously sampled transects, the surveyors used a resource grade Trimble GeoXH GPS receiver to locate the start and end points of each transect sampled. In Unit 7, transects were allocated separately within the 316-foot-wide primary containment lines (areas to be masticated) and within the interior of the Units beyond the containment lines. This was not necessary in Units 5E and 23E, since those units were to be entirely masticated and not burned. Numbers of transects sampled within each unit were as follows:

Unit 7: 31 total (including four containment area transects sampled previously)

Unit 5E: 1 total (no transects sampled previously)

Unit 23E: 1 total (no transects sampled previously)

Transect sampling in the primary containment areas of Unit 7 was conducted on 1 and 2 May 2013, and in the interior areas of the unit between 2 and 28 May 2013. Transect sampling in Units 5E and 23E was conducted on 1 May 2013.

Transect sampling was conducted using the line intercept method along 50-m long transects. 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 selected for sampling. The end point of each transect was located on or near one of the boundaries of the 100×100 foot grid selected as the basis for transect placement. Transect placement was such that the vegetation along the transect was representative of the surrounding area, and such that a substantial portion of the transect was within the grid selected for sampling (it is impossible to include all of a 50-meter transect within a 100×100 foot grid). In Unit 7, containment area transects were placed such that the entire transect was within the proposed containment area, and interior transects were placed such that the entire transect was within the interior area (i.e., did not extend into the containment area). When transects sampled in a previous year were sampled in 2013, the previously recorded start and end points were used for the 2013 sampling.

All transects were established by stretching out a 50 meter measuring tape between the transect start and end points. For transects not sampled in a previous year, the start and end points of each transect were recorded using the resource grade GPS receiver, and the GPS data was post-processing corrected.

Species for which cover data were recorded included all woody species (shrubs and subshrubs) present along the transect length. Iceplant and pampas grass were recorded separately because they are invasive species. Herbaceous vegetation was recorded as “herb”, with no breakdown by species, although the herbaceous species present along the transect were noted on the datasheets. Bare ground (including dead vegetation) 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 decimeter intervals. Lengths less than 1 decimeter 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 meters. Due to the presence of multiple vegetation layers, total percent cover often exceeded 100 percent.

2.3.4. Annual Grass Monitoring

Non-native annual grass monitoring was conducted within the primary containment lines surrounding Unit 7 and all of Units 5E and 23E on 3 June 2013. This monitoring included 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 a combination of driving the perimeter roads surrounding the 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 percent

2 (medium) = 6–25 percent

3 (high) = >25 percent

2.3.5. Invasive Species

Invasive species, including iceplant, pampas grass, and French broom, were encountered incidentally during the meandering transect survey and the HMP annuals density monitoring and shrub transect monitoring. When invasive species were encountered, the locations were mapped using a recreational-grade GPS unit. A comprehensive survey for invasive species was not conducted

2.4. Unit 7 and Units 5E and 23E – Results and Discussion

The estimated areas and percent of the area that was considered occupied by HMP annual species (i.e. suitable habitat) is summarized in Table 2-2. No HMP annuals were observed in Units 5E or 23E. In Unit 7, a total of 47 grids were mapped as having HMP annuals present. Therefore, the minimum number of grids required (38 grids) were sampled in Unit 7. To calculate the estimated suitable area occupied by HMP species in Unit 7, the total suitable area from the 38 grids sampled (1.13 acres) was multiplied by the ratio of the total number of suitable grids present in the unit (i.e., 47) divided by the number of grids sampled (i.e., 38). This calculation yielded an estimated suitable area in Unit 7 of 1.40 acres, or 0.4 percent of the Unit.

Table 2-2
Percentage of Habitat Suitable for HMP Annual Species in Each Unit

Unit	Total Area (acres)	Suitable Area (acres)	Percentage of Unit	Grids Surveyed
Unit 7	340	1.40	0.4%	38
Unit 5E	4	0	0	0
Unit 23E	5	0	0	0

Maps of locations of survey grids are provided in Appendix A1.

2.4.1. Sand Gilia

Thirty-eight (38) grids were surveyed for HMP plants including sand gilia in 2013 on Unit 7 (Table 2-3; Map A1-1). Twenty-nine grids were located in the prescribed burn area and 9 grids were located within the primary containment area (masticated prior to prescribed burning). Sand gilia was absent (density class 0) in 95 percent of the sampled grids in Unit 7. The average density class for sand gilia was 0.05 in areas of suitable habitat.

Table 2-3
Sand Gilia – Number of Grids per Density Class in Unit 7

Density	Prescribed Burn Area[1]	Primary Containment Area
0 plants/grid (percent of total grids)	27 (71%)	9 (24%)
1–50 plants/grid (percent of total grids)	2 (5%)	0 (0%)
51–100 plants/grid (percent of total grids)	0 (0%)	0 (0%)
101–500 plants/grid (percent of total grids)	0 (0%)	0 (0%)
> 500 plants/grid (percent of total grids)	0 (0%)	0 (0%)
Total Occupied Grids	**2**	**0**
Total Grid Sampled	**29**	**9**

[1] Prescribed burn area is the area planned for the prescribed burn, and the primary containment area is cut prior to the prescribed burn.

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

2.4.2. Seaside Bird's-Beak

Seaside bird's-beak was not observed in any grids in Unit 7 during the meandering transects, and was not present in any of the 38 grids sampled for HMP annual species (Map A1-2). Monterey Spineflower

2.4.3. Monterey Spineflower

Monterey spineflower was present at moderate to high densities in 36 of the 38 grids sampled in Unit 7 (Table 2-4; Map A1-3). Monterey spineflower was present at an average density class of 3.5 in areas of suitable habitat.

Table 2-4
Monterey Spineflower – Number of Grids per Density Class in Unit 7

Density	Burn Area[1]	Primary Containment Area
0 plants/grid (percent of total grids)	1 (2.5%)	0 (0%)
1–50 plants/grid (percent of total grids)	2 (5%)	2 (5%)
51–100 plants/grid (percent of total grids)	0 (0%)	0 (0%)
101–500 plants/grid (percent of total grids)	3 (7.5%)	0 (0%)
> 500 plants/grid (percent of total grids)	23 (61%)	7 (0%)
Total Occupied Grids	**28**	**9**
Total Grid Sampled	**29**	**9**

[1] Prescribed burn area is the area planned for the prescribed burn, and the primary containment area is cut prior to the prescribed burn.

*Each grid is 100- x 100- feet, or 10,000 square feet, or 0.23 acre.

2.4.4. Shrub Transect Monitoring

A total of 33 transects were sampled over the three Units (Map A1-4), with 31 transects located in Unit 7, and 1 transect each in Units 5E and 23E . Average total shrub cover on transects in Units 7, 5E, and 23E in 2013 averaged 110.9 percent, and ranging from 65.2 percent to 154.0 percent (Figure 2-2). Shrub cover often exceeded 100 percent because of overlapping cover between adjacent shrubs. Bare ground averaged 10.2 percent, and herbaceous vegetation occupied 0.02 percent across the three Units. Raw data for the shrub transects sampled in 2013 are provided in Appendix B.

To assess baseline conditions in association structure, several standard metrics were examined; total cover, species richness, diversity, and evenness (Table 2-5).

The dominant species in the pre-burn shrub association included shaggy-barked manzanita (*A. tomentosa* ssp. *tomentosa*), which averaged 58 percent cover and occurred on all transects, and chamise (*A. fasciculatum*) which averaged 32 percent cover and occurred on all transects. All other species were present at less than 10 percent cover across all transects. Monterey ceanothus (*C. rigidus*) and black sage (*S. mellifera*) occur frequently on the transects (85 percent and 78 percent of the transects, respectively), but at low percent cover. These results are consistent with baseline transects on Units 2, 3, 6, and 10 which are located near Unit 7, and were sampled in 2012 (Tetra Tech and EcoSystems West 2013).

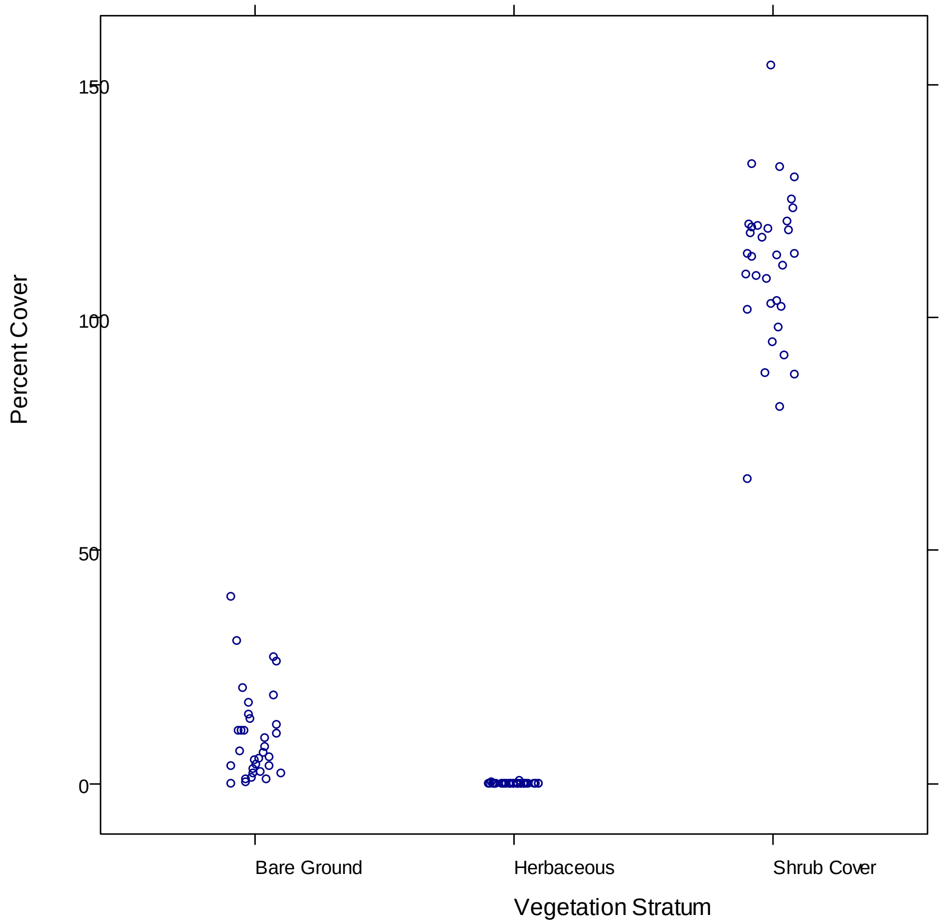

Figure 2-2 Percent cover of bare ground, herbaceous plants, and shrubs on transects in Units 7, 5E, and 23E. Points in each stratum are horizontally offset to allow results from individual transects to be seen.

Species richness (number of species per transect) was variable between transects, with between 3 and 10 species present on each transect. Species richness was similar to that observed in baseline transects in 2012.

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 maximum when all species are present in equal abundance. This diversity index is calculated as:

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

where,

p_i = proportion of the i^{th} species $= \frac{n_i}{N}$

Diversity ranged from 0.44 to 1.54 in the shrub transects.

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. Species evenness varied between transects, ranging from 0.32 to 0.88.

Table 2-5
Community Structure Parameters for Baseline Transects in Units 7, 5E, and 23E

	Parameter			
	Total Cover (percent)	**Number of Species**	**Diversity (H')**	**Evenness (J')**
Minimum	65	3	0.44	0.32
25 percentile	102.2	4	0.92	0.56
Median	113.4	5	1.08	0.62
Mean	110.9	5.54	1.06	0.64
75 percentile	119.8	6	1.22	0.72
Maximum	154.0	10	1.54	0.88

All community structure parameters (i.e., total cover, species richness, dominant species, diversity and evenness) exhibited similar means and ranges as the results from baseline transects in Units 2, 3, 6, and 10, sampled in 2012 (Tetra Tech and EcoSystems West 2013a).

Multivariate statistics (cluster analysis and ordination) was 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 samples (transects). This analysis was conducted using the R vegan package (Oksanen 2011; R Development Core Team 2012).

The results of the cluster analysis indicate that there are structural patterns in the shrub community (Figure 2-3). Two major groups of transects are evident in the cluster analysis along with two minor groups. The first association consists of 9 transects labeled as 7-7 to 7-T26-2 towards the left side of the cluster dendogram. The second major association appears in the middle of the dendogram and consists of 20 transects labeled 7-13 through 7-19. The third association is represented by only three transects (7-T26-1, 7-12, and 7-14) on the right hand side of the dendogram. Transect 5E-1 is separated from all other transects, and does not belong with any identified association.

Excluding transect 5E-1, the three remaining associations are all dominated by shaggy-barked manzanita (*A. tomentosa* ssp. *tomentosa*) and chamise (*A. fasciculatum*), but in differing percent cover (Figure 2-4). In the first association, the two species are approximately equal in percent cover (49% and 41%, respectively). However, in the second association, shaggy-barked manzanita is dominant (70% cover) whereas chamise provides only 23% cover. Association 2 is consistent with the dominant chaparral shrub association on the former Fort Ord (Tetra Tech 2013b). The situation is reversed in the third association with chamise having 74% cover, and shaggy-barked manzanita only 17% cover. Again, these general patterns are consistent with the structure of the baseline communities in Units 2, 3, 6, and 10 that were sampled in 2012 (Tetra Tech and EcoSystems West 2013a).

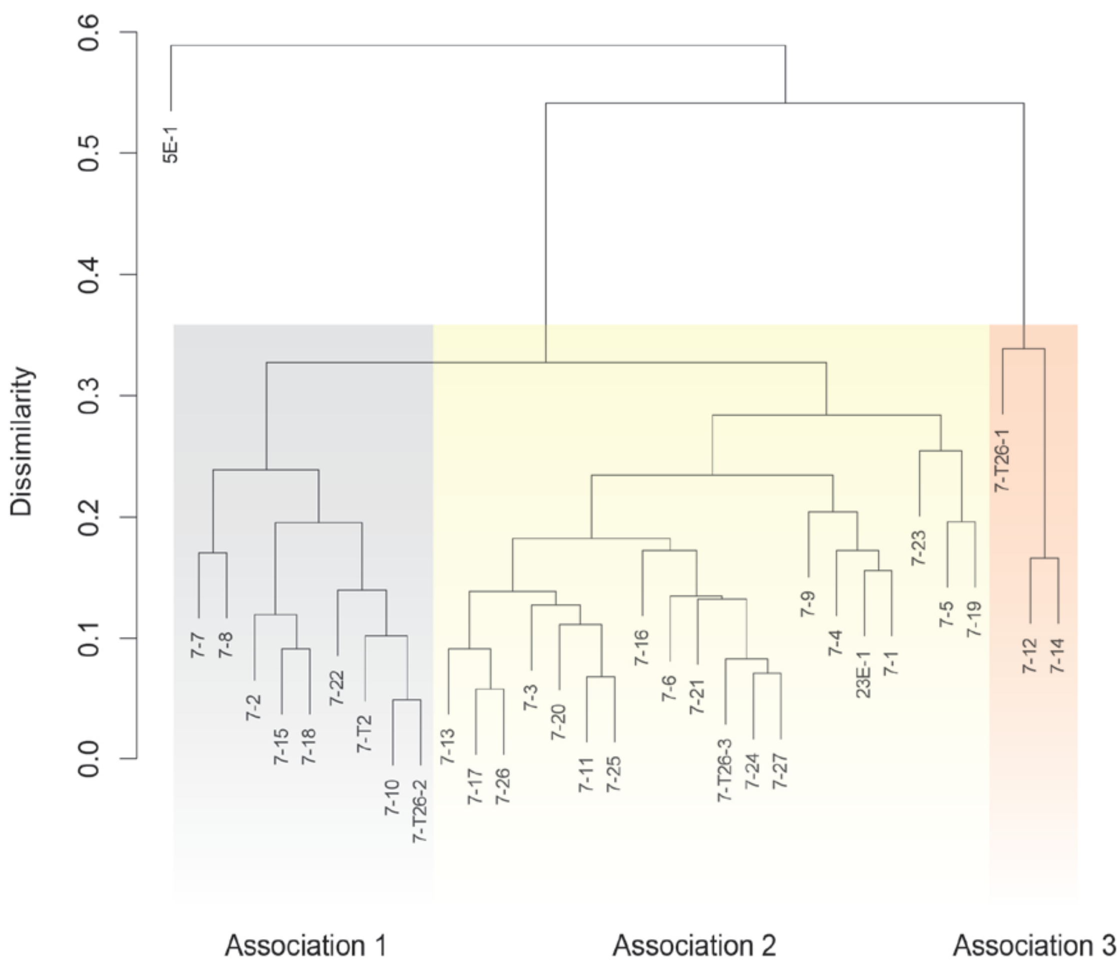

Figure 2-3 Results of cluster analysis of shrub transects on baseline Units.

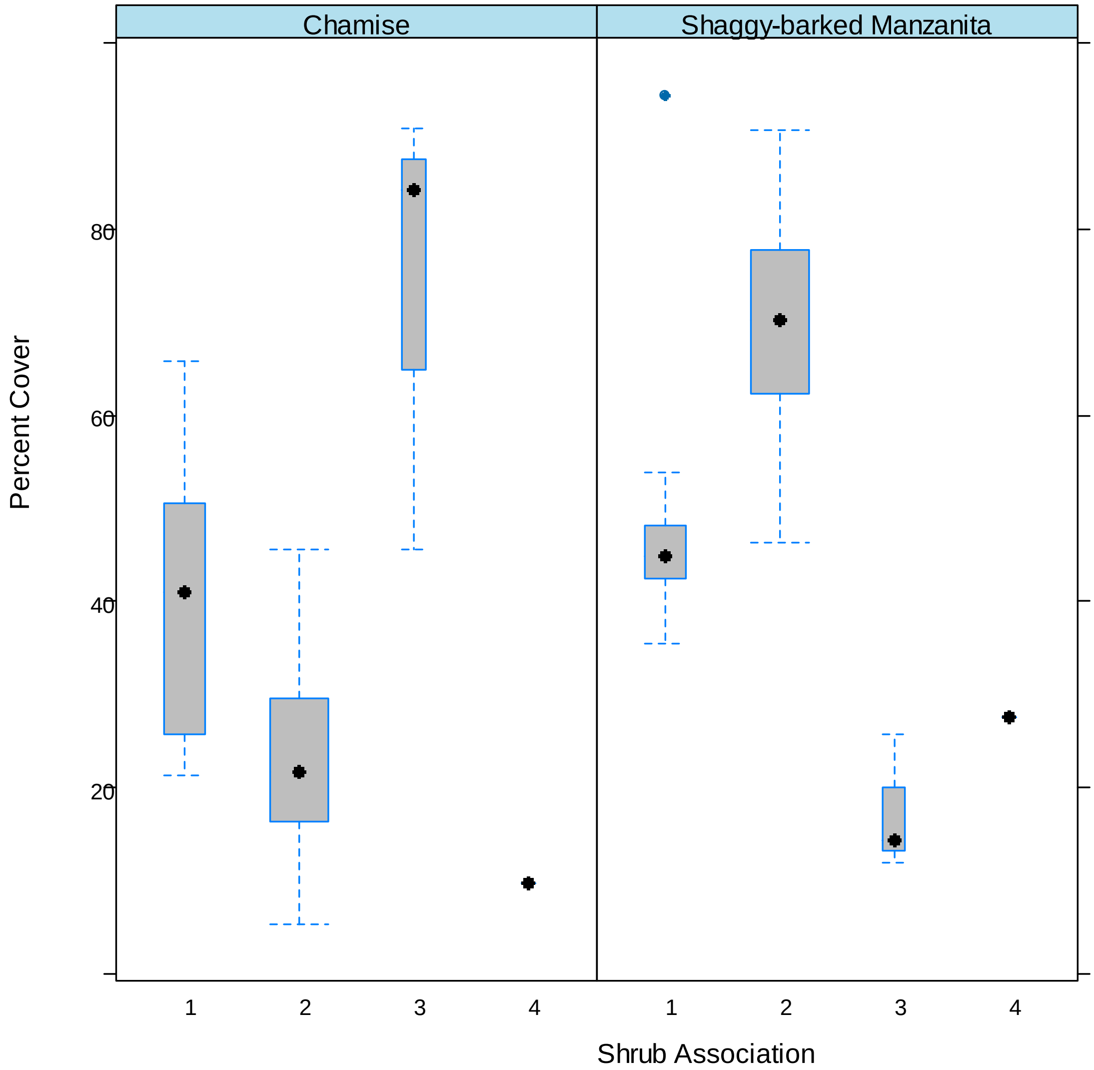

Figure 2-4 **Percent cover of chamise and shaggy-barked manzanita in identified shrub associations. Black dots represent the median value and the grey boxes the 25th to 75th percentiles of the data. The whiskers represent the non-outlier range of the data.**

Analysis of variance (ANOVA) analyses were conducted on the community structure metrics to test for differences between the four associations. None of the ANOVAs identified any significant differences in total cover, species richness, diversity, or evenness between the associations (Figure 2-5).

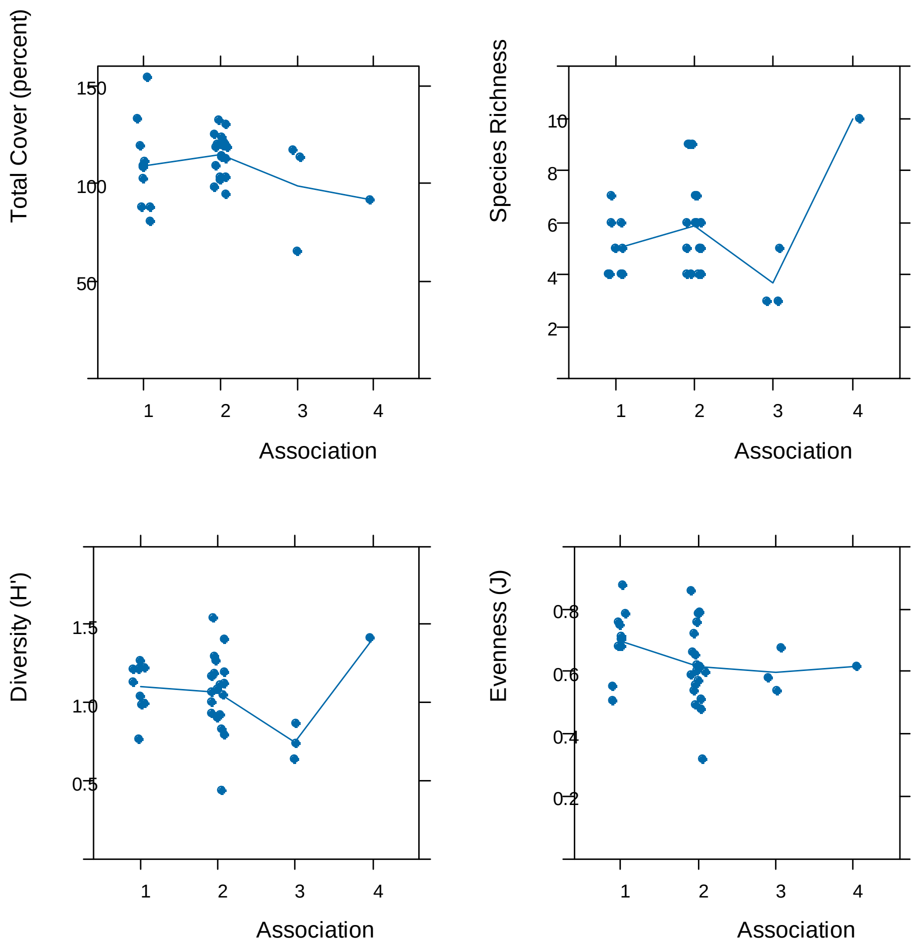

Figure 2-5 **Comparison of community structure metrics between identified shrub associations. The lines connect the group averages. No statistically significant differences were detected between shrub associations.**

2.4.5. 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 grasses were limited to the periphery of the Units although a large area of high density grasses was present in the northwest corner of Unit 7 (Map A1-5). Estimated areas occupied by annual grasses are summarized in Table 2-6.

Table 2-6
Estimated Area Occupied (Acres) by Annual Grasses in Baseline Surveys

Cover Class	Unit 7	Unit 5E	Unit 23E
1 (low) = 1–5 percent	2.3	0.05	0.29
2 (medium) = 6–25 percent	2.5	0.0	0.04
3 (high) = >25 percent	4.6	0.0	0.05
Total Acreage	**9.5**	**0.05**	**0.38**

2.4.6. Invasive Species Monitoring

When invasive species were encountered in the baseline Units the locations were mapped using a recreational-grade GPS unit. Iceplant was pervasive throughout the baseline units and was not mapped. No other invasive species were noted in Units 7, 5E, and 23E.

SECTION 3

Year 3 Vegetation Monitoring – Units 15, 21, 32, and 34

3.1. Units 15, 21, 32, and 34 – Introduction

A prescribed burn was conducted in Units 15 and 21 in fall 2010, while portions of Units 32 (except in the eastern section) and Unit 34 were masticated and burned (Figure 2-1). After mastication, cut vegetation in portions of Units 32 and 34 was burned with a terra-torch. Baseline monitoring was conducted prior to these treatments within these four Units in spring 2010 (Tetra Tech and EcoSystems West 2011). This 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 in Units 15, 21, and 34 (no HMP density monitoring was conducted in Unit 32 because no HMP annuals were observed in that Unit in meandering transect surveying); transect surveys to sample shrub composition in the maritime chaparral; and annual grass monitoring in the primary containment areas around the perimeters of the four Units. Year 1 follow-up monitoring was conducted in the spring and early summer of 2011 in these four units in order to assess recovery of the three HMP annual species in the first season after burning as well as to assess the status of non-native annual grasses in the primary containment areas. The Year 3 monitoring conducted in these units in spring 2013 is reported in this section.

3.2. Units 15, 21, 32, and 34 – Setting

Unit 15 encompasses an area of 238 acres; Unit 21 encompasses an area of 168 acres; Unit 32 encompasses an area of 55 acres; and Unit 34 encompasses an area of 37 acres (Figure 1-1; Appendix A-2 Maps). The terrain is gently rolling to locally steep. In pre-treatment condition, Units 15 and 34 were vegetated primarily with mature maritime chaparral, with some localized disturbed areas. Unit 21 was also largely vegetated with mature maritime chaparral, but exhibited more extensive areas of past disturbance, especially in the central portion which contains a large seasonal pond and various outbuildings in various states of disrepair. The western portion of Unit 32 (approximately 2/3 of the Unit) and its southeastern portion were vegetated primarily with mature maritime chaparral with some localized areas of woodland dominated by coast live oak. Coast live oak woodland also predominates in the northeastern portion of this Unit. This portion of the Unit also includes some areas dominated by grasses and herbs, some of which may be disturbance-related, along with a large seasonal pond.

The soils over Units 15, 21, 34, and the southern and extreme western portions of Unit 32 are mapped by USDA (2013) as Arnold-Santa Ynez complex (Table 2-1). The southern portion of

Unit 32 (except the extreme western portion) is mapped as Arnold loamy sand, 9 to 15 percent slopes.

3.3. Units 15, 21, 32, and 34 – Methods

The 2013 Year 3 follow-up monitoring consisted of the following:

- Density monitoring for three HMP annual species: Monterey spineflower, sand gilia, and seaside bird's-beak.
- Line intercept transect sampling to sample shrub species composition in the mature maritime chaparral.
- Mapping of non-native annual grasses within the primary containment areas.
- Mapping of invasive species, including iceplant, pampas grass, and French broom, where encountered.

3.3.1. HMP Annuals Density Monitoring

Density monitoring for the three HMP annual species in Units 15, 21, and 34 was conducted between 22 and 26 April 2013. This time period was optimal for observing Monterey spineflower and sand gilia. Seaside bird’s-beak was not yet in flower when this density monitoring was conducted but was readily identifiable by its vegetative characteristics. In the baseline monitoring conducted in 2010 (Tetra Tech and EcoSystems West 2011), sample grids in Units 15 and 21 were randomly selected from among the 100×100 foot grids mapped during meandering transect surveying as containing one or more of the three HMP annual species. Because there were fewer grids containing HMP annuals in Unit 34, nearly all occupied grids in that unit were sampled in 2010. In the 2010 monitoring, a total of 41 grids were sampled in Unit 15; 39 grids were sampled in Unit 21; and 50 grids were sampled in Unit 34 (some grids selected for sampling straddle the boundary between Units 21 and 34; these were treated as occurring within the unit that contained the majority of the area of the grid).

In 2011 and 2013, only grids sampled in 2010 were resampled; no additional grids previously unoccupied by HMP annuals were sampled. Two grids in Unit 15 were not sampled in 2011 or 2013 because a large portion of the grid (> 50 percent) was located outside the unit or outside the area subject to the 2010 treatments. Thirteen grids in Unit 34 were not sampled in 2011 or 2013, either because more than 50 percent of the grid was located outside the unit or outside the area subject to the 2010 treatments or because the grid was not included in the original 2010 selection set. In addition, there were four grids in Unit 15, six grids in Unit 21, and three grids in Unit 34 that were sampled in 2011 or 2013 that extended outside the 2010 treatment area. In these cases, only the portion of the grid within the unit and subject to treatment in 2010 was sampled in 2011 and 2013.

Two grids in Unit 21 that had been sampled in 2010 and 2011 were not resampled in 2013 because more than 50 percent of these grids were impacted by recent soil remediation activities. Two additional grids in Unit 21 were impacted by recent soil remediation; however, since greater than 50 percent of the grid remained undisturbed the undisturbed portions were included in 2013

Year 3 monitoring. One grid in Unit 34 was accidentally missed. A total of 38 grids in Unit 15, 37 grids in Unit 21, and 36 grids in Unit 34 were monitored in 2013.

The methodology for the 2013 density monitoring in Units 15, 21, 32, and 34 was similar to that described above for the baseline monitoring. The surveyors used a resource grade Trimble GeoXH GPS receiver with the grid boundaries loaded as a map layer to locate the grids to be sampled. Following vegetation treatment in 2011, the corners of the grids were marked by wooden lath stakes by ordnance removal crews. In many cases, the corner stakes were missing or lying on the ground when sampling was conducted in 2013. When present, the stakes were used to precisely determine the boundaries of the sample grid and calibrate the GPS unit for consistent daily positional offsets.

Once the grids were located, sampling was conducted as described for the baseline monitoring, and the same density classes were used. However, as mentioned above (Section 2.3.2), grids were fully censused to estimate density; 2.5-meter radius circular subplots were not used in 2013. When only a portion of the grid was sampled, the observed plant abundances were scaled proportional to the percentage of the total grid sampled prior to determining the density class.

3.3.2. Shrub Transect Monitoring

Monitoring of shrub species composition in Units 15, 21, 32, and 34 was conducted between 13 May and 23 May 2013. All shrub transects in Units 15, 21, and 34 monitored by Tetra Tech and EcoSystems West in 2010 were resampled in 2013. Transect 21-10 in Unit 21 was crossed by a temporary access roads. The disturbed portions of this transect was not included in the cover and association structure determinations. One transect in Unit 32 (32-5) was not resampled in 2013 because it was located in an area where vegetation was not treated with mastication or burning and therefore is still in its baseline condition.

The surveyors used a resource grade Trimble GeoXH GPS receiver to locate the previously recorded start and end points of each transect monitored. Once the start and end points were located, the transects were sampled using the line intercept method following the same methodology as in the baseline monitoring areas (Section 2.3.3).

3.3.3. Annual Grass Monitoring

Non-native annual grass monitoring was conducted within the 230-foot wide primary containment lines surrounding Units 15, 21, 32, and 34 on 31 May and 1 June 2013. Annual grass species included in this monitoring were the same species as in the baseline areas annual grass monitoring. Annual grass monitoring was conducted using the same methodology and density classes as those used in the baseline monitoring.

3.3.4. Invasive Species

Invasive species, including iceplant, pampas grass, and French broom, were encountered incidentally during the meandering transect survey and the HMP annuals density monitoring and shrub transect monitoring. When invasive species were encountered, the locations were mapped using a recreational-grade GPS unit. A comprehensive survey for invasive species was not conducted.

3.4. Units 15, 21, 32, and 34 – Results and Discussion

Density monitoring was not conducted in Unit 32 because no HMP annuals were observed during the baseline meandering transect survey conducted in 2010. Maps of survey grids for the sampled Units are provided in Appendix A2.

3.4.1. Sand Gilia

Sand gilia appears to show a slight positive response to the effects of the prescribed burn in 2010. The species was present in 70 percent of the 115 grids sampled in 2011 and 66 percent of the 111 grids sampled in 2013 (Table 3-1; Maps A2-1, A2-6, and A2-13). In comparison, only 59 percent of the 127 grids sampled under pre-burn conditions in 2010 were occupied by sand gilia.

Table 3-1
Sand Gilia – Number of Grids per Density Class in Units 15, 21, and 34

Density	Unit 15 Grids			Unit 21 Grids			Unit 34 Grids		
	2010	**2011**	**2013**	**2010**	**2011**	**2013**	**2010**	**2011**	**2013**
0 plants/grid (percent of grids)	18 (45%)	9 (24%)	10 (26%)	17 (44%)	16 (41%)	17 (46%)	17 (35%)	8 (24%)	11 (31%)
1–50 plants/grid (percent of grids)	14 (35%)	8 (21%)	9 (24%)	11 (28%)	5 (13%)	11 (30%)	16 (33%)	13 (34%)	11 (31%)
51–100 plants/grid (percent of grids)	3 (8%)	6 (16%)	4 (11%)	4 (10%)	10 (26%)	1 (3%)	6 (13%)	5 (13%)	7 (19%)
101–500 plants/grid (percent of grids)	5 (13%)	8 (21%)	10 (26%)	5 (13%)	3 (8%)	6 (16%)	6 (13%)	10 (26%)	6 (17%)
>500 plants/grid (percent of grids)	0 (0%)	7 (18%)	5 (13%)	2 (5%)	5 (13%)	2 (5%)	3 (6%)	1 (3%)	1 (3%)
Number of Occupied Grids	**22**	**29**	**28**	**22**	**23**	**20**	**31**	**29**	**25**
Total Grids Sampled	**40**	**38**	**38**	**39**	**39**	**37**	**48**	**37**	**36**
*Each grid is 100- x 100- feet or 10,000 square feet.									

3.4.2. Seaside Bird's-Beak

Seaside bird's-beak does not appear to show a substantial response to the effects of the prescribed burn. The species was present in 6 percent of the 2010 grids, 6 percent of the grids sampled in 2011, and 13 percent of the grids sampled in 2013 (Table 3-2; Maps A2-2, A2-7, and A2-14).

Table 3-2
Seaside Bird's-Beak – Number of Grids per Density Class in Units 15, 21, and 34

Density	Unit 15 Grids			Unit 21 Grids			Unit 34 Grids		
	2010	2011	2013	2010	2011	2013	2010	2011	2013
0 plants/grid (percent of grids)	39 (98%)	37 (97%)	34 (89%)	37 (95%)	38 (97%)	34 (92%)	42 (88%)	30 (81%)	29 (81%)
1–50 plants/grid (percent of grids)	1 (3%)	0 (0%)	2 (5%)	2 (5%)	1 (3%)	2 (5%)	5 (10%)	6 (16%)	4 (11%)
51–100 plants/grid (percent of grids)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	1 (3%)
101–500 plants/grid (percent of grids)	0 (0%)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	1 (2%)	1 (3%)	2 (6%)
>500 plants/grid (percent of grids)	0 (0%)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Number of Occupied Grids	**1**	**1**	**4**	**2**	**1**	**3**	**6**	**7**	**7**
Total Grids Sampled	**40**	**38**	**38**	**39**	**39**	**37**	**48**	**37**	**36**
*Each grid is 100- x 100- feet or 10,000 square feet.									

3.4.3. 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 2010, the species was present in 98 percent of the sampled grids (Table 3-3; Maps A2-3, A2-8, and A2-15). In 2011, the species was present in 83 percent of the sampled grids. In 2013, the species was present in 84% of the sampled grids.

Units 15 and 21 included both masticated areas around the periphery of the Unit and burned areas within the central portion of each Unit. It is expected that the HMP annual species may respond differently to these treatments. The HMP survey grids were assigned to these treatments based on whether the grid fell within the containment area (masticated) or interior of the Unit (burned). At least 80 percent of the grid needed to fall in one of these areas in order to be classified. If less than 80 percent of a grid fell within one of these areas, the grid was classified as "indeterminate". In addition, Unit 34 was first masticated and then burned.

Table 3-3
Monterey Spineflower – Number of Grids per Density Class in Units 15, 21, and 34

Density	Unit 15 Grids			Unit 21 Grids			Unit 34 Grids		
	2010	**2011**	**2013**	**2010**	**2011**	**2013**	**2010**	**2011**	**2013**
0 plants/grid (percent of grids)	0 (0%)	4 (11%)	5 (13%)	2 (5%)	1 (3%)	3 (8%)	1 (2%)	5 (11%)	10 (27%)
1–50 plants/grid (percent of grids)	13 (33%)	10 (26%)	8 (21%)	5 (13%)	7 (18%)	13 (35%)	12 (25%)	18 (50%)	16 (43%)
51–100 plants/grid (percent of grids)	2 (5%)	6 (16%)	1 (3%)	4 (10%)	3 (8%)	1 (3%)	6 (13%)	6 (17%)	6 (17%)
101–500 plants/grid (percent of grids)	9 (23%)	8 (21%)	9 (24%)	7 (18%)	14 (36%)	13 (35%)	10 (21%)	7 (19%)	3 (8%)
>500 plants/grid (percent of grids)	16 (40%)	10 (26%)	15 (39%)	21 (54%)	14 (36%)	7 (19%)	19 (40%)	1 (3%)	1 (3%)
Number of Occupied Grids	**40**	**34**	**33**	**37**	**38**	**34**	**47**	**32**	**26**
Total Grids Sampled	**40**	**38**	**38**	**39**	**39**	**37**	**48**	**37**	**36**

*Each grid is 100- x 100- feet or 10,000 square feet.

3.4.4. Effect of Treatment on HMP Density

To assess whether treatment had an effect on the subsequent density of the HMP annual plants, the average density class for each species, treatment, and Unit was calculated for each of the three monitoring years (Figure 3-1). Variation in response of the species can be seen in the plot. Patterns in average density class appear to vary between Units within a species. As a result of this variability, no clear pattern of response to treatment could be discerned from these data.

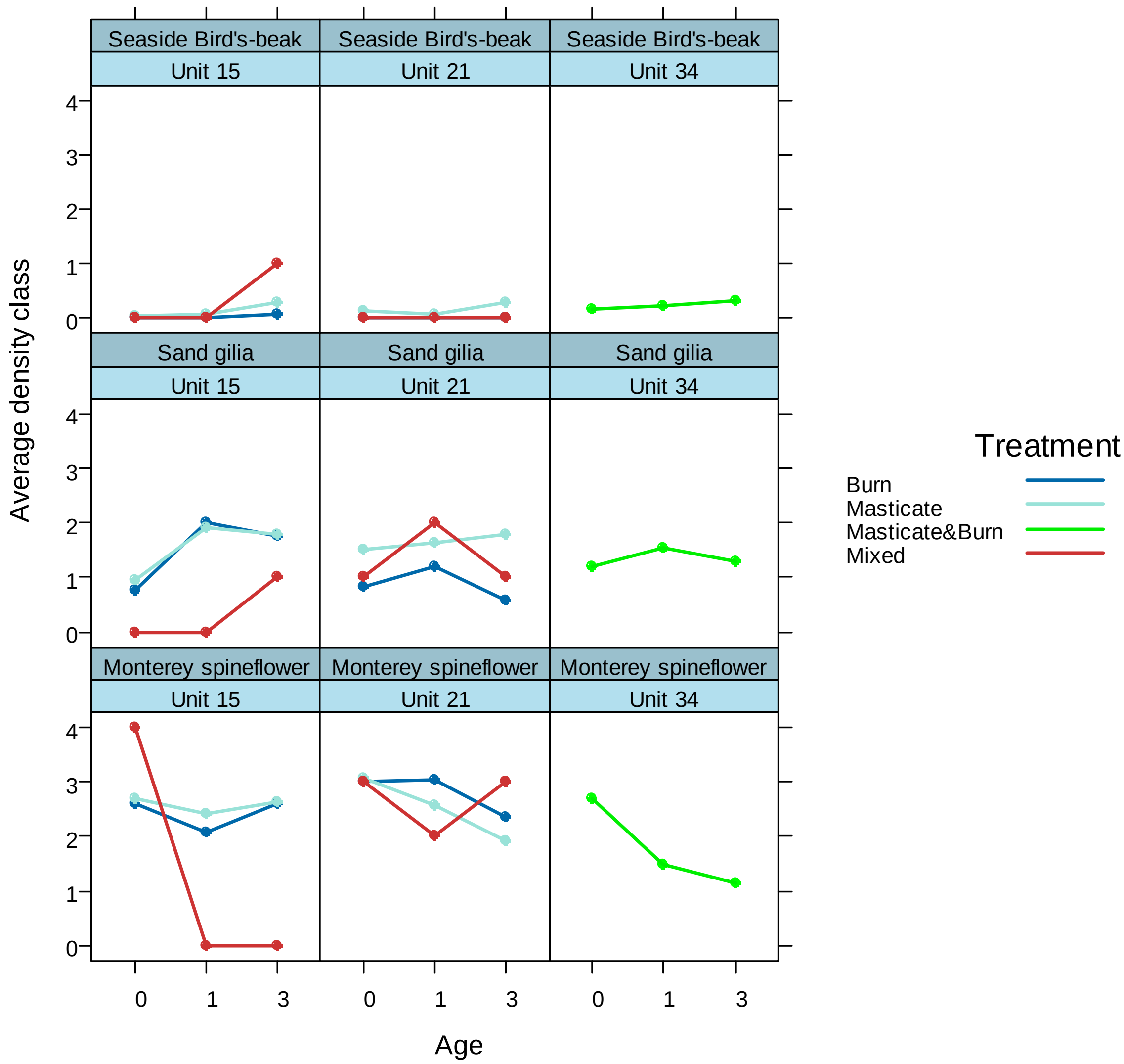

Figure 3-1 Average density class of each HMP annual species plotted by Unit and age.

3.4.5. Shrub Transect Monitoring

A total of 44 transects were sampled on the four Units (Maps A2-4, A2-9, A2-11, and A2-16). The raw data for the shrub transects sampled in 2013 are provided in Appendix B. Between-year changes in association structure parameters are shown in Figure 3-2, Figure 3-3, Figure 3-4, and Figure 3-5. The association structure parameters respond as expected after vegetation removal. Total cover in Year 3 is reduced, whereas diversity and species richness (the number of species identified per transect) increase as a result of recruitment of subshrubs such as dwarf ceanothus, golden yarrow, peak rush-rose and deerweed. Evenness also increases, indicating lower dominance by climax species.

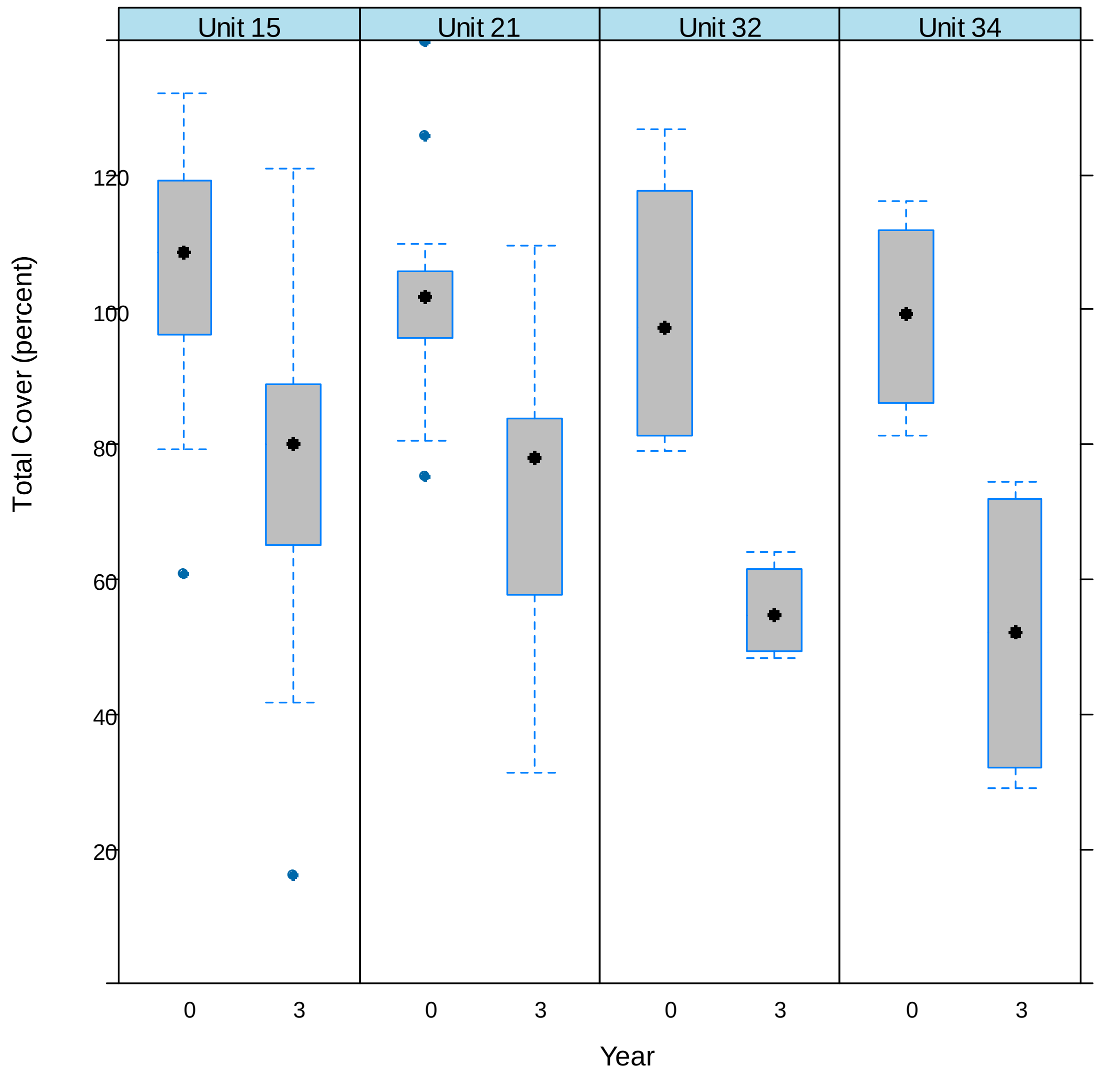

Figure 3-2 **Changes in total cover between baseline and Year 3 surveys on Units 15, 21, 32, and 34. Black dots represent the median value and the grey boxes the 25th to 75th percentiles of the data. The whiskers represent the non-outlier range of the data.**

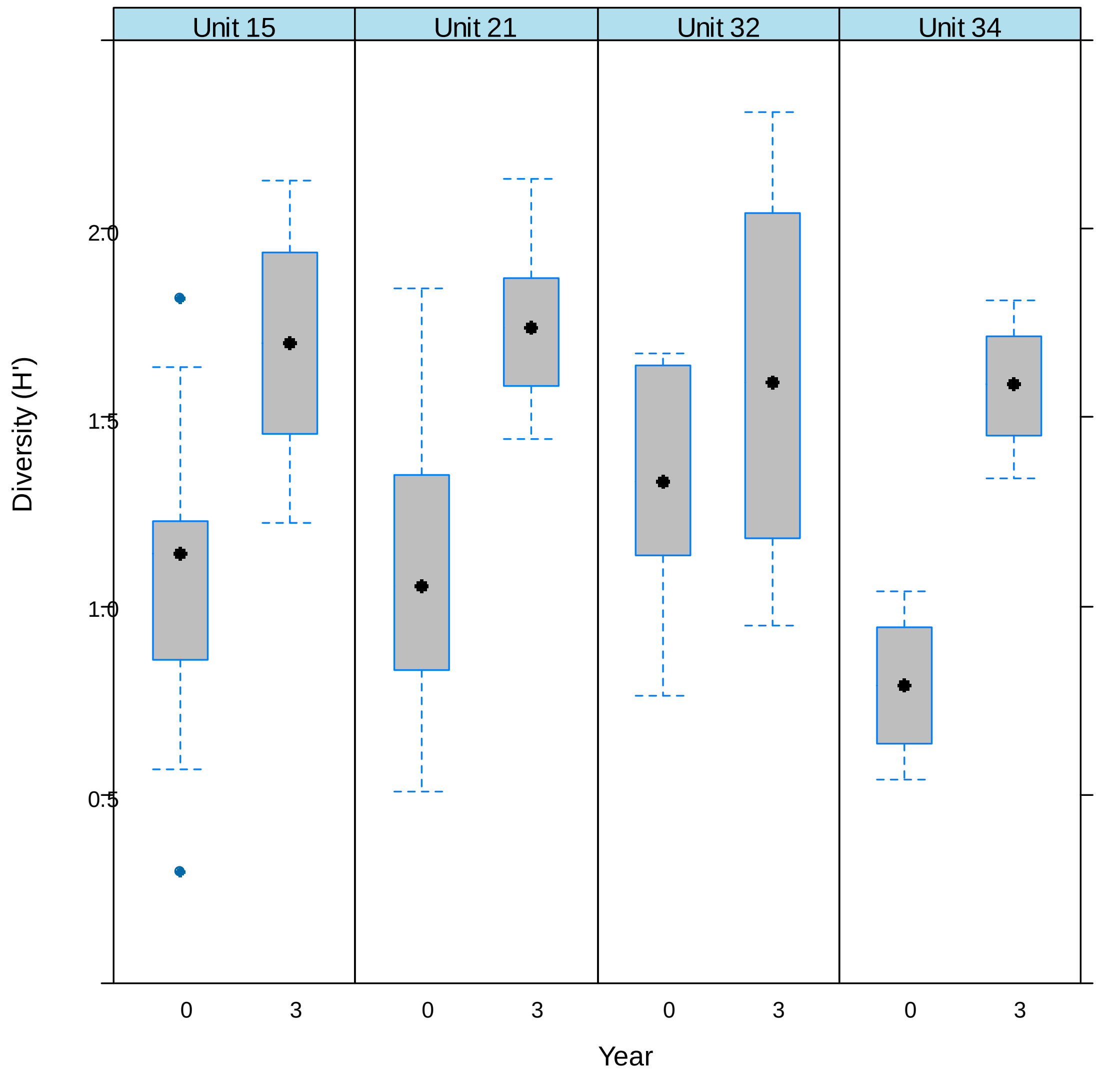

Figure 3-3 **Changes in diversity (H') between baseline and Year 3 surveys on Units 15, 21, 32, and 34. Black dots represent the median value and the grey boxes the 25th to 75th percentiles of the data. The whiskers represent the non-outlier range of the data.**

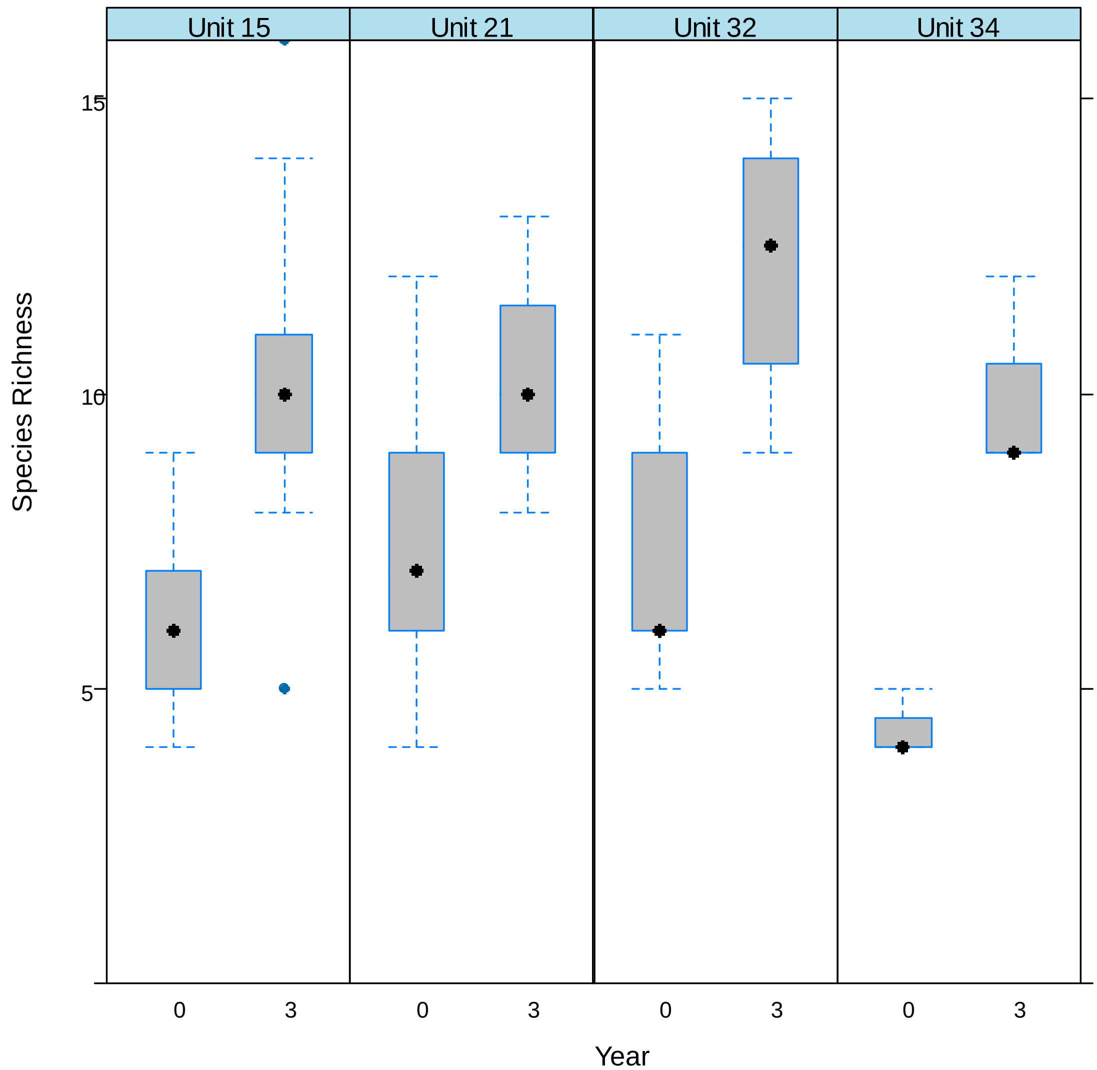

Figure 3-4 **Changes in species richness between baseline and Year 3 surveys on Units 15, 21, 32, and 34. Black dots represent the median value and the grey boxes the 25th to 75th percentiles of the data. The whiskers represent the non-outlier range of the data.**

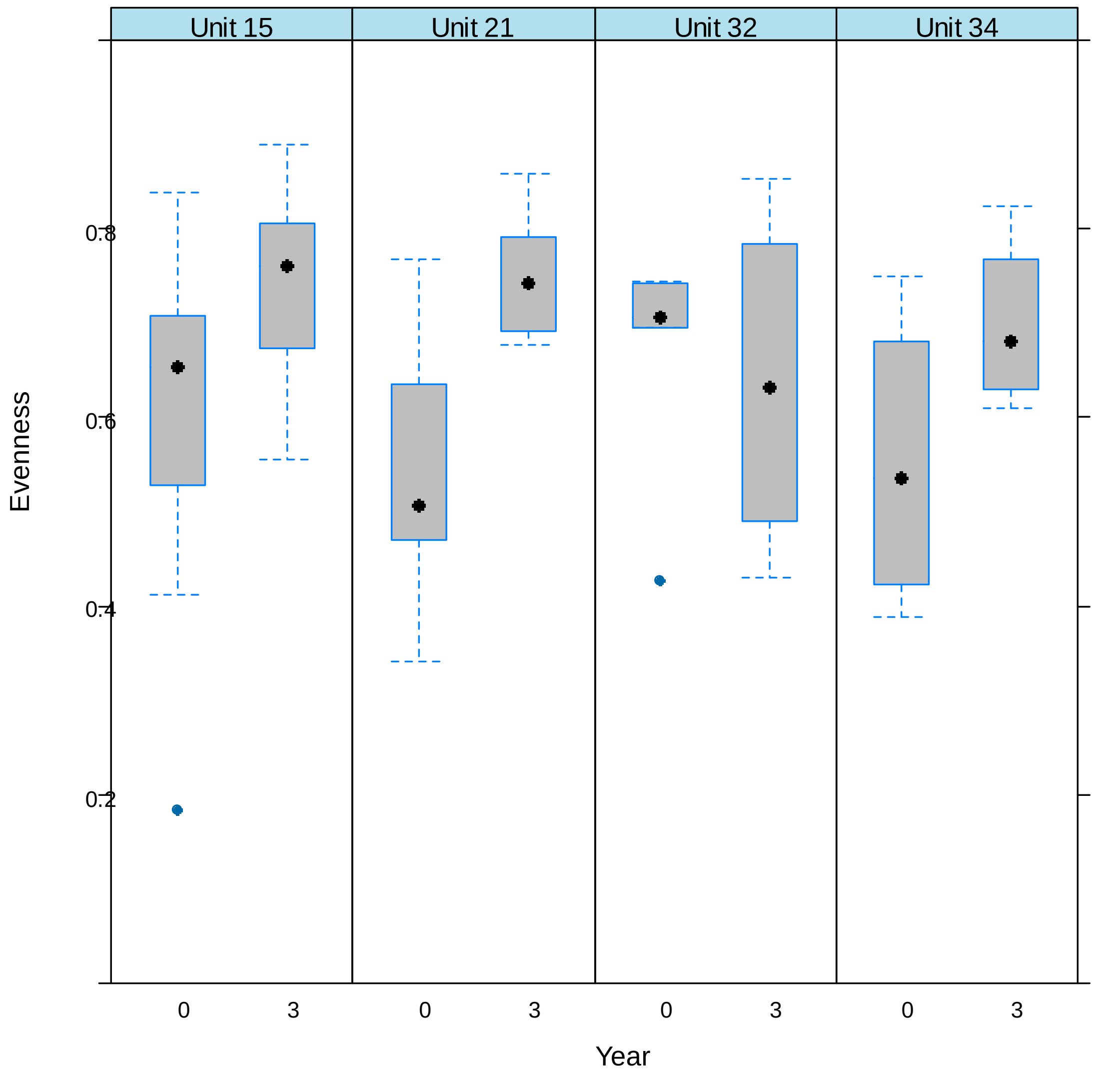

Figure 3-5 Changes in evenness between baseline and Year 3 surveys on Units 15, 21, 32, and 34. Black dots represent the median value and the grey boxes the 25th to 75th percentiles of the data. The whiskers represent the non-outlier range of the data.

To test whether treatment had an effect on association structure, multivariate statistics (ordination techniques) were used. These techniques are based on measures of dissimilarity between samples (transects). This analysis was conducted using non-metric multidimensional scaling (NMDS) as implemented in function “metaMDS” in the “vegan” package in R (Oksanen et al. 2011).

The results of the NMDS ordination show an association-level response relative to both time and treatment. Temporal changes are clearly evident in Figure 3-6 which displays the position of each transect relative to the centroid for each year. The baseline transects are clearly separated from both post-treatment years. Permutational MANOVA (Oksanen et al. 2011) of the shrub association data indicates that time, Unit, and treatment effects are all significant; time explains approximately 29 percent of the variability, whereas Unit effect explains approximately 6 percent and treatment explains approximately 4 percent of the variability between groups (Table 3-4).

Table 3-4
Results of Permutational MANOVA of Shrub Association Structure on Units 15, 21, 32, and 34

Source	**df**	**Sum Sqs**	**Mean Sq**	**F**	**R^2**	**p**
Year	1	5.90	5.90	39.7	0.29	0.001
Unit	3	1.17	0.39	2.6	0.06	0.001
Treatment	1	0.87	0.87	5.8	0.04	0.001
Residuals	83	12.32	0.15		0.61	
Total	**88**	**20.26**				

The effect of time since treatment is clearly seen when the ordination results are presented graphically as in Figure 3-6.

The effect of treatment and Unit can be clearly seen when the 95 percent confidence ellipsoids are plotted for each combination of Treatment, and Unit for the Year 3 (post-treatment) transect data (Figure 3-7). The confidence ellipsoids are a two-dimensional representation of the confidence interval surrounding the average position (i.e. centroid) of each group. Differences in the position of the confidence ellipsoids between the burn and mastication treatments in Units 15 and 21 is indicative of a statistically significant difference in association response to treatment.

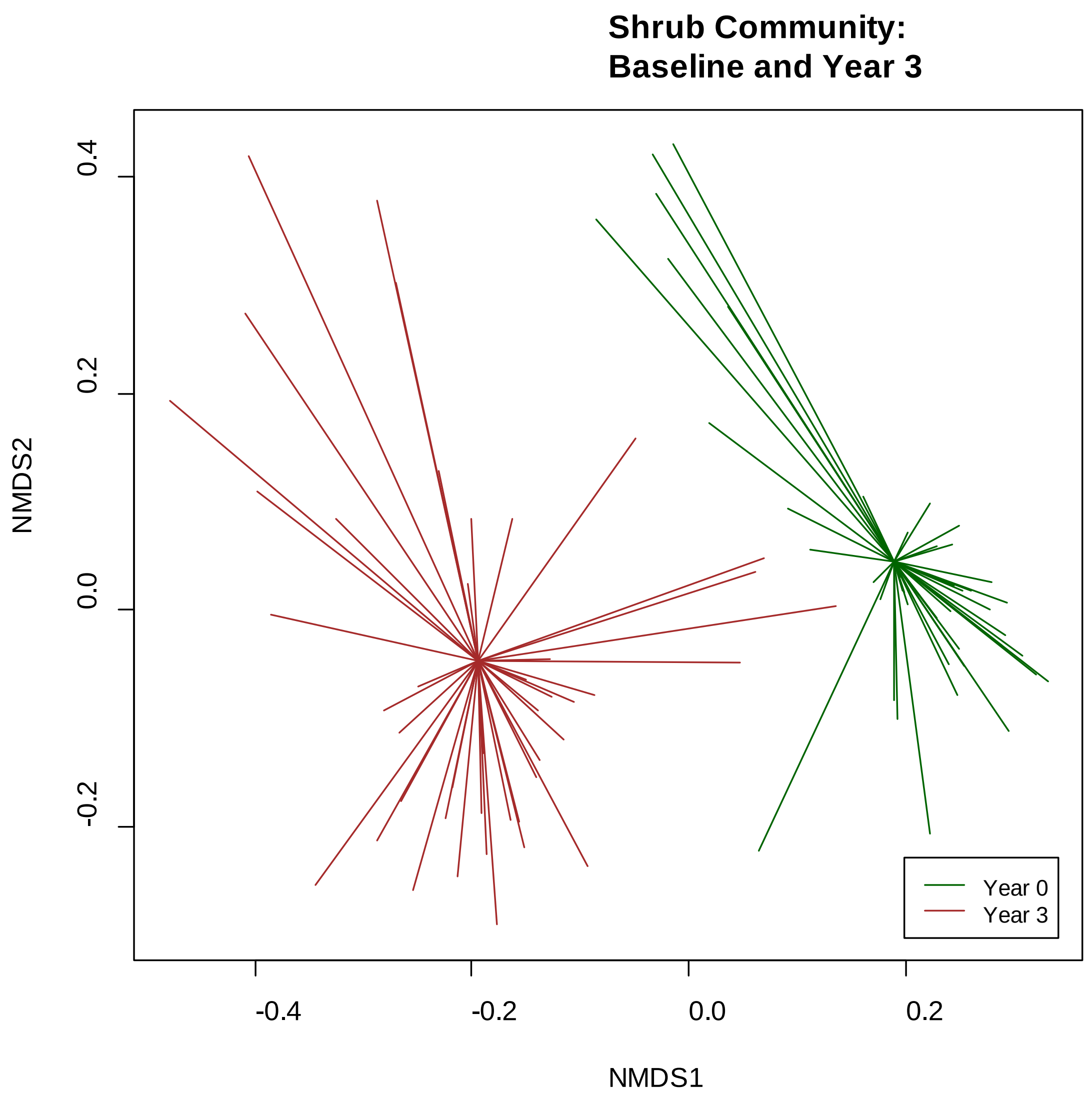

Figure 3-6 **NMDS ordination plot of shrub association structure on Units 15, 21, 32, and 34 with respect to time. The spider plot showing the position of transects relative to the centroid for that group indicates a clear separation between years.**

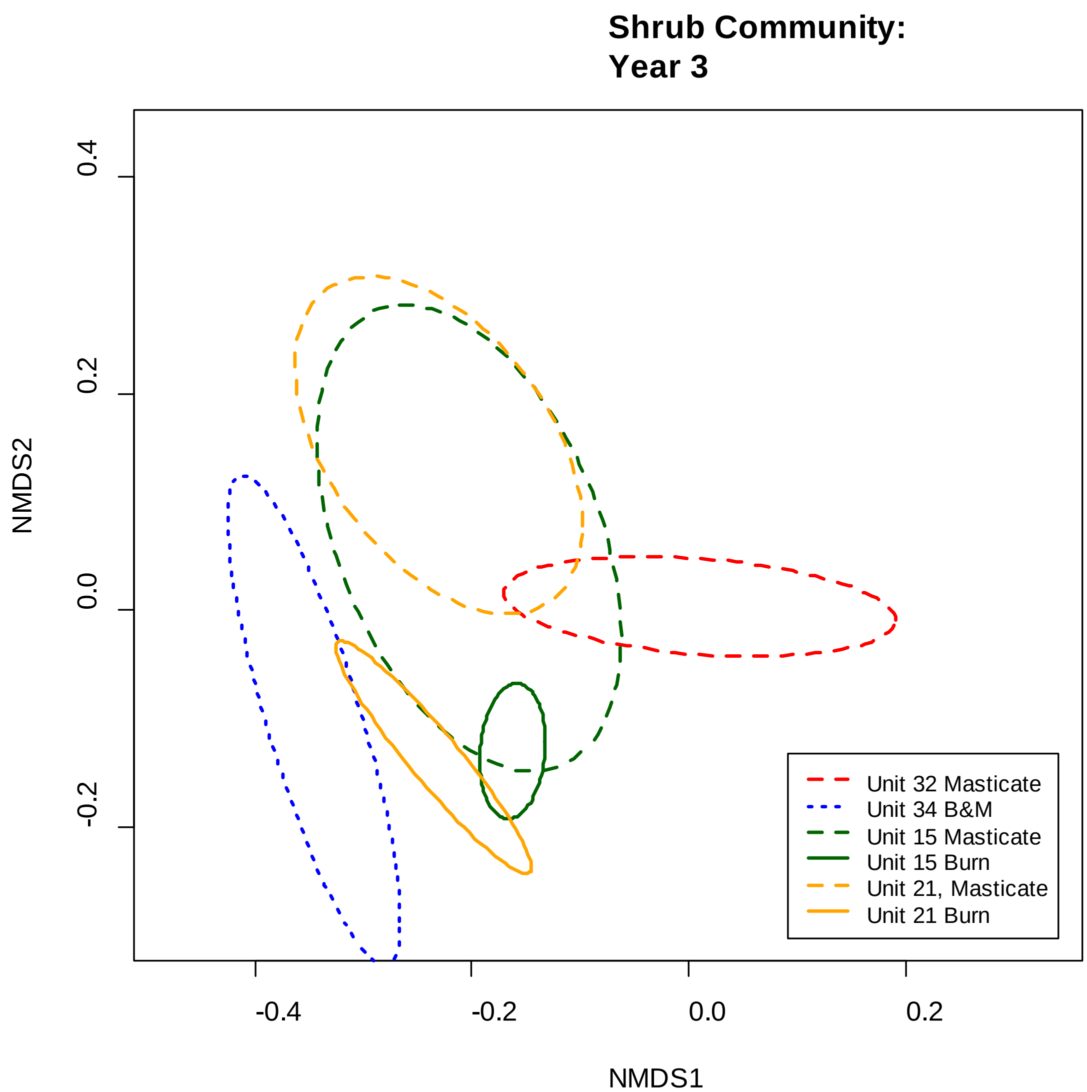

Figure 3-7 Comparison of 95 percent confidence ellipsoids for Unit and treatment groupings in Year 3 transects. Limited overlap ellipsoids indicates a statistical difference, whereas substantial overlap indicates no statistical difference. Significant differences were identified between treatments for both Units 15 and 21 (p<0.01). For clarity, the ordination axes were limited to the extent of the Year 3 data.

3.4.6. Annual Grass Monitoring

Annual grass surveys were limited to the periphery of the Units. Estimated areas occupied by annual grasses in Years 1 and 3 are summarized in Table 3-5**Error! Reference source not found.**, and Maps A2-5, A2-10, A2-12, and A2-17. The area occupied by annual grasses decreased by between 10 to 30% between Years 1 and 3 in Units 15 and 21, but increased substantially in Units 32 and 34 (200 to 500 %).

Table 3-5
Estimated Area Occupied (Acres) by Annual Grasses in Year 1 and Year 3 Surveys in Units 15, 21, 32, and 34

Cover Class	Unit 15		Unit 21		Unit 32		Unit 34	
	2011	2013	2011	2013	2011	2013	2011	2013
1 (low) = 1–5 percent	57.86	42.3	33.42	18.7	0.55	1.2	0.56	7.8
2 (medium) = 6–25 percent	14.17	14.1	6.53	7.5	0.41	1.9	5.46	3.7
3 (high) = >25 percent	4.42	12.7	6.45	5.7	0.42	4.2	2.75	6.2
Total Acreage	**76.45**	**69.2**	**46.40**	**31.8**	**1.38**	**7.4**	**8.77**	**17.8**

3.4.7. Invasive Species Monitoring

When invasive species were encountered in Units 15, 21, 32, and 34, the locations were mapped using a recreational-grade GPS unit. No individual invasive plants were mapped on these Units in 2013. Iceplant was widely distributed throughout the Units and was not mapped. French broom was observed on Unit 21, but was treated before its distribution could be mapped.

SECTION 4

Year 5 Vegetation Monitoring – Units 18 and 22

4.1. Units 18 and 22 – 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 50-meter transects in Unit 18 and 14 50-meter 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 percent cover was estimated by cover class.

A prescribed burn was conducted in Units 18 and 22 in December 2008. In 2009, Burleson Consulting 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 foot grids was superimposed over the maps of areas occupied by one or more HMP annual species in 2008, as mapped by Shaw (2009). Twenty percent of grids mapped as occupied in 2008, plus ten percent of grids along the outer boundaries of the occupied areas, were randomly selected for sampling in 2009. 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 (Section 2.3.2) for the 2013 baseline sampling, except that 2.5-meter radius circular subplots were used exclusively.

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 (Shaw 2009) into the data table for analysis.

In 2013, Year 5 sampling in Units 18 and 22 was conducted at the same locations as for the 2011 Year 3 follow-up monitoring.

4.2. Units 18 and 22 – Setting

Unit 18 is located south of Eucalyptus Road, east of Orion Road, and north of Broadway Avenue (Figure 1-1; Map A3-1). Unit 22 is located south of Broadway Avenue, west of Watkins Gate Road, and northeast of Chinook Road (Map A3-6). 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 areas, especially in the northern portion.

Soils in both Year 5 monitoring units are mapped by USDA (2013) as Arnold-Santa Ynez complex. Characteristics of this soil type are presented in Table 2-1.

4.3. Units 18 and 22 – Methods

The 2013 monitoring conducted in Units 18 and 22 consisted of the following:

- Density monitoring for three HMP annual species: Monterey spineflower, sand gilia, and seaside bird's-beak.
- Line intercept transect sampling of transects previously sampled in 2008 and 2011 (Shaw 2009, Tetra Tech and EcoSystems West 2012) to sample shrub species composition in the maritime chaparral that is recovering from past disturbance (the 2008 prescribed burn and subsequent munitions and ordnance cleanup).
- Mapping of non-native annual grasses within the primary containment areas.
- Mapping of invasive species, including iceplant, pampas grass, and French broom, where encountered.

4.3.1. HMP Annuals Monitoring

Density monitoring for the three HMP annual species in Units 18 and 22 was conducted between 12 and 22 April 2013. This time period was optimal for observing Monterey spineflower and sand gilia. Seaside bird's-beak was not yet in flower when this density monitoring was conducted, but was readily identifiable by its vegetative characteristics.

In the 2011 monitoring, 95 of the 107 previously occupied grids in Unit 18, and 89 of the 91 previously occupied grids in Unit 22 that were sampled by Burleson Consulting in 2009 (Burleson 2009b) were resampled. The remaining grids sampled in 2009 (12 in Unit 18 and two in Unit 22) were not resampled in 2011, either because they extend substantially out of the treatment areas or because they are located in areas heavily disturbed by soil remediation activities since the prescribed burn. In 2013, all grids sampled in 2011 were resampled for Year 5 follow-up monitoring.

The methodology for the 2013 density monitoring in Units 18 and 22 was similar to that described above for the baseline monitoring (Section 2.3.2). The surveyors used a resource grade Trimble GeoXH GPS receiver with the grid boundaries loaded as a map layer to locate the grids to be sampled. Generally, the corners of the grids were marked by wooden lath stakes, although, in many cases, the stakes were missing or lying on the ground. When present, the stakes were used to precisely determine the boundaries of the sample grid and calibrate the GPS unit for consistent daily positional offsets.

Once the grids to be sampled were located, sampling was conducted as described for the baseline monitoring, and the same density classes were used. However, as mentioned above (Section 2.3.2), all grids were censused to calculated density; no 2.5-meter radius circular subplots were used in 2013. When only a portion of the grid was sampled, the density classes were scaled proportional to the percentage of the total grid sampled.

4.3.2. Shrub Transect Monitoring

Monitoring of shrub species composition in Units 18 and 22 was conducted between 8 April and 13 May 2013. Twenty-one of the 22 transects in Unit 18 and all 14 of the transects in Unit 22 that were sampled by Shaw Environmental in 2008 (Shaw 2009) were resampled in 2013. One transect in Unit 18 that was sampled in 2008 was not resampled in 2011 or 2013 because it was located in an area heavily disturbed by soil remediation activities after the prescribed burn was conducted.

The surveyors used a resource grade Trimble GeoXH GPS receiver to locate the previously recorded start and end points of each transect monitored. Once the start and end points were located, the transects were sampled using the line intercept method following the same methodology as in the baseline monitoring areas (Section 2.3.3).

4.3.3. Annual Grass Monitoring

Non-native annual grass monitoring was conducted within the 230 foot wide primary containment areas surrounding Units 18 and 22 on 31 May and 3 June 2013. Annual grass species included in this monitoring were the same species as in the baseline areas annual grass monitoring. Annual grass monitoring was conducted using the same methodology as that used in the baseline monitoring, and the same density classes were used (Section 2.3.4).

4.3.4. Invasive Species

Invasive species were mapped when encountered incidentally during the HMP annuals density monitoring and shrub transect monitoring. When invasive species were encountered, the locations were mapped using a recreational-grade GPS unit. A comprehensive survey for invasive species in Units 18 and 22 was not conducted.

4.4. Units 18 and 22 – Results and Discussion

Density monitoring of HMP annuals was conducted in Units 18 and 22 between 12 and 22 April 2013. Maps of survey grids for the sampled Units are provided in Appendix A3.

4.4.1. Sand Gilia

In 2013, sand gilia was present in 88 percent of the 183 grids surveyed in Units 18 and 22 (Table 4-1; Maps A3-1 and A3-6). Sixty-three percent of the sampled grids supported over 100 plants in these Units, indicating a substantial increase in density between 2011 and 2013.

Table 4-1
Sand Gilia – Number of Grids per Density Class in Units 18 and 22

Density	Unit 18				Unit 22			
	2008	**2009**	**2011**	**2013**	**2008**	**2009**	**2011**	**2013**
0 plants/grid (percent of grids)	0 (0%)	15 (23%)	21 (21%)	10 (11%)	0 (0%)	3 (6%)	21 (24%)	12 (14%)
1–50 plants/grid (percent of grids)	7 (78%)	10 (15%)	56 (60%)	18 (19%)	7 (64%)	3 (6%)	47 (53%)	12 (14%)
51–100 plants/grid (percent of grids)	1 (11%)	4 (6%)	9 (10%)	6 (6%)	4 (36%)	4 (9%)	10 (11%)	9 (10%)
101–500 plants/grid (percent of grids)	1 (11%)	20 (30%)	6 (6%)	26 (27%)	0 (0%)	11 (23%)	9 (10%)	28 (32%)
>500 plants/grid (percent of grids)	0 (0%)	17 (26%)	2 (2%)	35 (37%)	0 (0%)	26 (55%)	2 (2%)	27 (31%)
Number of Occupied Grids	**9**	**51**	**73**	**94**	**11**	**44**	**68**	**76**
Total Grids Sampled	**9**	**66**	**94**	**95**	**11**	**47**	**89**	**88**

4.4.2. Seaside Bird's-Beak

In 2013, seaside bird's-beak was present in 44 percent of the 183 grids sampled (Table 4-2). When present, seaside bird's-beak tended to be found in the upper two density classes (i.e., over 100 plants per grid), similar to the density distribution found in Year 3 (2011).

4.4.3. Monterey Spineflower

Monterey spineflower densities exhibited an increasing trend between 2009 (Year 1) and 2013 (Year 5). In Unit 18, the frequency of grids containing Monterey spineflower increased from 74 percent of the grids surveyed in 2009 to 97 percent in 2011, and to 100 percent in 2013 (Table 4-3). In Unit 22, the frequency of grids containing Monterey spineflower increased from 82 percent in 2009 to 100 percent in 2011, and 99 percent in 2013. In 2013, Monterey spineflower occurred throughout both Units (Maps A3-3 and A3-8) at high densities (>500 plants per grid) in 58 percent of grids in Unit 18 and 59 percent of grids in Unit 22.

Units 18 and 22 included both masticated areas around the periphery of the Unit and burned areas within the central portion of each Unit (Figure 2-1). It is expected that the HMP annual species may respond differently to these treatments. The HMP survey grids were assigned to these treatments based on whether the grid fell within the buffer zone (masticated) or interior of the Unit (burned). At least 80 percent of the grid needed to fall in one of these areas in order to be classified. If less than 80 percent of a grid fell within one of these areas, the grid was classified as “indeterminate”.

Table 4-2
Seaside Bird’s-Beak – Number of Grids per Density Class in Units 18 and 22

	Unit 18				Unit 22			
Density Class	**2007–2008**	**2009**	**2011**	**2013**	**2008**	**2009**	**2011**	**2013**
0 plants/grid (percent of grids)	0 (0%)	31 (74%)	56 (60%)	58 (61%)	0 (0%)	18 (43%)	43 (48%)	45 (51%)
1–50 plants/grid (percent of grids)	6 (100%)	3 (7%)	5 (5%)	8 (8%)	1 (25%)	6 (14%)	6 (7%)	7 (8%)
51–100 plants/grid (percent of grids)	0 (0%)	2 (5%)	3 (3%)	4 (4%)	1 (25%)	3 (7%)	3 (3%)	5 (6%)
101–500 plants/grid (percent of grids)	0 (0%)	6 (14%)	8 (9%)	9 (9%)	2 (50%)	7 (17%)	10 (11%)	18 (20%)
>500 plants/grid (percent of grids)	0 (0%)	0 (0%)	21 (23%)	16 (17%)	0 (0%)	8 (19%)	27 (30%)	13 (15%)
Number of Occupied Grids	**6**	**11**	**37**	**37**	**4**	**24**	**46**	**43**
Total Grids Sampled	**6**	**42**	**93**	**95**	**4**	**42**	**89**	**88**

Table 4-3
Monterey Spineflower – Number of Grids per Density Class in Units 18 and 22

Density	Unit 18				Unit 22			
	2008	2009	2011	2013	2008	2009	2011	2013
0 plants/grid (percent of grids)	0 (0%)	23 (26%)	3 (3%)	0 (0%)	0 (0%)	9 (18%)	0 (0%)	1 (1%)
1–50 plants/grid (percent of grids)	9 (41%)	9 (10%)	26 (27%)	8 (8%)	5 (20%)	1 (2%)	12 (13%)	6 (7%)
51–100 plants/grid (percent of grids)	8 (36%)	8 (9%)	6 (6%)	6 (6%)	5 (20%)	2 (4%)	7 (8%)	5 (6%)
101–500 plants/grid (percent of grids)	5 (23%)	16 (18%)	22 (23%)	26 (27%)	6 (24%)	10 (20%)	20 (22%)	24 (27%)
>500 plants/grid (percent of grids)	0 (0%)	31 (36%)	38 (40%)	55 (58%)	9 (36%)	28 (56%)	50 (56%)	52 (59%)
Number of Occupied Grids	**22**	**65**	**92**	**95**	**25**	**41**	**89**	**87**
Total Grids Sampled	**22**	**87**	**95**	**95**	**25**	**50**	**89**	**88**

4.4.4. Effect of Treatment on HMP Density

To assess whether treatment had an effect on the subsequent density of the HMP annual plants, the average density class for each species, treatment, and Unit was calculated for each of the four monitoring years (Years 0, 1, 3, and 5) (Figure 4-1). Variation in response of the species can be seen in the plot.

The average density class of seaside bird’s-beak increased slightly after-treatment, and has remained relatively constant between Year 3 and 5. In 2013, seaside bird’s-beak densities in Unit 18 were similar to baseline (Year 0) densities, whereas densities in Unit 22 were similar to Year 1 conditions. There is little difference between the burned and masticated treatments in both Units.

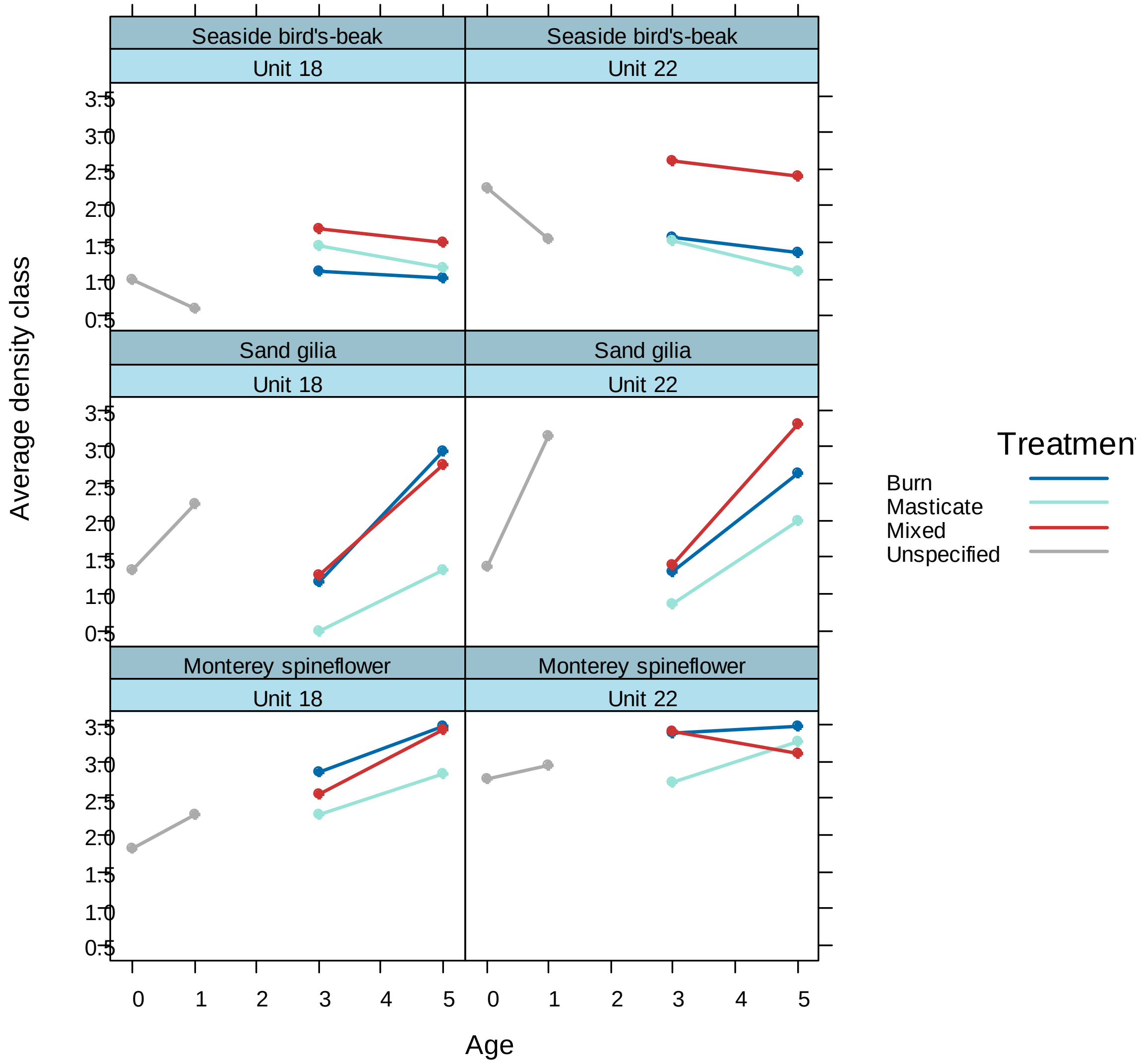

Figure 4-1 Average density class of each HMP annual species plotted by Unit and age.

In contrast, both sand gilia and Monterey spineflower show an increase in density in both Units 18 and 22 between Years 3 and 5, but differ in their response to treatment (Table 4-4 and Table 4-5). Sand gilia shows a pronounced effect of treatment with higher densities in burned grids. In contrast, the effect of treatment is not significant for the Monterey spineflower.

Table 4-4
ANOVA on Effects of Age and Treatment on Densities of Sand Gilia in Units 18 and 22

Source	Degrees of Freedom	Mean Square	F	p
Age	1	63.3	43.6	<<0.001
Treatment	1	19.1	13.1	<<0.001
Error	152	1.5		

Table 4-5
ANOVA on Effects of Age and Treatment on Densities of Monterey Spineflower in Units 18 and 22

Source	Degrees of Freedom	Mean Square	F	p
Age	1	10.4	8.4	0.004
Treatment	1	3.6	2.9	0.09
Error	147	1.2		

Hence, these data suggest a positive effect of treatment (particularly burning) on sand gilia in Years 3 and 5. The effect of treatment on Monterey spineflower density is weak; only significant at the 0.1 level. However, there is no effect on seaside-bird's beak density due to either treatment or time.

4.4.5. Shrub Transect Monitoring

Total shrub cover on the 35 shrub transects sampled in Units 18 and 22 averaged 57 percent and ranged from 16 to 109 percent (Figure 4-2). Herbaceous vegetation occupied 6.7 percent, and bare ground averaged 46 percent (Figure 4-3, Figure 4-4). Raw data for the shrub transects sampled in 2013 are provided in Appendix B.

Units 18 and 22 were burned in 2008. Therefore there has been sufficient time for shrub species to recolonize the area, and successional trends are likely to be observed when comparing data collected between years and between treatments in Units 18 and 22. Temporal trends follow expected patterns with a decrease in total shrub cover after treatment, and increasing bare ground and herb cover after treatment (Figure 4-2 to Figure 4-4). Herbaceous cover exhibits a decline in Year 5 in both Units, but the percent of bare ground continues to increase in Unit 22.

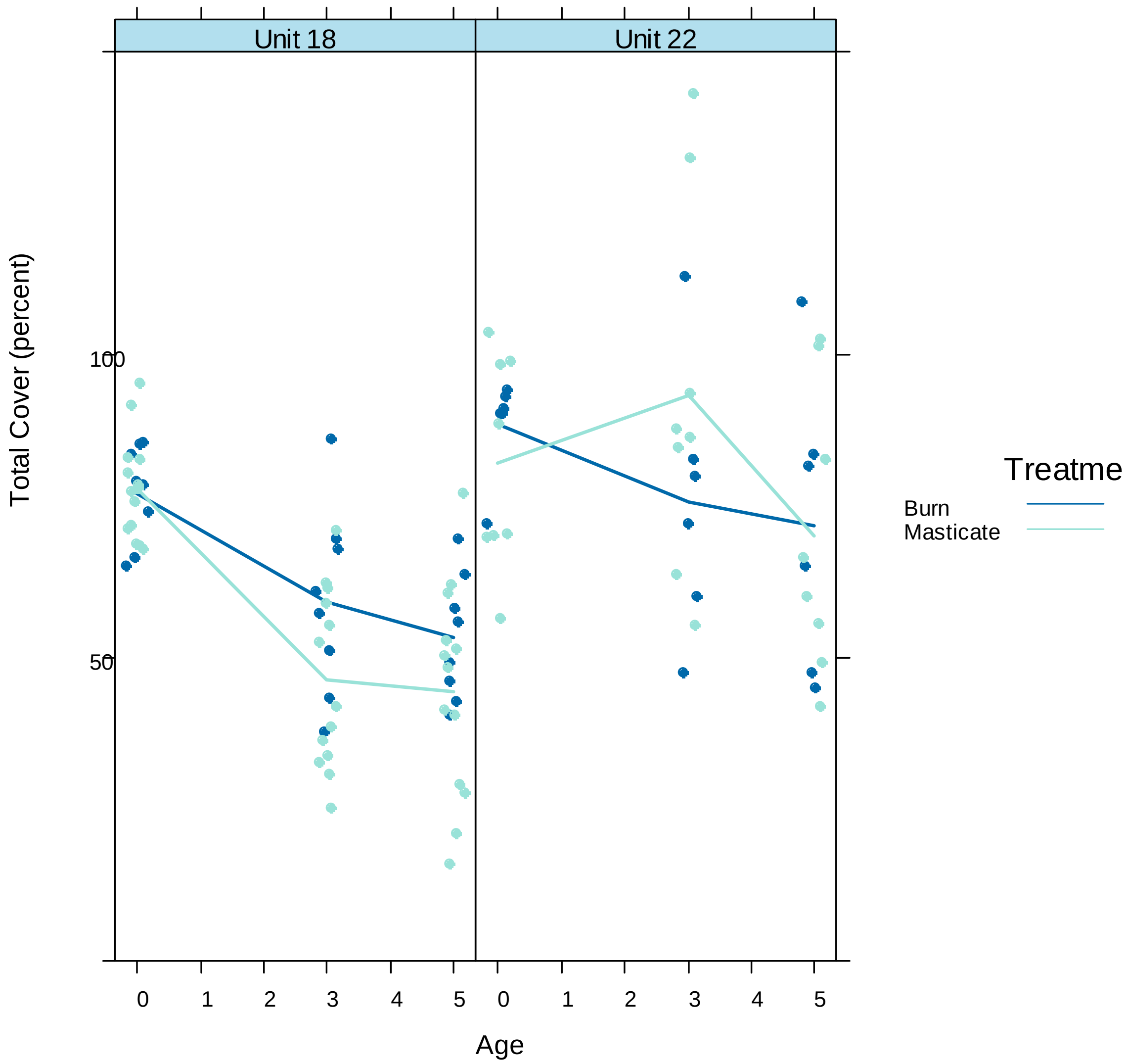

Figure 4-2 Temporal changes in total shrub cover on Units 18 and 22.

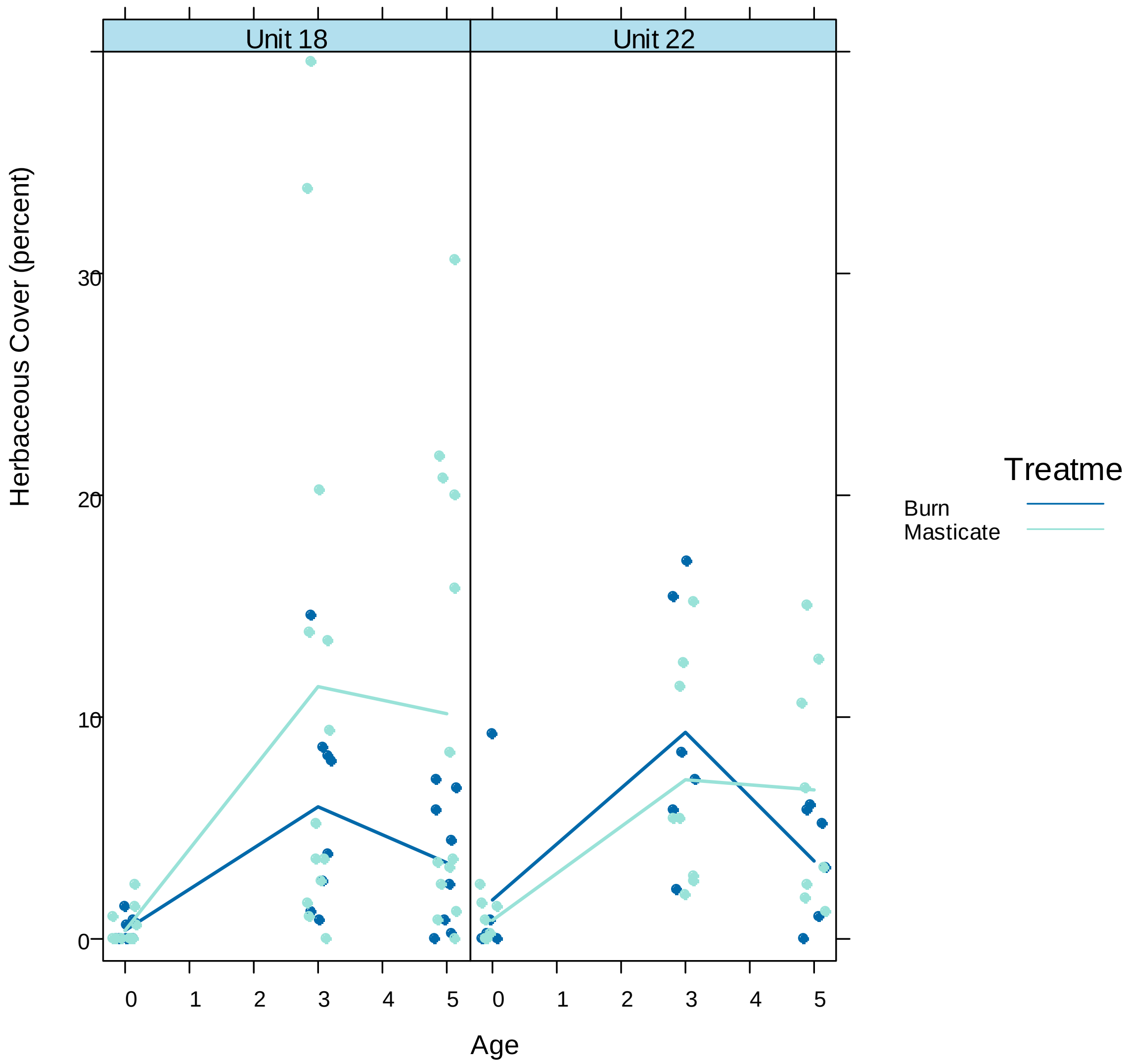

Figure 4-3 Temporal changes in herbaceous plant cover on Units 18 and 22.

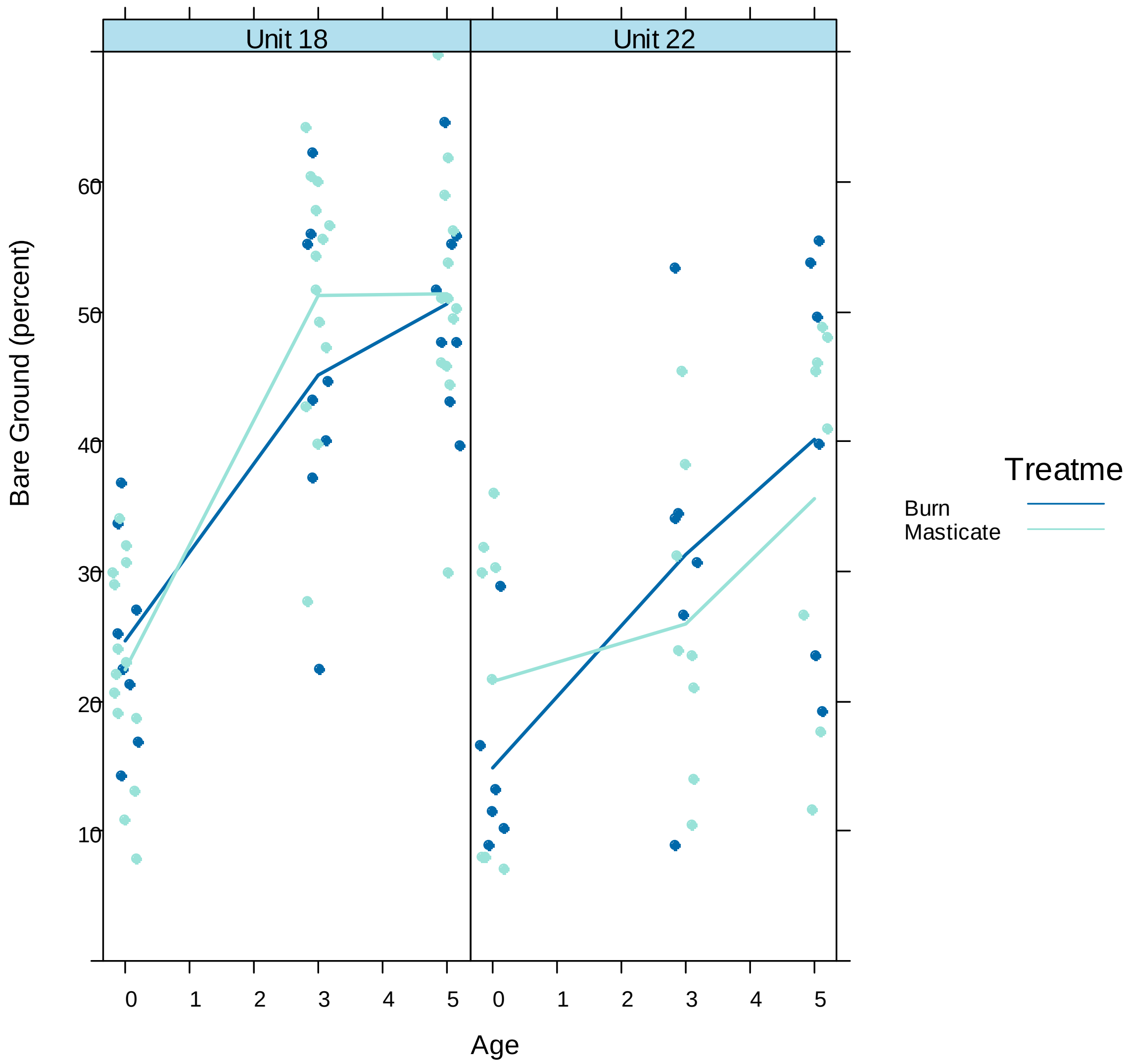

Figure 4-4 Changes in cover of bare ground on Units 18 and 22.

To assess the effect of treatment and Unit on association metrics (total shrub cover, diversity, species richness, evenness, herbaceous cover, and bare ground), the differences between the treatments in Year 5 (2013) were tested using analysis of variance (ANOVA). Of the summary metrics tested, only herbaceous cover exhibited a between-treatment effect, being higher in the masticated treatments than in the burned treatment (Figure 4-5). In contrast, the amount of bare ground was greater in Unit 18 than in Unit 22, but did not exhibit an effect of treatment (Figure 4-6).

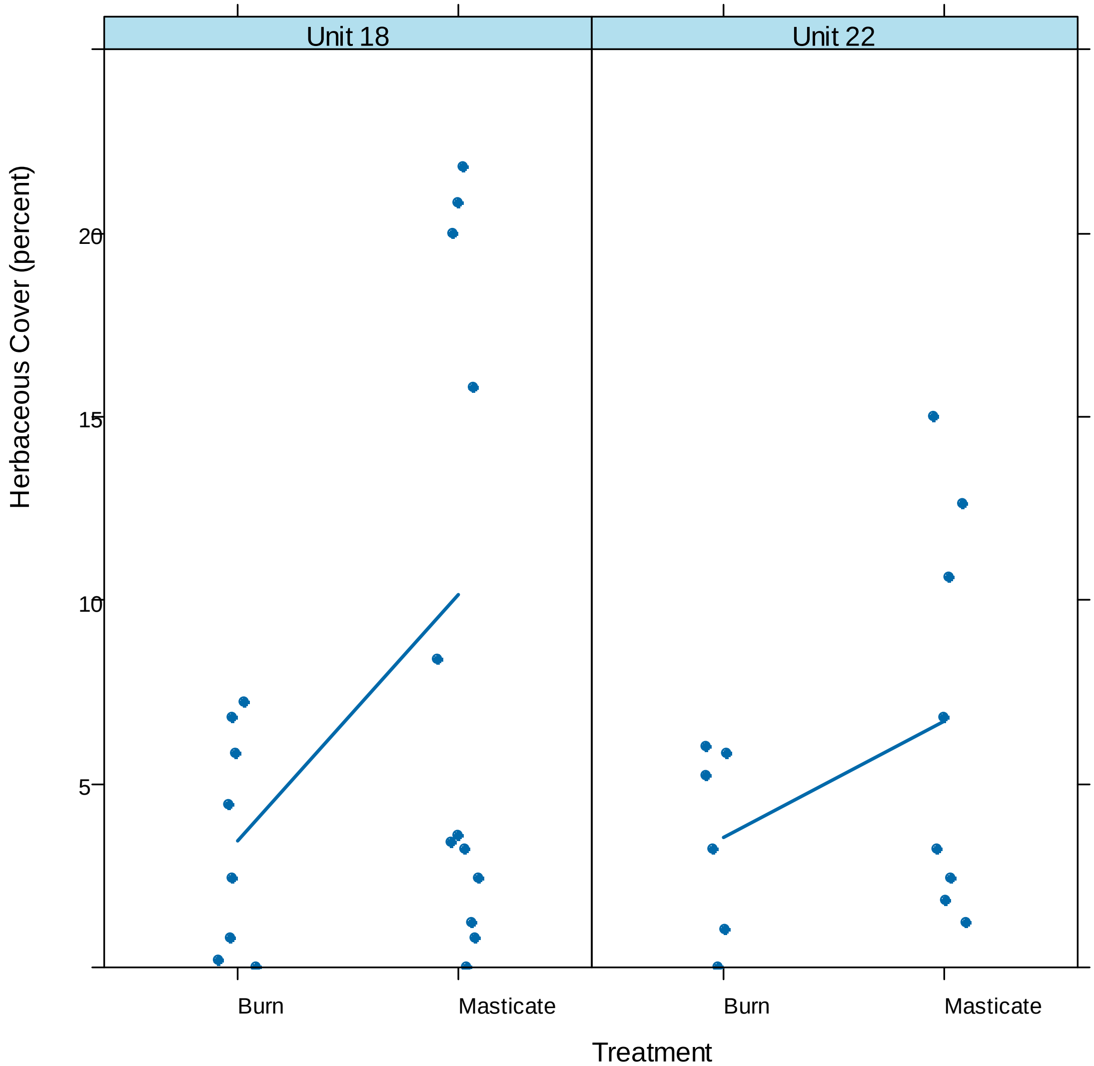

Figure 4-5 Effect of treatment on herbaceous cover in Units 18 and 22 in Year 5 (2013). Lines connect the group averages within each Unit. Herbaceous cover is significantly higher in the masticated treatments (p=0.03).

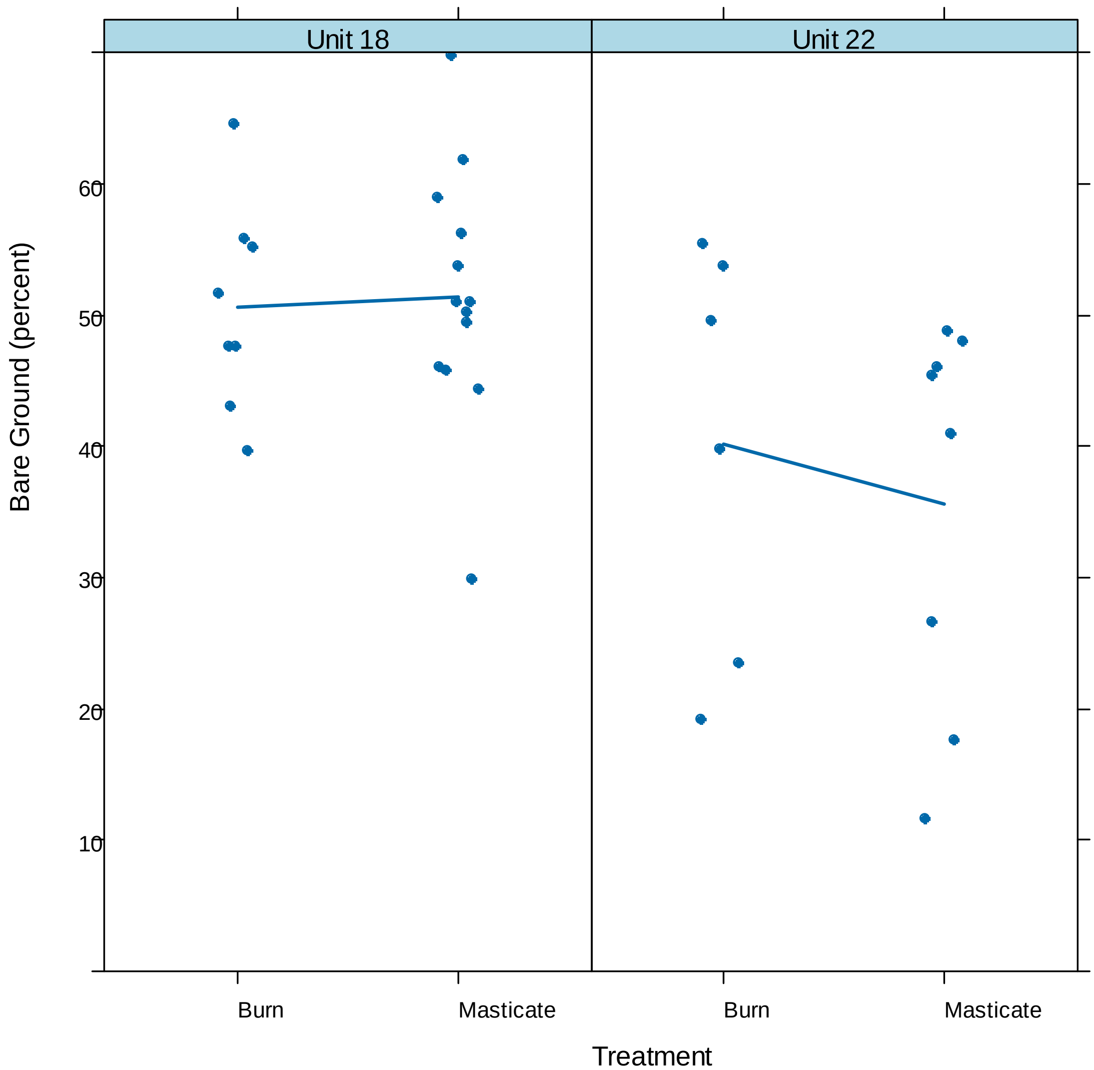

Figure 4-6 Effect of treatment on extent of bare ground in Units 18 and 22 in Year 5 (2013). Lines connect the group averages within each Unit. There is no difference between treatments. However, bare ground was statistically greater in Unit 18 than in Unit 22 (p=0.002).

To test whether treatment had an effect on association structure, multivariate statistics (ordination techniques) were used. These techniques are based on measures of dissimilarity between samples (transects). This analysis was conducted using non-metric multidimensional scaling (NMDS) as implemented in function "metaMDS" in the "vegan" package in R (Oksanen et al. 2011).

The results of the NMDS ordination show an association level response relative to both time and treatment. Temporal changes are clearly evident in Figure 4-7, which displays the position of each transect relative to the centroid for each year. The baseline transects are clearly separated from both post-treatment years.

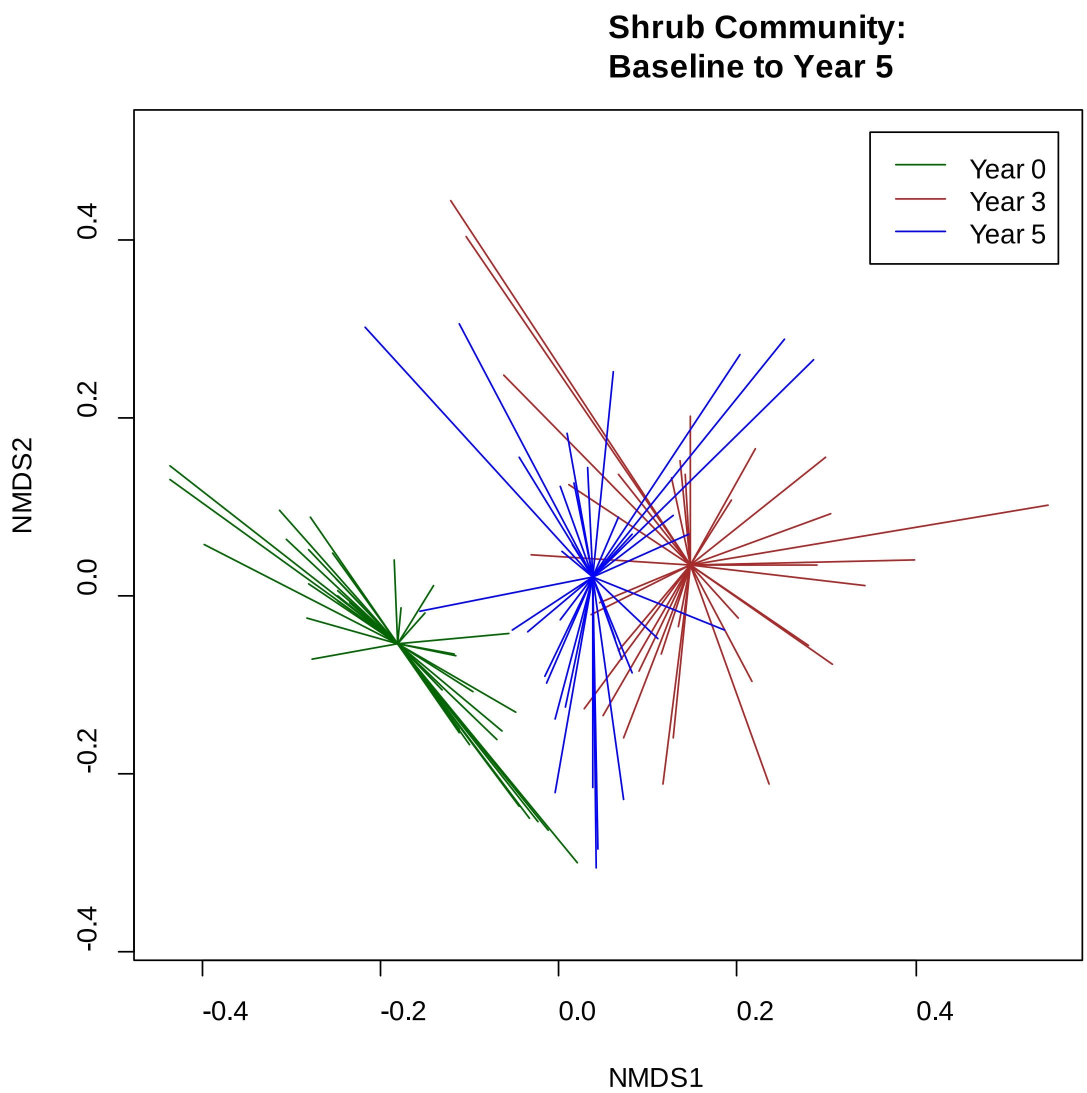

Figure 4-7 NMDS ordination plot of shrub association structure on Units 18 and 22 with respect to time. The spider plot showing the position of transects relative to the centroid for that group indicates a clear separation between years.

Permutational MANOVA (Oksanen et al. 2011) of the association data indicates that year, treatment, and Unit effects are all significant; whereas year explains approximately 20 percent of the variability, Unit explains approximately 5 percent, and treatment explains approximately 3 percent of the variability between groups (Table 4-6).

Table 4-6
Results of Permutational MANOVA of Shrub Association Structure on Units 18 and 22

Source	df	Sum Sqs	Mean Sq	F	R^2	p
Year	2	4.92	2.46	14.4	0.20	0.001
Unit	1	1.19	1.19	6.9	0.05	0.001
Treatment	1	0.81	0.81	4.8	0.03	0.001
Residuals	101	17.3	0.17		0.71	
Total	**105**	**13.68**				

The effect of treatment and time can be clearly seen when the 95 percent confidence ellipsoids are plotted separately for each Unit (Figure 4-8 and Figure 4-9). The confidence ellipsoids are a two-dimensional representation of the confidence interval surrounding the average position (i.e. centroid) of each group. In Unit 18, a clear separation can be seen between the burn (red ellipses) and mastication (blue ellipses) (Figure 4-8). Temporal changes in association structure are also evident, with slight, but significant changes in association structure between Years 3 and 5.

Temporal changes are more important than the effect of treatment in Unit 22 (Figure 4-9). Differences between treatments are still evident in Year 3. However, there is no statistically significant difference between treatments in Year 5.

To illustrate changes in association structure a suite of six species that exhibited dominance, high frequency of occurrence, or uniqueness within a particular treatment and Unit were identified. These species are considered to represent the major changes in shrub association structure occurring over time (Figure 4-10). Chamise exhibits only a slight decline in cover after burning, but a strong response to mastication. The responses of shaggy-barked manzanita and sandmat manzanita to both treatments are substantially more pronounced; these species exhibit a rapid decrease in percent cover due to burning, and then a limited recovery in Years 3 and 5. In contrast, Monterey ceanothus exhibits a gradual increase in cover after the initial reduction due to treatment. The subshrubs, deerweed and golden yarrow, show an initial increase in cover in Year 3 and then decline in Year 5, consistent with the response in total herbaceous cover (Figure 4-3).

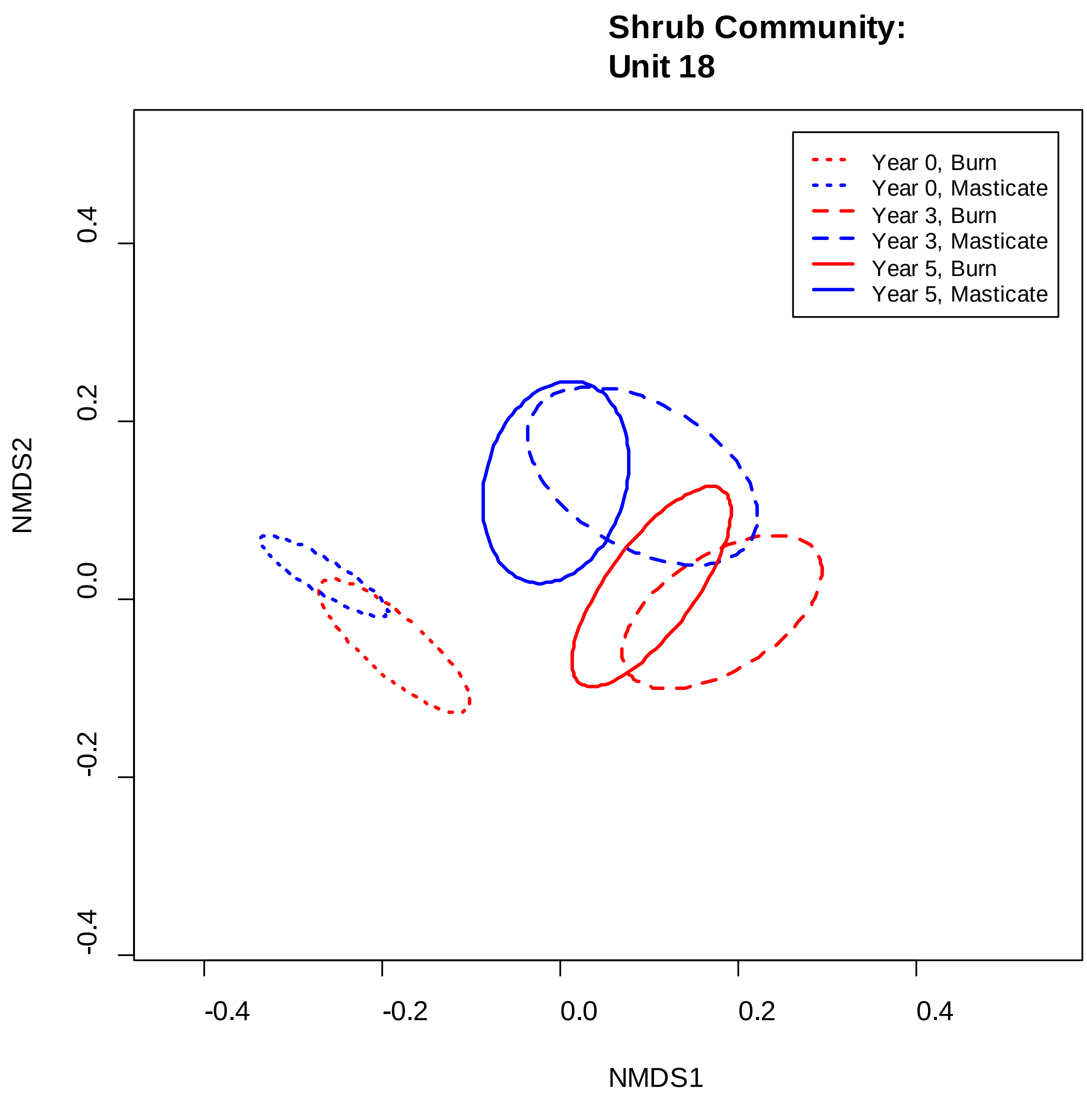

Figure 4-8 **Comparison of 95 percent confidence ellipsoids for temporal and treatment groupings in Unit 18. Separation of ellipsoids indicates significant difference between years and treatments.**

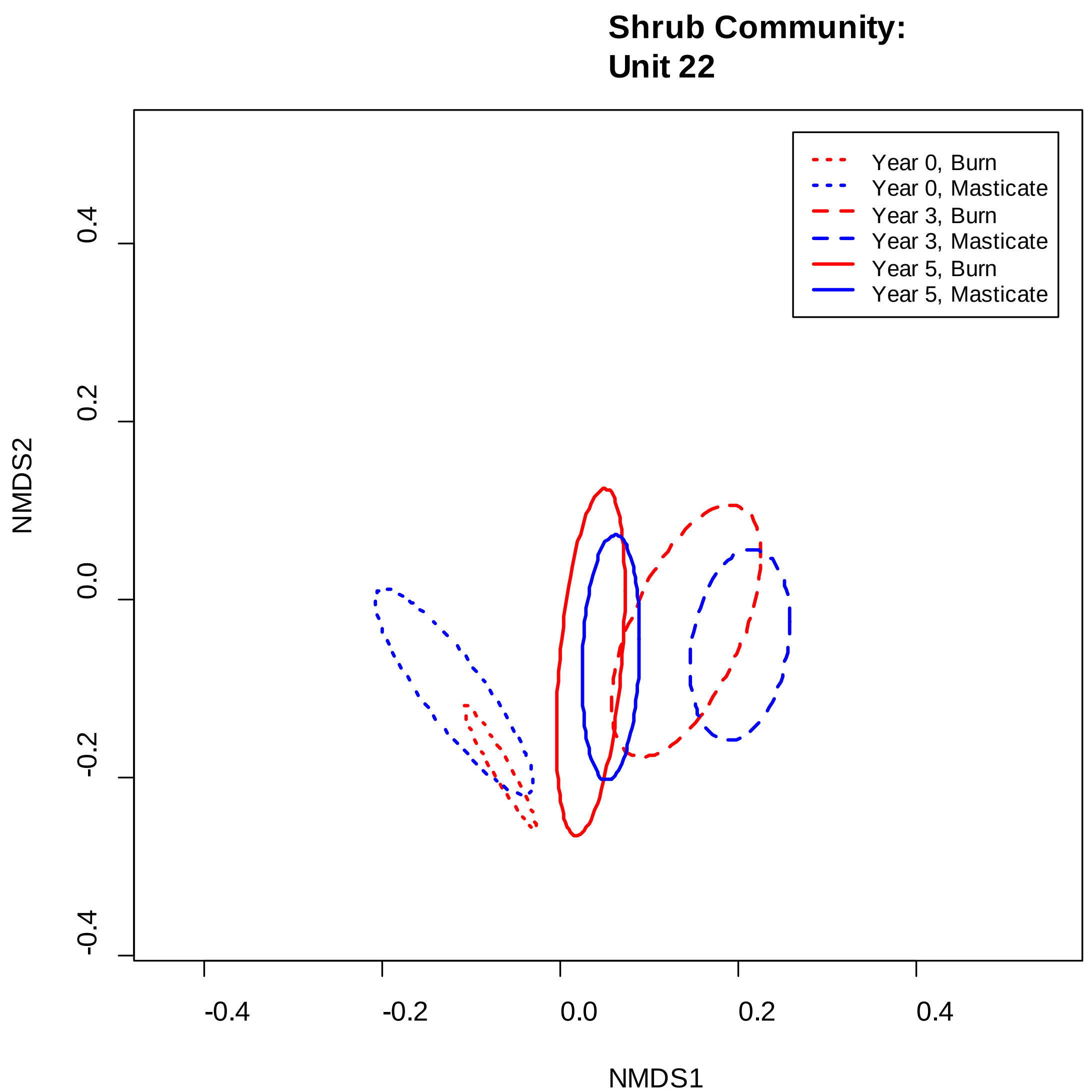

Figure 4-9 **Comparison of 95 percent confidence ellipsoids for temporal and treatment groupings in Unit 22. Overlap of ellipsoids between treatments within the Year 0 and Year 5 groups indicates lack of a statistically significant difference in treatment. Limited overlap of Year 3 ellipsoids indicates a statistical difference in association structure due to treatment.**

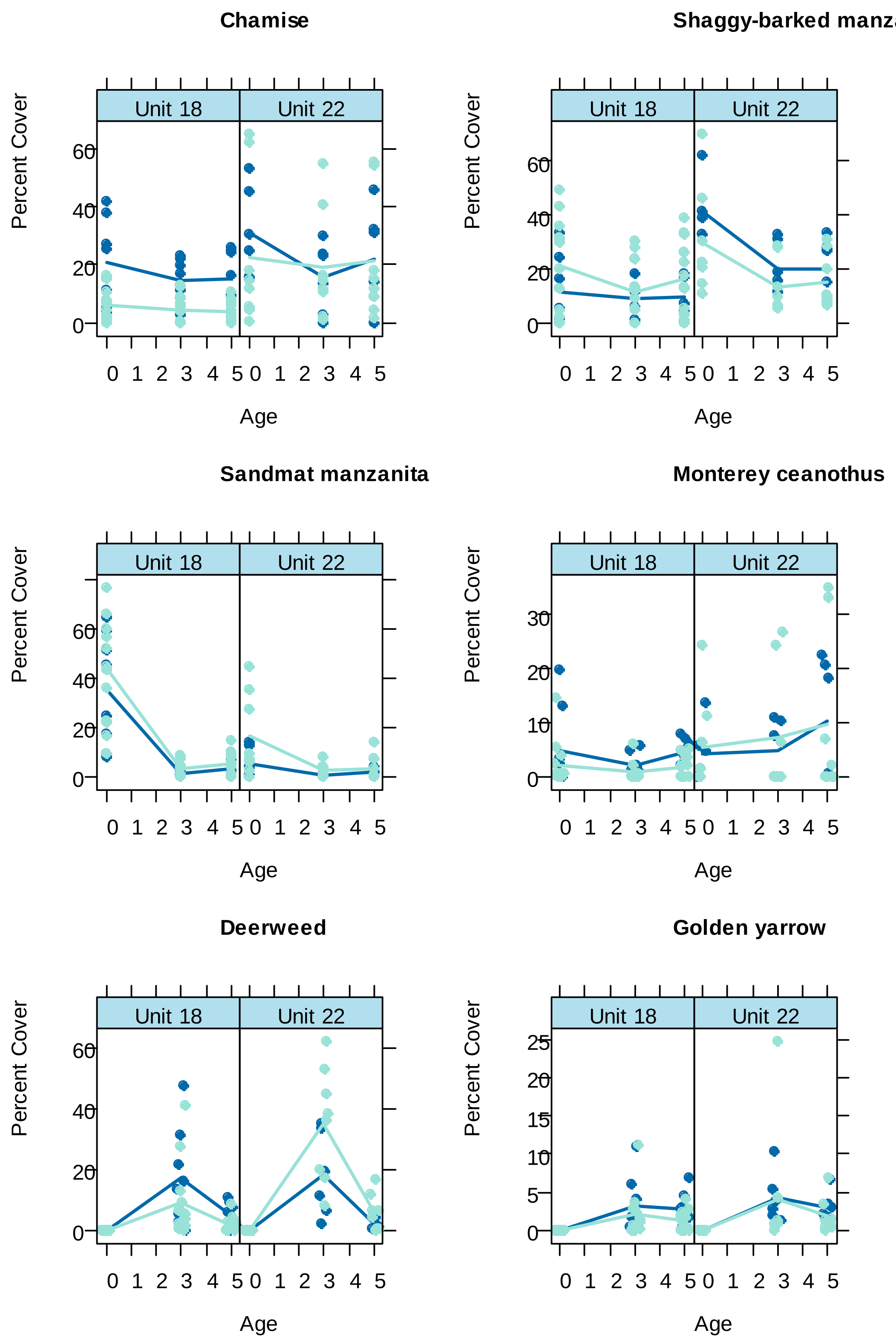

Figure 4-10 Temporal patterns in key plants species on Units 18 and 22. Blue symbols represent burned transects and light blue symbols represent masticated transects.

4.4.6. Annual Grass Monitoring

The areal extent of annual grasses on Units 18 and 22 is shown on Maps A3-5 and A3-10, respectively. The areal extent of annual grasses on Unit 18 is similar between 2011 (Year 3) and 2013 (Table 4-7). However, density cover class 2 has increased, suggesting an overall increase in density. In contrast, Unit 22 exhibited a substantial reduction in total coverage of annual grasses, particularly in the high density class.

Table 4-7
Estimated Area Occupied (Acres) by Annual Grasses in Year 1 and Year 3 Surveys in Units 18 and 22

Cover Class	Unit 18		Unit 22	
	2011	**2013**	**2011**	**2013**
1 (low) = 1–5 percent	14. 9	11.8	20.9	17.4
2 (medium) = 6–25 percent	5.1	11.4	2.3	2.5
3 (high) = >25 percent	17.8	15.8	25.0	8.2
Total Acreage	**37.7**	**38.9**	**48.2**	**28.2**

Observations by Parsons Inc. (2004) indicated that annual grasses responded to the clearance of vegetation for firebreaks, but that the effect on the density of annual grasses was highly variable. Other factors that may have an effect on the presence and density of annual grasses include periodic mowing, application of fire retardants which provide a fertilization effect, effects of low rainfall, or increased cover by shrubs.

4.4.7. Invasive Species Monitoring

When invasive species were encountered in Units 18 and 22, the locations were mapped using a recreational-grade GPS unit. Yellow star thistle was observed at a single location in the northern corner of Unit 18 (Map A5-3). No invasive species were mapped in Unit 22.

SECTION 5

Year 10 Vegetation Monitoring – Ranges 43–48

5.1. Ranges 43–48 – Introduction

Vegetation monitoring in the Ranges 43–48 area began in 1999–2000, when baseline (pre-treatment) monitoring was conducted (Harding Lawson 2001). A total of 79 transects were established in those years to sample shrub species composition in the maritime chaparral using the line intercept method; 12 transects were sampled in 1999 and 67 in 2000. Density sampling for the HMP annual species Monterey spineflower, sand gilia, and seaside bird's-beak was also conducted in the Ranges 43–48 area in 2000. A controlled burn was scheduled in the Ranges 43–48 area in 2000, but the area was not burned until October 2003. Removal of munitions and ordnance was conducted between December 2003 and September 2005.

In spring 2004, in the first season following the controlled burn, MACTEC conducted density monitoring of the three HMP annuals (MACTEC 2005). Transect monitoring of shrub composition was not conducted in 2004, since this was only a few months after the burn, and shrub regeneration was still at an early stage.

Vegetation monitoring was conducted in Ranges 43–48 in 2005 and 2008 (Parsons 2005; Burleson 2008). In 2005, vegetation monitoring consisted of density monitoring of the three HMP annuals over the entire original Ranges 43–48 area and resampling for shrub species composition on the original transects sampled by Harding Lawson (2001) in 1999–2000 (Parsons 2005). The 2008 monitoring included only a portion of the original area, designated as the "Non-Environmental Services Cooperative Agreement (ESCA) Ranges 43–48 site" (Burleson 2008). The 2008 monitoring consisted of density monitoring of the three HMP annuals and resampling of shrub species composition of the original shrub transects.

The 2013 monitoring is referred to as "Year 10 follow up vegetation monitoring", based on the fact that the controlled burn was conducted in 2003, and munitions and ordnance cleanup-related disturbance continued until September 2005.

The 2013 Year 10 follow-up monitoring in the Ranges 43–48 area consisted of the following activities:

- Density monitoring for three HMP annual species: Monterey spineflower, sand gilia, and seaside bird's-beak.
- Line intercept sampling of transects previously sampled in 1999–2000, 2005, 2008, and 2010 (Harding Lawson 2001; Parsons 2005; Burleson 2008; Tetra Tech and EcoSystems West 2011) for shrub species composition in the maritime chaparral that is recovering from past disturbance (the 2003 controlled burn and the 2003–2005 munitions and ordnance cleanup).

- Mapping of non-native annual grasses within the primary containment areas.
- Mapping of invasive species, including iceplant, pampas grass, and French broom, where encountered.

5.2. Ranges 43–48 – Setting

The area included in the 2013 monitoring is the same as that included in the 2008 and 2010 monitoring (Burleson 2008; Tetra Tech and EcoSystems West 2011). This area encompasses approximately 273 acres of generally rolling terrain. It is divided into the Range 43 portion, here treated as the area east and northeast of the southern portion of Felix Road (south of its junction with Oscar Road), and the Range 48 portion, here treated as the area west and northwest of the southern portion of Felix Road (south of its junction with Oscar Road). Two major vegetation types predominate in the area: maritime chaparral, now recovering from the 2003 burn and subsequent disturbance; and areas dominated by grasses and herbs with only scattered shrubs.

5.3. Ranges 43–48 – Methods

5.3.1. HMP Annuals Monitoring

Density monitoring for three HMP annual species (Monterey spineflower, sand gilia, and seaside bird's-beak) in the Ranges 43–48 area was conducted between 9 and 13 May 2013. This time period was optimal for observing Monterey spineflower and sand gilia. Seaside bird's-beak was not yet in flower when this density monitoring was conducted but was readily identifiable by its vegetative characteristics. In 2010 Year 5 follow-up monitoring, 20 percent of the grids at which the HMP annuals had previously been observed in previous surveys were randomly selected for sampling. In addition, 10 percent of the grids immediately adjacent to grids that had previously supported HMP annuals were randomly selected for a total of 91 grids. In 2013, 98 previously grids were sampled.

The methodology for the 2013 follow-up density monitoring in the Ranges 43–48 area was similar to that described above for the baseline monitoring. The surveyors used a resource grade Trimble GeoXH GPS receiver with the grid boundaries loaded as a map layer to locate the grids selected as sample grids for sampling. Generally, the corners of the grids were marked by wooden lath stakes following the 2003 prescribed burn, although, in most cases, the stakes were missing or lying on the ground. When present, the stakes were used to precisely determine the boundaries of the sample grid and calibrate the GPS unit for consistent daily positional offsets.

Once the grids to be sampled were located, sampling was conducted as described for the baseline monitoring, and the same density classes were used. However, as mentioned above (Section 2.3.2), all grids were censused to calculated density; no 2.5-meter radius circular subplots were used in 2013. When only a portion of the grid was sampled, the density classes were scaled proportional to the percentage of the total grid sampled.

5.3.2. Shrub Transect Monitoring

Monitoring of shrub species composition in the Ranges 43–48 area was conducted between 30 April and 9 May 2013. The transects monitored had been previously established and monitored in 1999 or 2000 (Harding Lawson 2001) and were monitored again in 2005, 2008, and 2010 (Parsons 2005; Burleson 2008; Tetra Tech and EcoSystems West 2011). A total of 34 transects were monitored. They included all of the original 1999–2000 transects contained within the non-ESCA area, with five exceptions. Three transects in the Range 48 area were not monitored in 2010 or 2013 because they were entirely within an accidental burn area that burned in 2009. Two additional transects at the south end of the Range 48 area were not monitored in 2010 or 2013 because they are located entirely within the cleared fuel break area along the southern boundary of the unit, and are thus not in a comparable successional stage to the remainder of the non-ESCA Ranges 43–48. The original northern end of transect BH1, located at the north end of the Range 48 area, is outside the area included in the 2013 monitoring. For this transect, the start and end points were moved 10 meters south of the original start and end points, so that the transect was contained entirely within the 2013 monitoring area.

The surveyors used a resource grade Trimble GeoXH GPS receiver to locate the previously recorded start and end points of each transect monitored. Once the start and end points were located, the transects were sampled using the line intercept method following the same methodology as in the baseline monitoring areas (Section 2.3.3).

5.3.3. Annual Grass Monitoring

Non-native annual grass monitoring was conducted within the 250 foot wide primary containment lines surrounding the Ranges 43–48 area on 6–7 June 2013. Annual grass species included in this monitoring were the same species as in the annual grass monitoring of baseline areas (Section 2.3.4). Annual grass monitoring was conducted by a combination of driving the perimeter roads surrounding the burn 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 by one of the same three density classes as in the baseline monitoring:

1 (low) = 1–5 percent

2 (medium) = 6–25 percent

3 (high) = >25 percent

5.3.4. Invasive Species

Invasive species were mapped when encountered during the HMP annuals density monitoring and shrub transect monitoring. When invasive species were encountered, the locations were mapped using a recreational-grade GPS unit except where the invasive species was widespread, in which case the area of occurrence was mapped onto an aerial photograph. A comprehensive survey of Ranges 43–48 area for invasive species was not conducted.

5.4. Ranges 43–48 – Results and Discussion

Surveys conducted on Ranges 43–48 included monitoring for density of HMP annual species, and shrub transect cover. In addition, the extent of annual grasses and the presence of invasive species were noted.

Maps of locations of survey grids are provided in Appendix A4.

5.4.1. Sand Gilia

Sand gilia was present in 68 percent of the 98 grids surveyed in 2013, and was widely, but patchily, distributed throughout Ranges 43–48 (Map A4-1). This species occurred most frequently in density class 1 (51% of grids) (Table 5-1). In the baseline surveys (1999–2000), sand gilia was present at an average density class of 1.1; whereas in 2013, it was present at an average density class of 0.9 (Figure 5-1).

Table 5-1
Sand Gilia – Number of Grids per Density Class in Ranges 43–48

Density Class	1999–2000	2005	2008	2010	2013
0 plants/grid (percent of grids)	0 (0%)	0 (0%)	32 (55%)	24 (26%)	31 (32%)
1–50 plants/grid (percent of grids)	69 (93%)	526 (41%)	17 (29%)	40 (44%)	50 (51%)
51–100 plants/grid (percent of grids)	3 (4%)	184 (14%)	5 (9%)	9 (10%)	9 (9%)
101–500 plants/grid (percent of grids)	2 (3%)	403 (32%)	4 (7%)	14 (16%)	8 (8%)
>500 plants/grid (percent of grids)	0 (0%)	164 (13%)	0 (0%)	4 (4%)	0 (0%)
Number of Occupied Grids	**74**	**1277**	**26**	**67**	**67**
Total Grids Sampled	**74**	**1277**	**58**	**91**	**98**

*Each grid is 100- x 100- feet or 10,000 square feet.

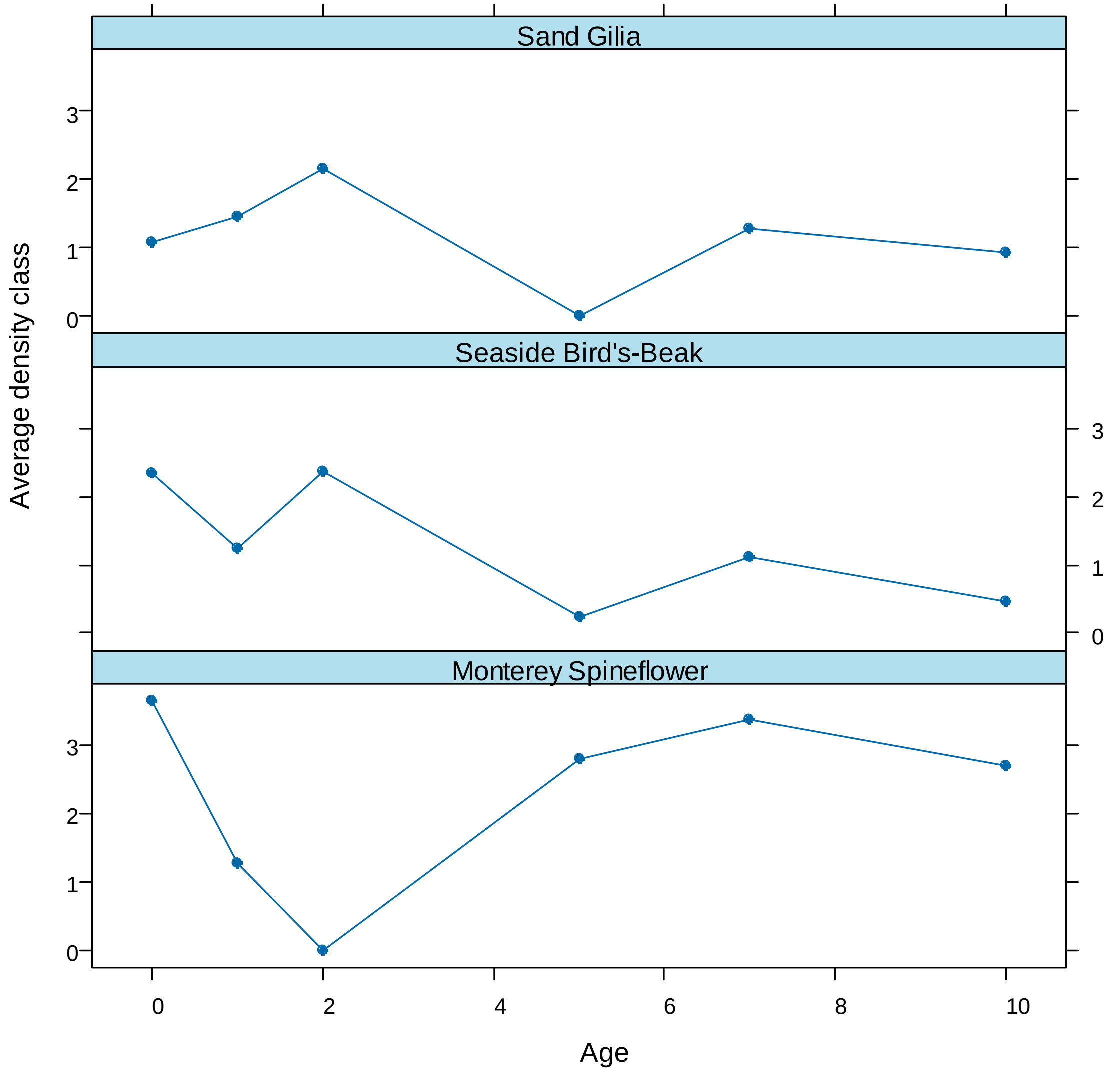

Figure 5-1 Temporal changes in average density class of HMP annual plants on Ranges 43–48.

5.4.2. Seaside Bird's-Beak

Seaside bird's-beak was present in 22 percent of the 98 grids surveyed in 2013, and was present primarily on the eastern side of Ranges 43–48 (Map A4-2) (Table 5-2). Seaside bird's-beak has exhibited a decline in density over the 10 year monitoring period. In the baseline surveys (1999–2000), sand gilia was present at an average density class of 2.3; whereas in 2013, it was present at an average density class of 0.4 (Figure 5-1).

Table 5-2
Seaside Bird's-Beak – Number of Grids per Density Class in Ranges 43–48

Density Class	1999–2000	2005	2008	2010	2013
0 plants/grid (percent of grids)	0 (0%)	0 (0%)	2 (1%)	53 (58%)	76 (78%)
1–50 plants/grid (percent of grids)	14 (47%)	93 (34%)	4 (9%)	8 (9%)	10 (10%)
51–100 plants/grid (percent of grids)	3 (10%)	34 (12%)	5 (11%)	7 (8%)	2 (2%)
101–500 plants/grid (percent of grids)	2 (7%)	100 (37%)	24 (55%)	12 (13%)	8 (8%)
>500 plants/grid (percent of grids)	11 (37%)	47 (17%)	10 (23%)	11 (12%)	2 (2%)
Number of Occupied Grids	**30**	**274**	**42**	**38**	**22**
Total Grids Sampled	**30**	**274**	**44**	**91**	**98**

*Each grid is 100- x 100- feet or 10,000 square feet.

5.4.3. Monterey Spineflower

Monterey spineflower was present in 92 percent of the 98 grids surveyed in 2013, and was widely distributed throughout Ranges 43–48 (Map A4-3). It occurred most frequently in density class 4 (41% of grids) (**Error! Reference source not found.**). Density of this species was highly variable over time. During the baseline surveys (1999–2000), Monterey spineflower was present at an average density class of 3.6, but was not identified on any grid during the 2005 (Year 2) survey. However, the species was present at high density in Years 5, 7, and 10, with average density classes of 2.8, 3.4, and 2.7, respectively (Figure 5-1).

Table 5-3
Monterey Spineflower – Number of Grids per Density Class in Ranges 43–48

Density Class	1999–2000	2005	2008	2010	2013
0 plants/grid (percent of grids)	0 (0%)	1,462 (100)	0 (0%)	2 (2%)	8 (8%)
1–50 plants/grid (percent of grids)	4 (11%)	0 (0%)	10 (23%)	6 (7%)	19 (19%)
51–100 plants/grid (percent of grids)	0 (0%)	0 (0%)	4 (9%)	8 (9%)	7 (7%)
101–500 plants/grid (percent of grids)	1 (3%)	0 (0%)	14 (33%)	14 (15%)	24 (24%)
>500 plants/grid (percent of grids)	32 (87%)	0 (0%)	15 (35%)	61 (67%)	40 (41%)
Number of Occupied Grids	**37**	**0**	**43**	**89**	**90**
Total Grids Sampled	**37**	**1,462**	**43**	**91**	**98**
*Each grid is 100- x 100- feet or 10,000 square feet.					

5.4.4. Shrub Transect Monitoring

In 2013, the total shrub cover on the 34 shrub transects averaged 80 percent and ranged from 63 to 110 percent (Figure 5-2). On average there were 8.2 species per transect in 2013. Bare ground averaged 33 percent, and herbaceous vegetation occupied 0.83 percent on average. Raw data for the shrub transects sampled in 2013 are provided in Appendix B.

All transects on Ranges 43–48 were burned in 2003; therefore there has been sufficient time for shrub species to recolonize the area, and successional trends are likely to be observed when comparing data collected between 1999/2000 (pre-burn) and 2013 (Year 10).

To assess temporal changes in association structure, several standard metrics were examined. Percent cover along the shrub transects decreased from an average of 98% pre-burn to 34% immediately after the burn (Figure 5-2). Cover increased in Year 5 and 7, but declined slightly to 80% in the Year 10 data.

Species richness (i.e., the number of species per transect) decreased slightly from pre-burn to Year 2, and then increased in Years 5 and 7 post-burn, with a slight decrease in Year 10 (2013) (Figure 5-3).

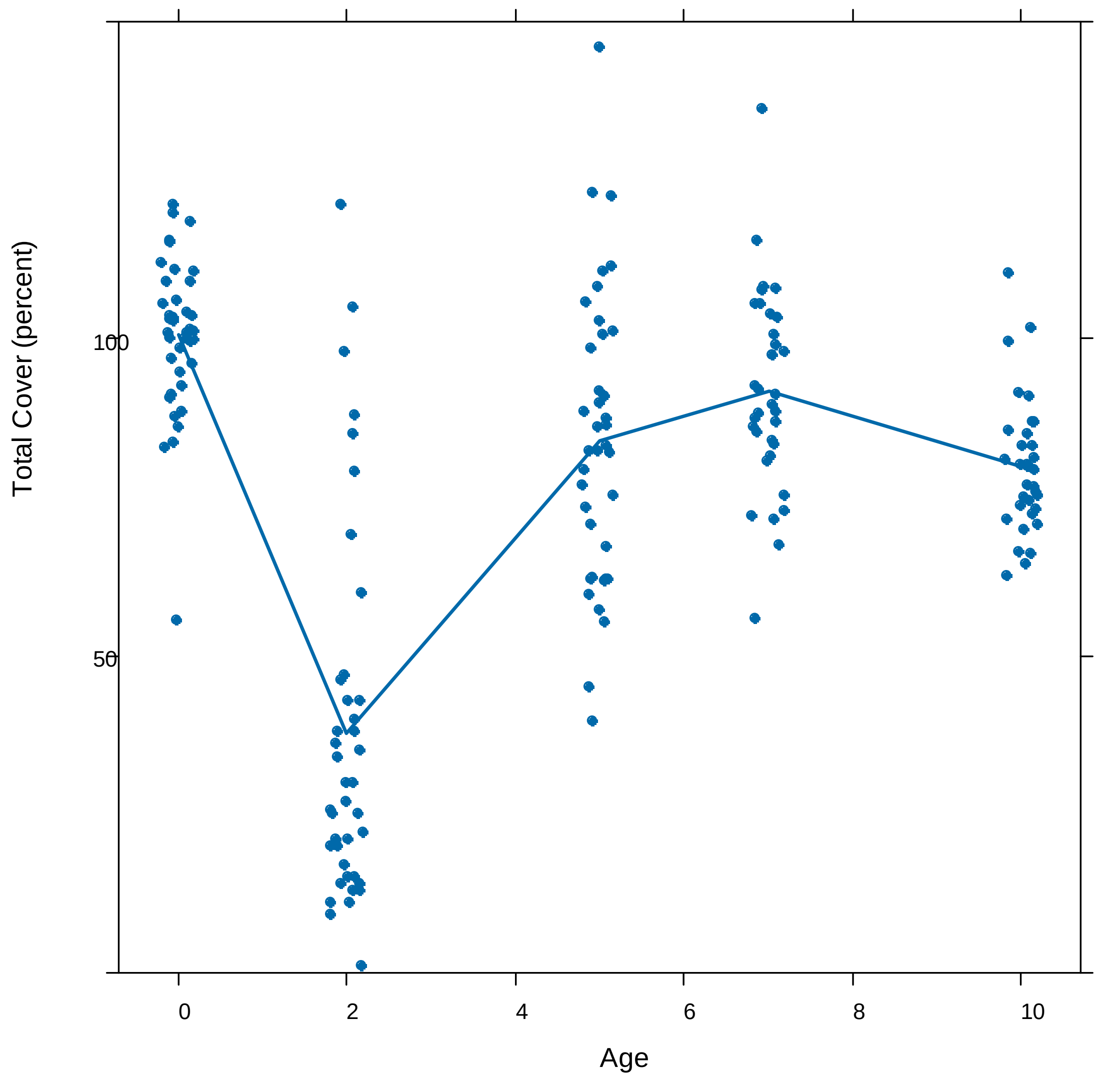

Figure 5-2 Percent cover of shrubs on transects in Ranges 43–48 over time.

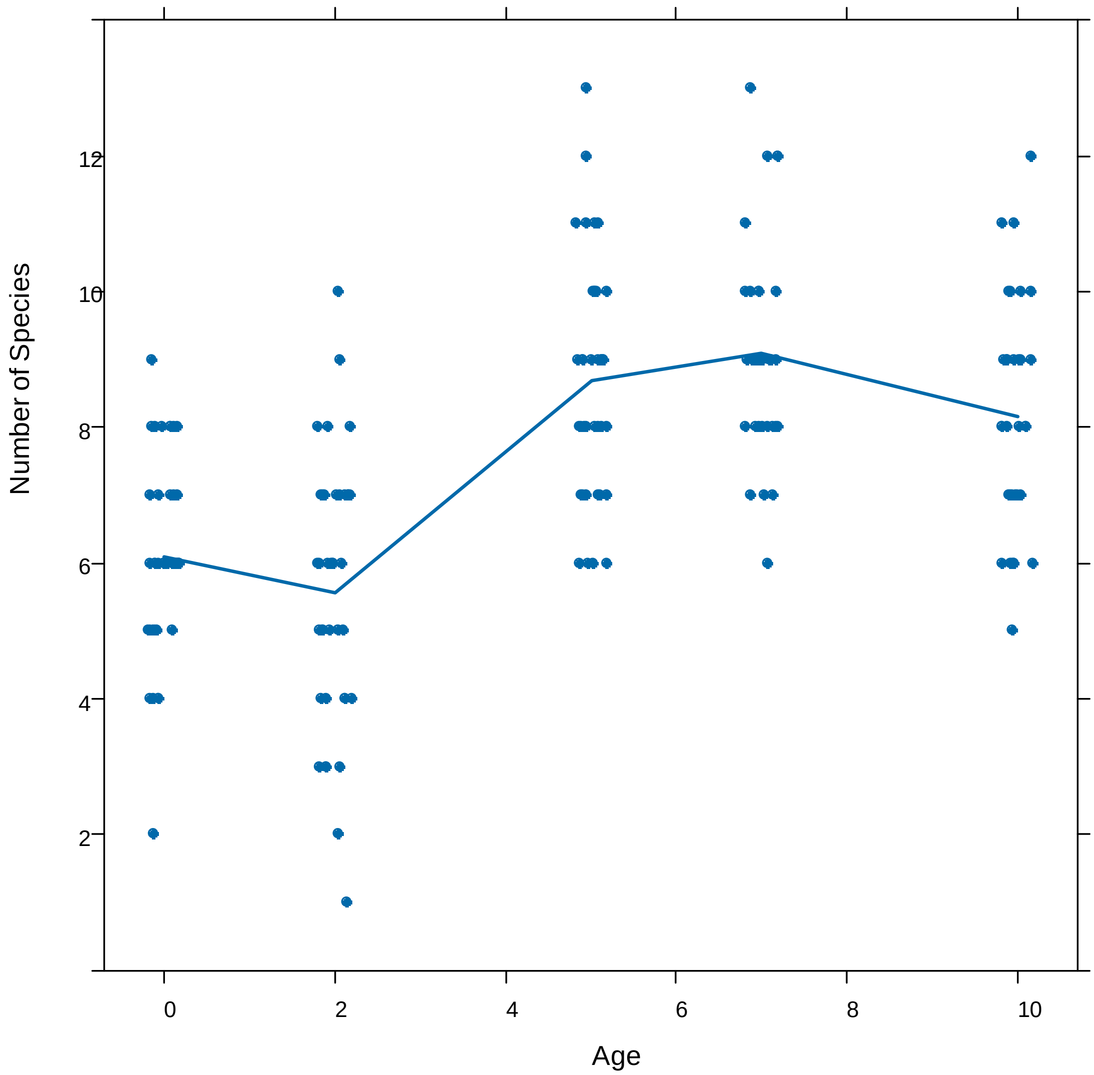

Figure 5-3 Species richness on Range 43–48 shrub transects over time.

The next metric examined was the change in diversity as measured by the Shannon-Weiner metric (Pielou 1974). The Shannon-Weiner 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 increased slightly after the burn (from an average of 1.1 to 1.2), and has increased to an average of 1.7 in Year 5 (Figure 5-4). Because diversity is a mixture of the number of species and their relative abundance, this pattern reflects the reduction in cover of the dominant species and the incorporation of new early successional species into the association. As succession progresses, diversity will increase until the climax species begin to re-establish their dominance in the final association.

The pattern described above is reflected in the changes in species evenness (Figure 5-5). Evenness is the equability of the relative contribution of species to the total cover in the association (Pielou 1974). Maximum evenness (value = 1) is achieved when all species are present in equal abundance. In the pre-burn association, evenness averaged 0.69, indicating that certain species dominated the association. In Year 2, evenness increased due to the effects of the burn reducing overall cover, particularly of the dominant species. Subsequently, evenness continued to increase as new early successional species were recruited into the association; average evenness varied between 0.74 and 0.78 in the Year 5 to Year 10 period. In addition, the evenness of individual transects showed a higher degree of variability in pre-burn and immediate post-burn (Year 2), than in the Year 5 through 10 surveys.

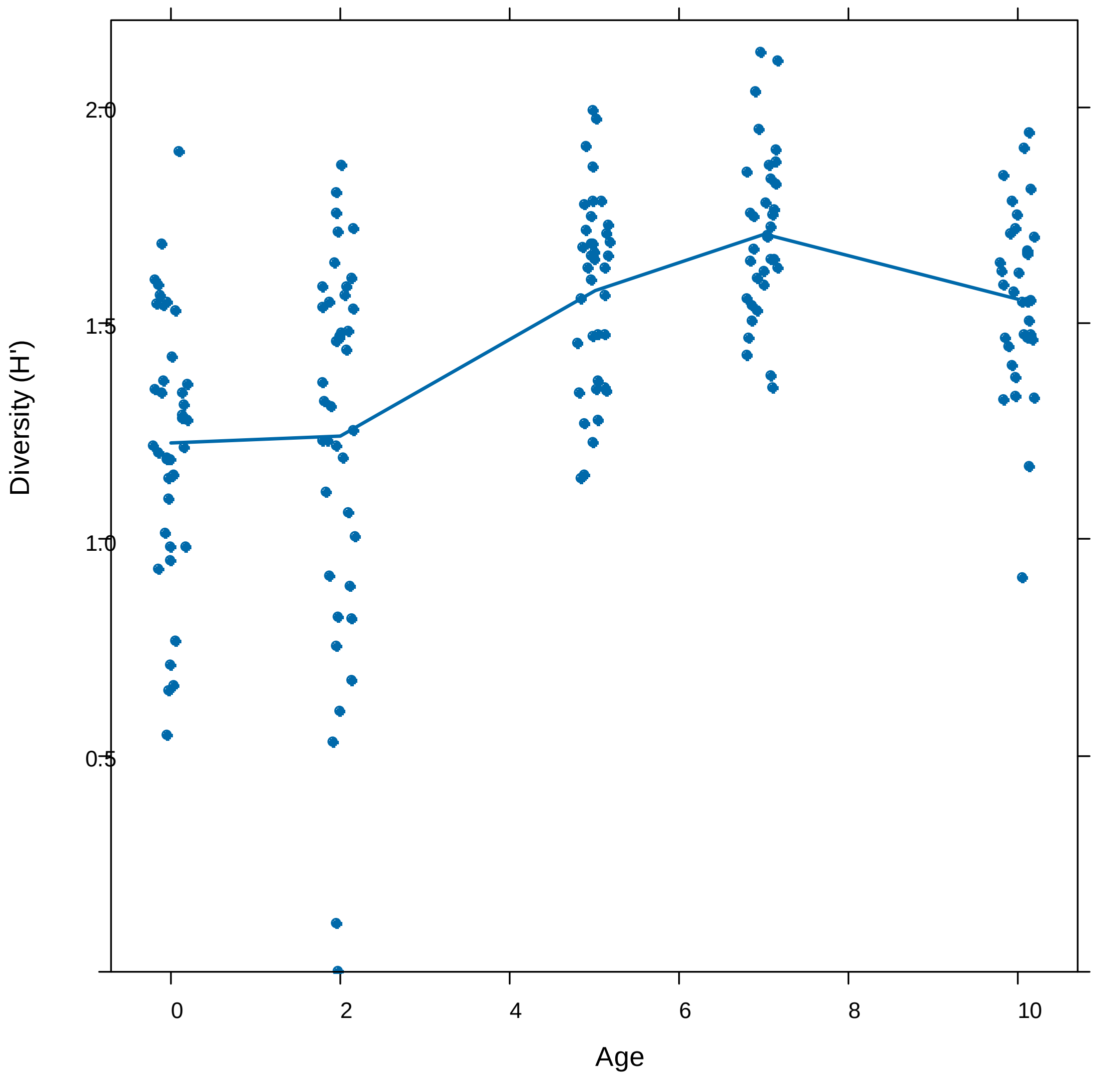

Figure 5-4 Shannon-Weiner diversity of Range 43–48 shrub transects over time.

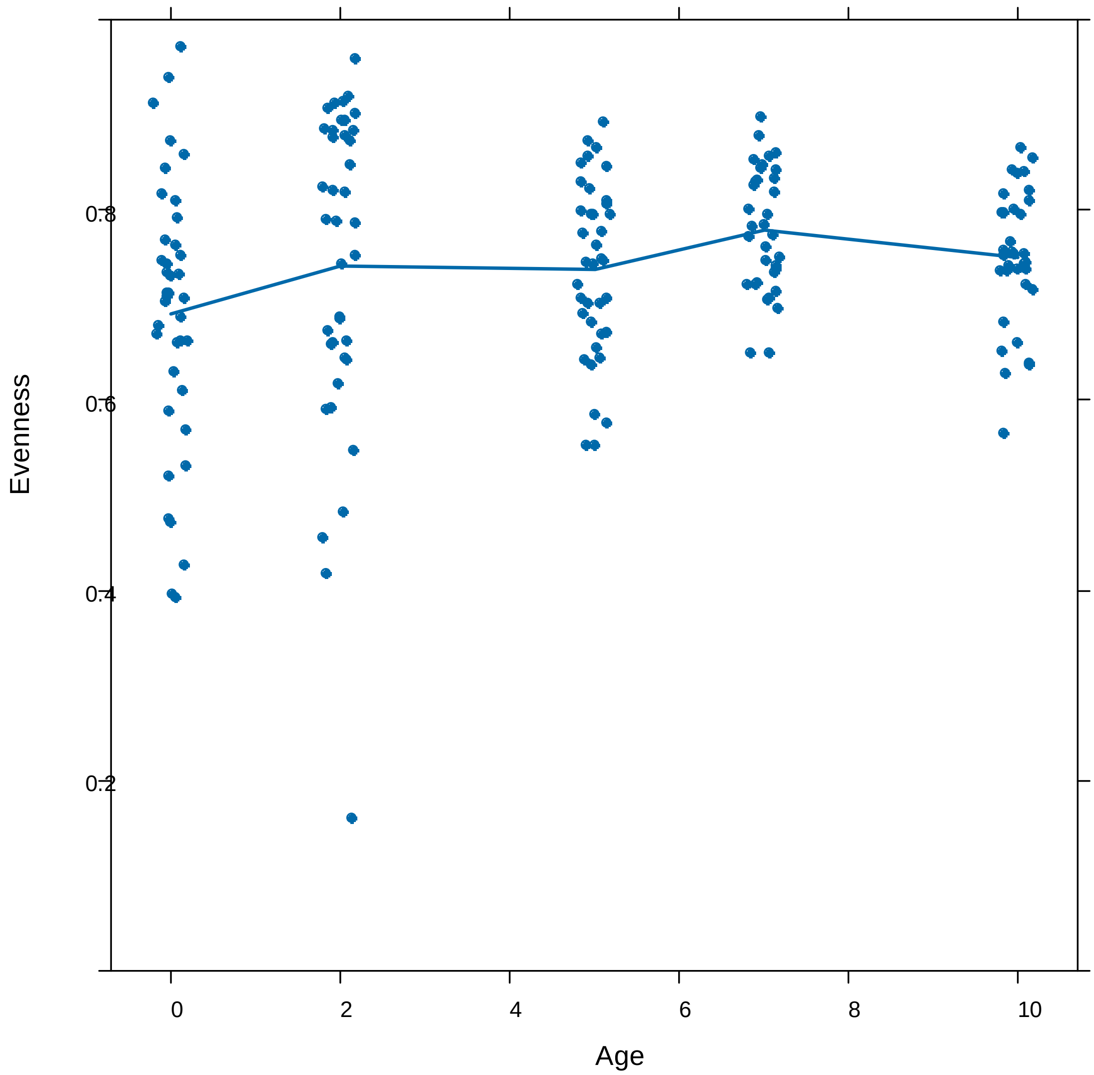

Figure 5-5 Association evenness on Range 43–48 shrub transects over time.

Multivariate statistics (ordination techniques) were used to assess whether there has been a change in species composition over time (Jongman et al. 1995). These techniques are based on measures of dissimilarity between samples (transects) and were conducted using non-metric multidimensional scaling (NMDS). Ordination techniques result in a multidimensional representation of samples (transects).

The results of the NMDS ordination show an association level response to the burn and subsequent recovery (Figure 5-6). In this plot, the centroid (multivariate average) of each group is indicated as a point with a radiating line extending to each individual transect in the group. Axis 1 of the ordination is interpreted to represent temporal patterns of recovery in the shrub association. The pre-burn conditions are shown in red on the right side of the plot. The Year 2 (2005; green) data appear on the left side of the plot, and appear to be relatively more variable than the other age classes. The Year 2 data are different from the other surveys as they are based on quadrat sampling rather than line-intercept sampling due to the limited amount of shrub regrowth. Therefore part of this difference is likely due to methodological differences. Typically, shrub community monitoring is not conducted until Year 3 for this reason. Subsequent Year 5 (2008; blue) and Year 7 (2010; orange) and Year 10 (2013; black) are intermediate and suggest a progressive shift in association structure towards the pre-burn condition. The 95 percent confidence ellipses indicate that the Year 0 transects are significantly different from all other ages; whereas the Year 5 and Year 7 associations are similar, but differ from Year 10.

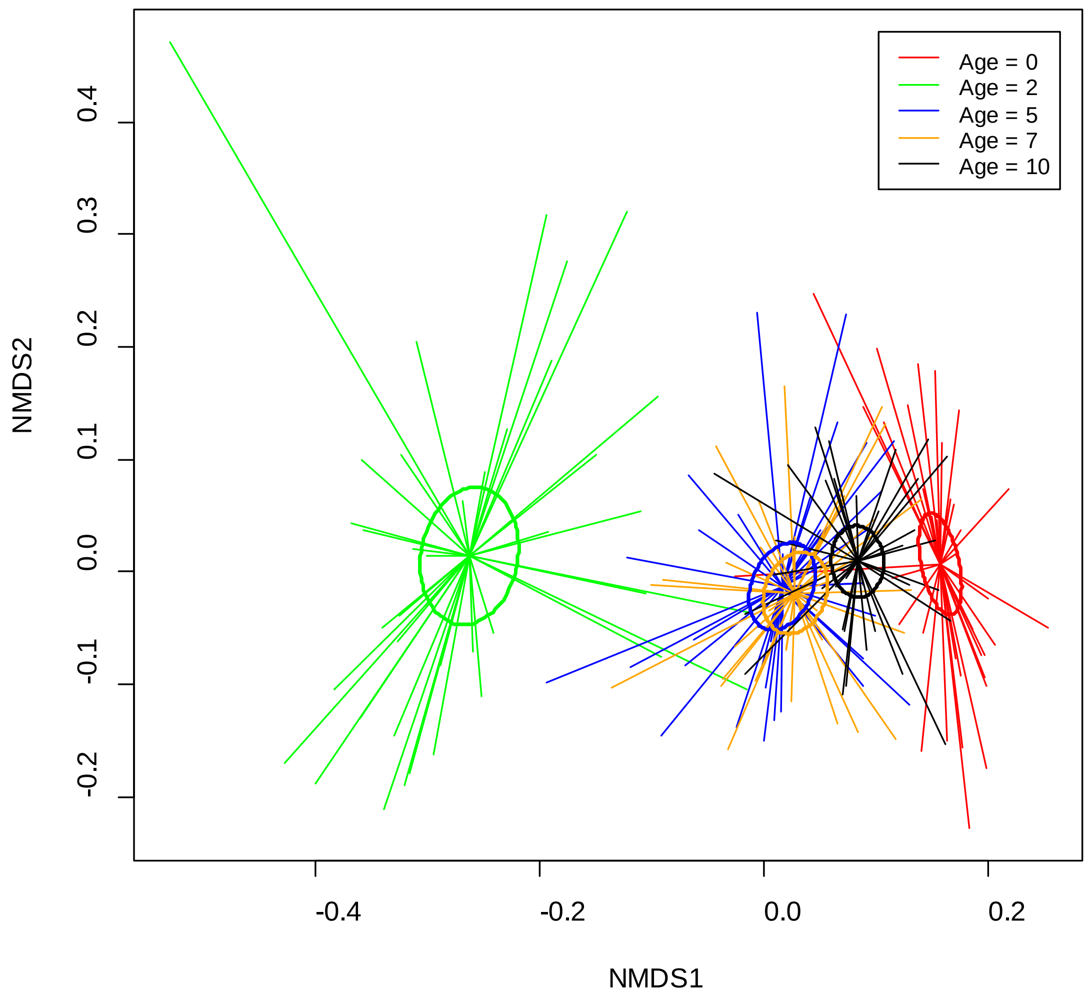

Figure 5-6 NMDS ordination plot of shrub association structure on Ranges 43–48 over time. The spider plots represent the location of individual transects relative to the centroid of the distribution. 95 percent confidence ellipses of the centroids are shown.

The results of the association metrics and the ordination suggest that there is a pattern to plant succession in the data from Ranges 43–48. However, these analyses do not provide an indication of which species are important in defining the differences between the groups. To illustrate changes in association structure a suite of six species that exhibited dominance, high frequency of occurrence, or uniqueness within different year classes were identified. The changes in percent cover of these species in shown in Figure 5-7.

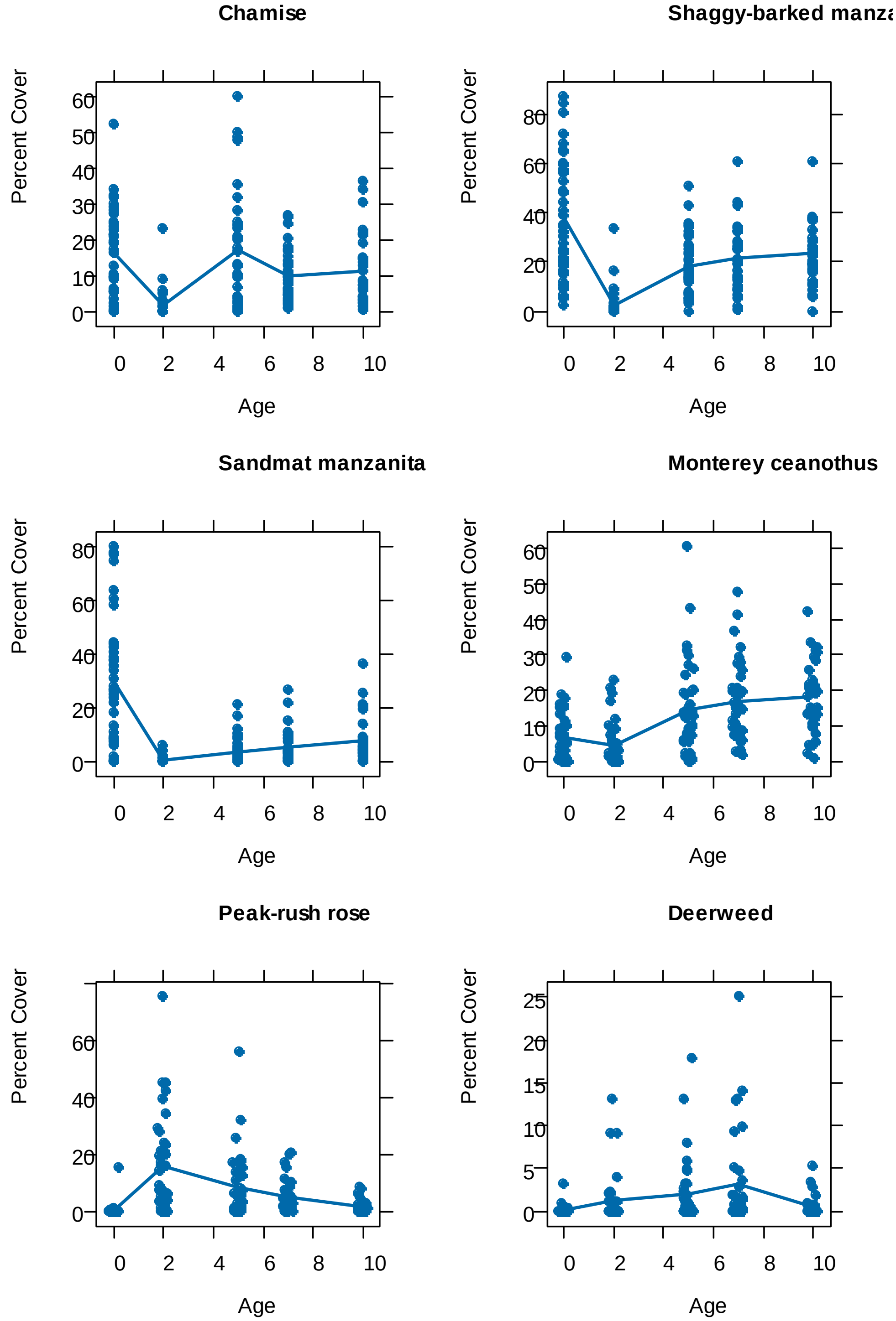

Figure 5-7 Temporal changes in percent cover of key plant species on Ranges 43–48, indicating successional patterns of recovery.

All species show a response in Year 2 as a result of the burn, generally a marked reduction in percent cover. Chamise shows an initial decline in cover, but a rapid rebound to pre-burn levels by Year 5. This species has two adaptations to disturbance including the ability to resprout from basal burls after burning or cutting, and the presence of seeds that require scarification from fire before germination.

The shaggy-barked manzanita is slower to recover after the burn, but by Year 10 has reached 23 percent cover, as compared to its initial cover of 38 percent. Like chamise, shaggy-barked manzanita can resprout from a basal burl. In contrast, sandmat manzanita exhibits a slow but constant rate of recovery, attaining 7.5 percent after 10 years, as compared to its pre-burn cover of 29 percent. This species is an obligate seeder and cannot resprout from the basal burl, hence its recovery is less pronounced due to the small size of the seedlings, and therefore low percent cover for each plant.

Although Monterey ceanothus was a relatively minor component of the community (~7 percent cover) in pre-burn conditions, it exhibited a rapid response becoming co-dominant with chamise and shaggy-barked manzanita by Year 7, attaining 18 percent cover by Year 10.

Other species, such as the subshrub peak rush-rose exhibit an increase in cover in Year 2 and subsequently decrease. Deerweed also increases in cover starting immediately after the burn, increasing through Year 7, with a decline to pre-burn levels by Year 10.

These species are considered to represent the major changes in shrub association structure occurring over time. The observed changes in species composition and relative abundance are consistent with the patterns observed in the 2010 survey of Ranges 43–48 (Tetra Tech and Ecosystems West 2011) as well as the changes in community structure seen in the Year 5 surveys on Units 18 and 22 conducted in 2013 (Section 4.4.5).

5.4.5. Annual Grass Monitoring

Annual grass surveys were limited to the periphery of Ranges 43–48 (Map A4-5). Areal cover of annual grasses in Ranges 43–48 has decreased between 2010 and 2013 in all cover classes (Table 5-4).

Table 5-4
Estimated Area Occupied (Acres) by Annual Grasses in Year 7 (2011) and Year 10 (2013) Surveys in Ranges 43–48

Cover Class	2010	2013
1 (low) = 1–5 percent	7.6	3.4
2 (medium) = 6–25 percent	7.7	4.1
3 (high) = >25 percent	24.3	15.9
Total Acreage	**39.5**	**23.4**

Observations by Parsons Inc. (2004) indicated that annual grasses were very limited in extent prior to the establishment of fire breaks in 2001. The effect of clearance for firebreaks on the density of annual grasses was highly variable. Mowing resulted in variable rates of encroachment of annual grasses into fire breaks. Application of fire retardants appeared to increase annual grass densities via a fertilization effect.

5.4.6. Invasive Species Monitoring

When invasive species were encountered in Ranges 43–48, the locations were mapped using a recreational-grade GPS unit. No invasive plants were mapped on Ranges 43–48.

SECTION 6

California Tiger Salamander and Vernal Pool Survey

A survey for the presence of the endangered California tiger salamander was conducted at six vernal pools on the former Fort Ord between November 2012 and May 2013. These pools were monitored for hydrology and presence of California tiger salamander (CTS) (*Ambystoma californiense*) and California fairy shrimp (*Linderiella californica*) as a requirement of the U.S. Fish and Wildlife Service's 2005 Biological Opinion (USFWS 2005) and the *Wetland Monitoring and Restoration Plan for Munitions and Contaminated Soil Remedial Activities at Former Fort Ord* (Burleson Consulting, Inc. 2006).

Spring aquatic surveys to monitor known California tiger salamander (CTS) (*Ambystoma californiense*) breeding pools and larval presence were performed from March through May 2013, following on-going munitions and lead remediation activities around the pools.

The results of the survey are provided as Appendix C to this report.

SECTION 7

Conclusions

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

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. However, HMP annual species exhibit considerable between-year and between-Unit variability with respect to density in monitored grids. Based on the data presented in this report, there does not appear to be a consistent differential response to burning or mastication treatments. The results of Year 5 surveys on Units 18 and 22 suggested that there was a differential response to treatment by sand gilia and Monterey spineflower (Section 4.4.4). However, trajectories of change in density and response to treatment for a given species often differ between adjacent Units (e.g., Units 15 and 21, Section 3.4.4). This variation in observed densities may be due to factors other than the applied treatment such as the timing and quantity of precipitation. 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 considerably between years. In general, both species have increased survival and seed set during years of higher spring rainfall and temperatures. However, sand gilia tends to have increased rates of germination in years with higher winter rainfall and temperatures, whereas Monterey spineflower germination is higher during cooler, drier years. Moreover, sand gilia abundance tends to increase with the number of years since the previous El Niño event while Monterey spineflower abundance tends to decline. Sand gilia abundance is independent of the previous years' seed set, while spineflower density is directly correlated to the previous years' seed set (Fox et al. 2006). Seaside bird's-beak densities are also known to fluctuate dramatically between years based on rainfall and other weather patterns. Further analysis of the data with respect to annual rainfall, soil conditions, and other climatic conditions is recommended.

Whereas the current monitoring approach for the HMP annual species focuses on determining the plant density in fixed plots monitored over time, it does not address changes in areal distribution in post-treatment years. Once the shrub canopy is opened by fire or mastication, annual species may colonize the open areas until such time as the shrub cover closes. Under the current monitoring protocol, the grids selected for monitoring represent a sample of the grids that were identified as supporting one or more HMP annual species during the meandering transects conducted in the baseline (Year 0) surveys. The same grids are monitored in all subsequent years. An alternative approach, using frequency of detection in macroplots, has been proposed and is currently under review by regulatory agencies (Tetra Tech and EcoSystems West 2013b). This approach will allow estimation of changes in both density and distribution of the HMP species.

7.2. Vegetation Transect Survey

Results of the shrub community structure analyses reaffirm the results of the 2012 surveys and protocol revision study that indicated the presence of at least three sub-associations that differ in the relative percentages of shaggy-barked manzanita and chamise (Tetra Tech and EcoSystems West 2013a,b). Successional patterns may differ between these sub-associations as a result of species composition as well as differential soil or microclimatic conditions.

The results of the shrub transects on the Year 3, Year 5, and Year 10 surveys were consistent with the successional pattern observed in the 2010 surveys (Tetra Tech and Ecosystems West 2011). Both total percent cover and shifts in dominant species were present. Shrub species show a consistent pattern of succession over the monitored period. Initial responses include re-sprouting of a limited suite of species from burls (i.e., chamise and shaggy-barked manzanita), and rapid colonization of open space by subshrub species such as peak-rush rose, deerweed, and golden yarrow (Figure 4-10 and Figure 5-7). Whereas the shrub species continue to increase in percent cover slowly, the smaller subshrub species eventually decline toward baseline levels.

A focus of the analyses conducted in this survey was the assessment of association-level responses to mastication and burning treatments. Because coastal chaparral is a fire-adapted association and several species are thought to require fire for germination or re-sprouting, it was anticipated that differences in succession may be present between the two treatments. Of the community metrics only cover exhibited statistically significant differences between treatments. No differences were detected in number of shrub species present, diversity, or evenness between treatments. However, shrub association structure (species composition and relative abundance) exhibited significant differences between treatments in Year 3 (Figure 3-7), and in Year 5 in Unit 18 (Figure 4-8). However, no differences in shrub association structure due to treatment were present in Year 5 transects in Unit 22(Figure 4-9).

The observed successional patterns in the shrub community follow those expected for a naturally regenerating chaparral community. After vegetation clearance there is an initial increase in the number of species present, diversity, and evenness (equitability of species cover) as subshrubs colonize the cleared areas. After 3–5 years the subshrubs decrease in cover as the dominant, slow-growing, shrubs become more important, and total shrub cover approximates pre-clearance levels. As a result, number of species, diversity and evenness begin to decrease towards baseline levels.

Community structure (species composition and relative cover) shows a convergence towards baseline structure for both the burned and masticated transects by Year 10, as evidenced by the ordination plots (Figure 4-8, Figure 4-9, Figure 5-6).

7.3. 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. Initial colonization by annual grasses in fuel break areas may be enhanced through the fertilization effect from application of fire suppression chemicals (Parsons 2004).

SECTION 8

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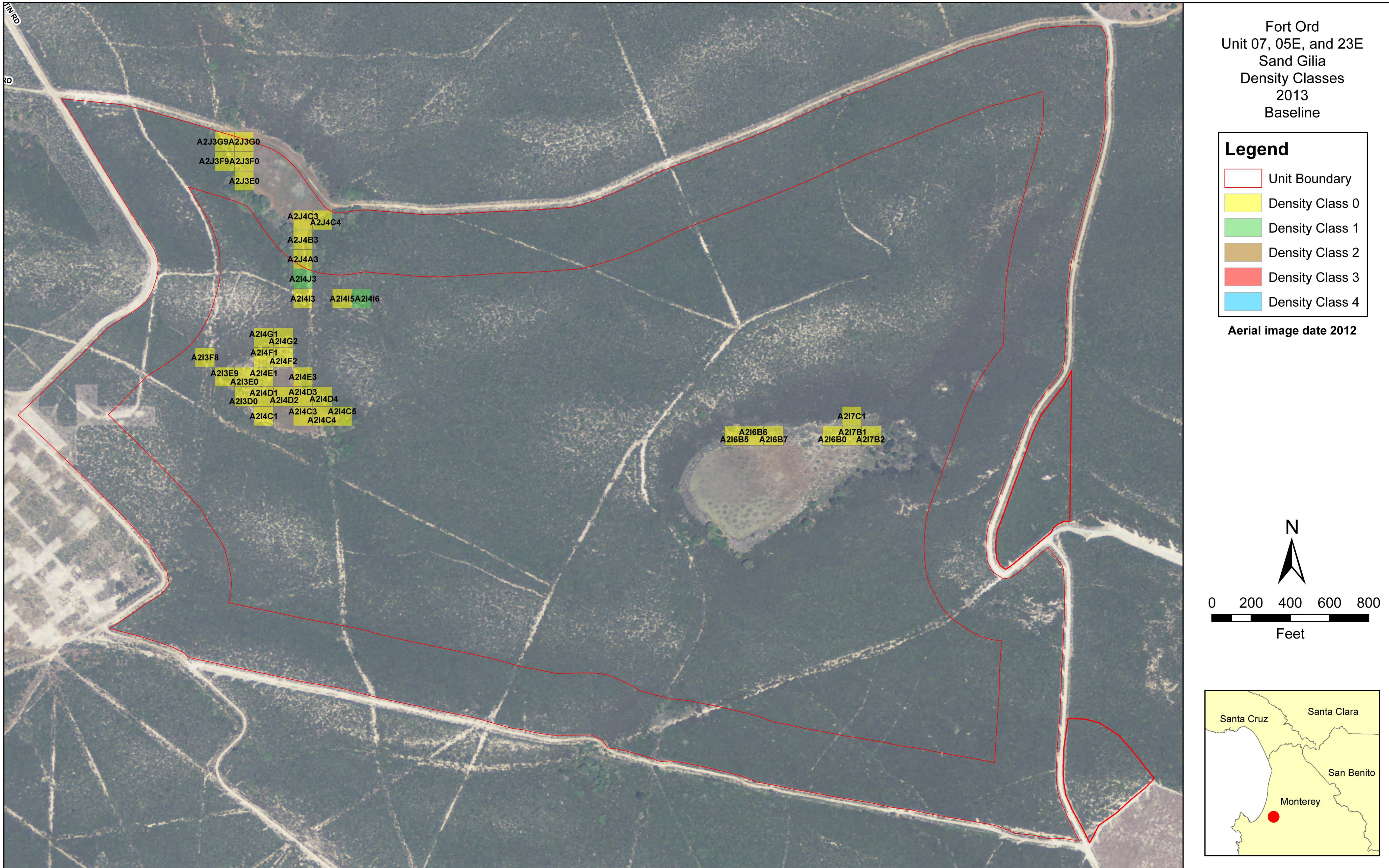
APPENDIX A
Maps


Fort Ord
Unit 07, 05E, and 23E
Sand Gilia
Density Classes
2013
Baseline
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 200 400 600 800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
A2J3G9
A2J3G0
A2J3F9
A2J3F0
A2J3E0
A2J4C3
A2J4C4
A2J4B3
A2J4A3
A2I4J3
A2I4I3
A2I4I5
A2I4I6
A2I4G1
A2I4G2
A2I3F8
A2I4F1
A2I4F2
A2I3E9
A2I4E1
A2I4E3
A2I3E0
A2I4D1
A2I4D3
A2I4D4
A2I3D0
A2I4D2
A2I4C3
A2I4C5
A2I4C1
A2I4C4
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A2I6B7
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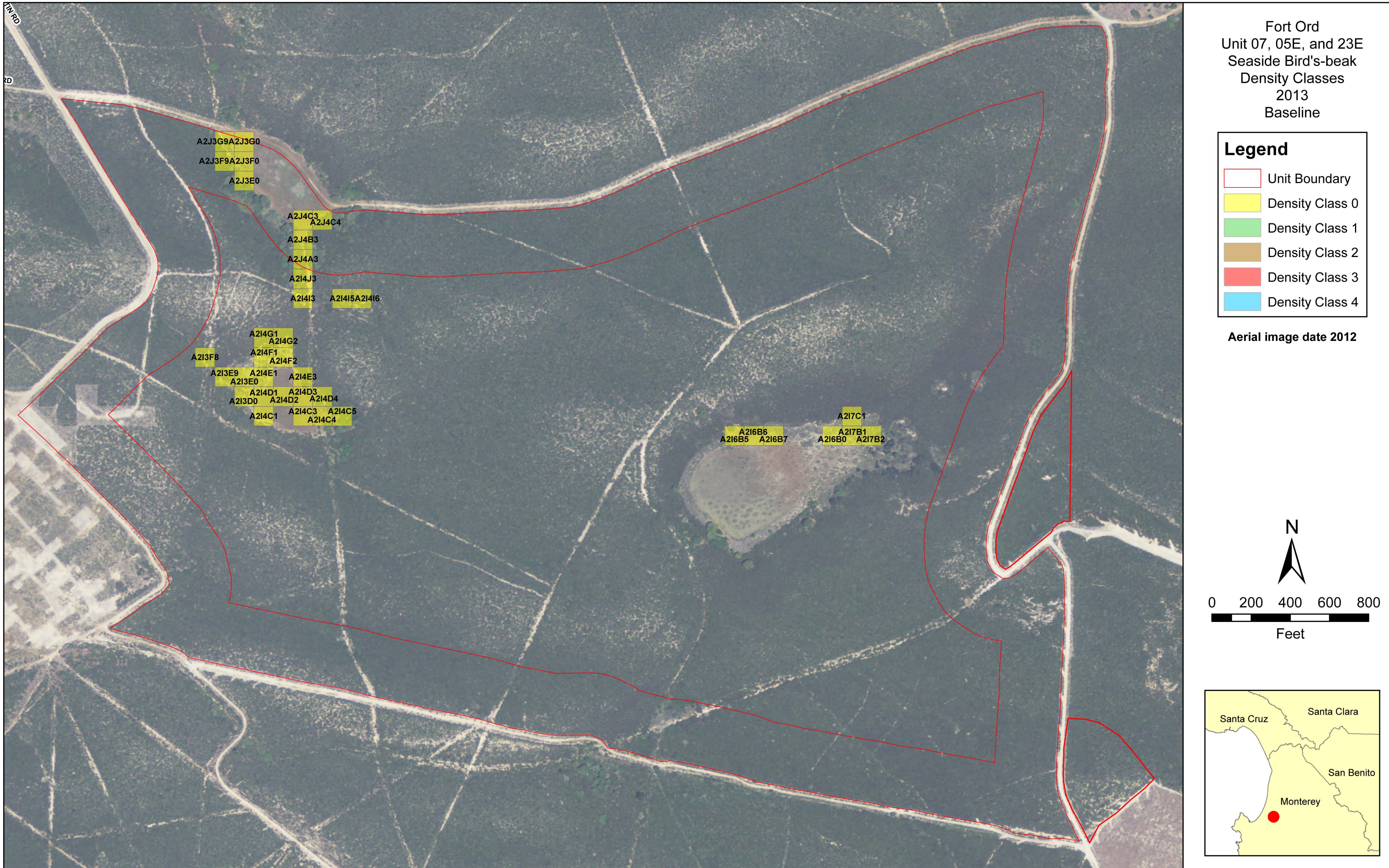
A2I6B0
A2I7B2

Map A1-1


Fort Ord
Unit 07, 05E, and 23E
Seaside Bird's-beak
Density Classes
2013
Baseline
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 200 400 600 800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
A2J3G9
A2J3G0
A2J3F9
A2J3F0
A2J3E0
A2J4C3
A2J4C4
A2J4B3
A2J4A3
A2I4J3
A2I4I3
A2I4I5
A2I4I6
A2I4G1
A2I4G2
A2I3F8
A2I4F1
A2I4F2
A2I3E9
A2I4E1
A2I3E0
A2I4E3
A2I4D1
A2I4D3
A2I3D0
A2I4D2
A2I4D4
A2I4C3
A2I4C5
A2I4C1
A2I4C4
A2I6B6
A2I6B5
A2I6B7
A2I7C1
A2I7B1
A2I6B0
A2I7B2

Map A1-2

Fort Ord
Unit 07, 05E, and 23E
Monterey Spineflower
Density Classes
2013
Baseline

Legend

- Unit Boundary
- Density Class 0
- Density Class 1
- Density Class 2
- Density Class 3
- Density Class 4

Aerial image date 2012

N

0 200 400 600 800
Feet

Fort Ord
Unit 07, 05E, and 23E
Vegetation Transect Locations
2013
Baseline
Legend
Vegetation Transect
Unit Boundary
Aerial image date 2012
N
0
200
400
600
800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
7-5
7-2
7-17
7-7
7-27
7-3
7-19
7-9
7-16
7-12
7-8
7-20
7-22
7-10
7-23
7-18
7-24
7-26
7-13
7-25
26-1
26-2
26-3
7-14
7-7
7-11
7-21
7-1
7-15
7-5
23E-1
5aE-1

Map A1-4


Fort Ord
Unit 07, 05E, and 23E
Annual Grass Distribution
2013
Baseline
Legend
Unit Boundary
Low Density (1-5%)
Medium Density (6-25%)
High Density (> 25%)
Aerial image date 2012
N
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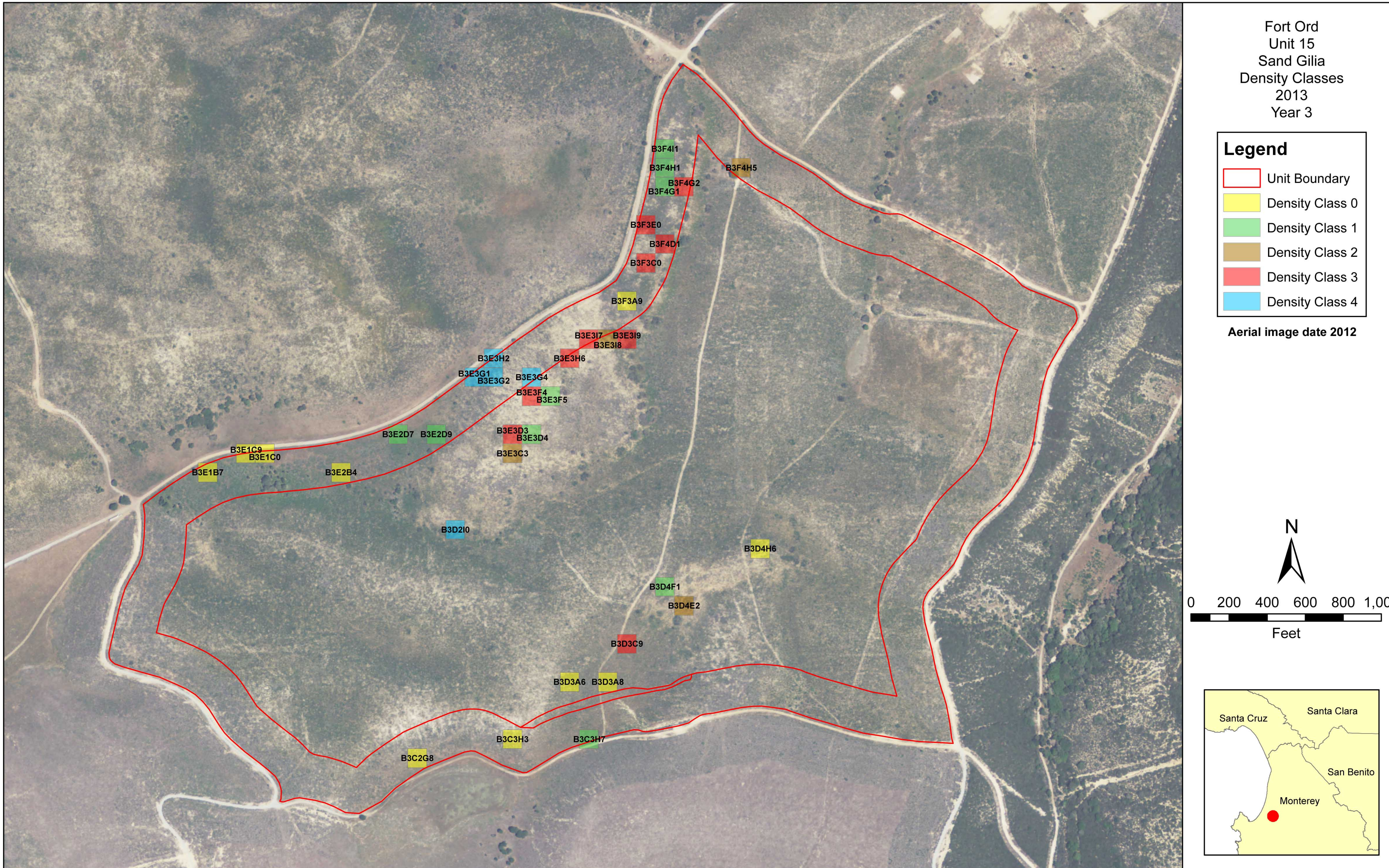
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A1-5



Fort Ord
Unit 15
Sand Gilia
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Classes 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 200 400 600 800 1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3F4I1
B3F4H1
B3F4G2
B3F4G1
B3F4H5
B3F3E0
B3F4D1
B3F3C0
B3F3A9
B3E3I7
B3E3I9
B3E3I8
B3E3H6
B3E3H2
B3E3G1
B3E3G2
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B3E3F4
B3E3F5
B3E2D7
B3E2D9
B3E3D3
B3E3D4
B3E3C3
B3E1C9
B3E1C0
B3E1B7
B3E2B4
B3D2I0
B3D4H6
B3D4F1
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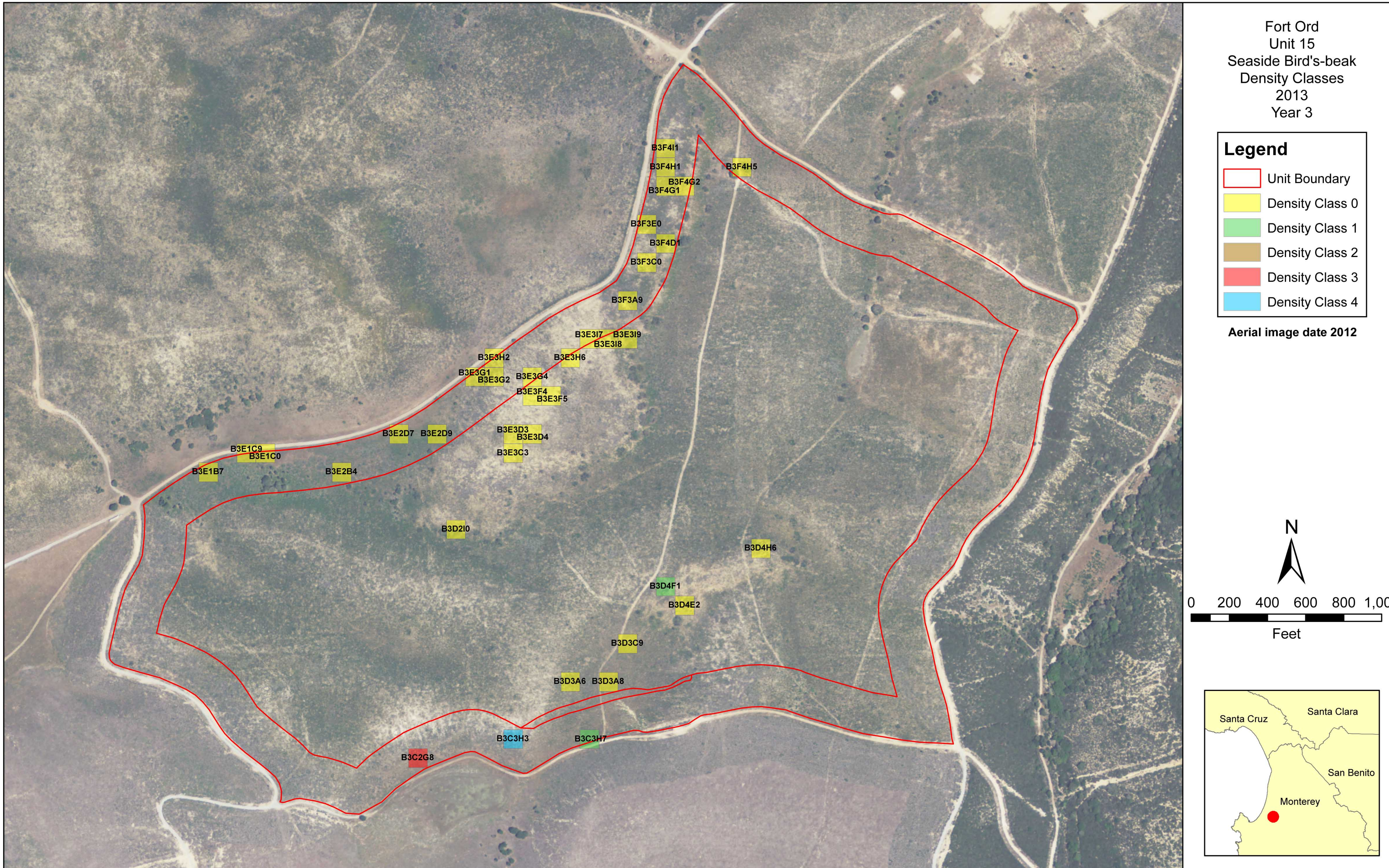
B3C2G8

Map A2-1


Fort Ord
Unit 15
Seaside Bird's-beak
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Classes 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 200 400 600 800 1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3F4I1
B3F4H1
B3F4G2
B3F4G1
B3F4H5
B3F3E0
B3F4D1
B3F3C0
B3F3A9
B3E3I7
B3E3I9
B3E3I8
B3E3H2
B3E3H6
B3E3G1
B3E3G2
B3E3G4
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B3E3F5
B3E2D7
B3E2D9
B3E3D3
B3E3D4
B3E3C3
B3E1C9
B3E1C0
B3E1B7
B3E2B4
B3D2I0
B3D4H6
B3D4F1
B3D4E2
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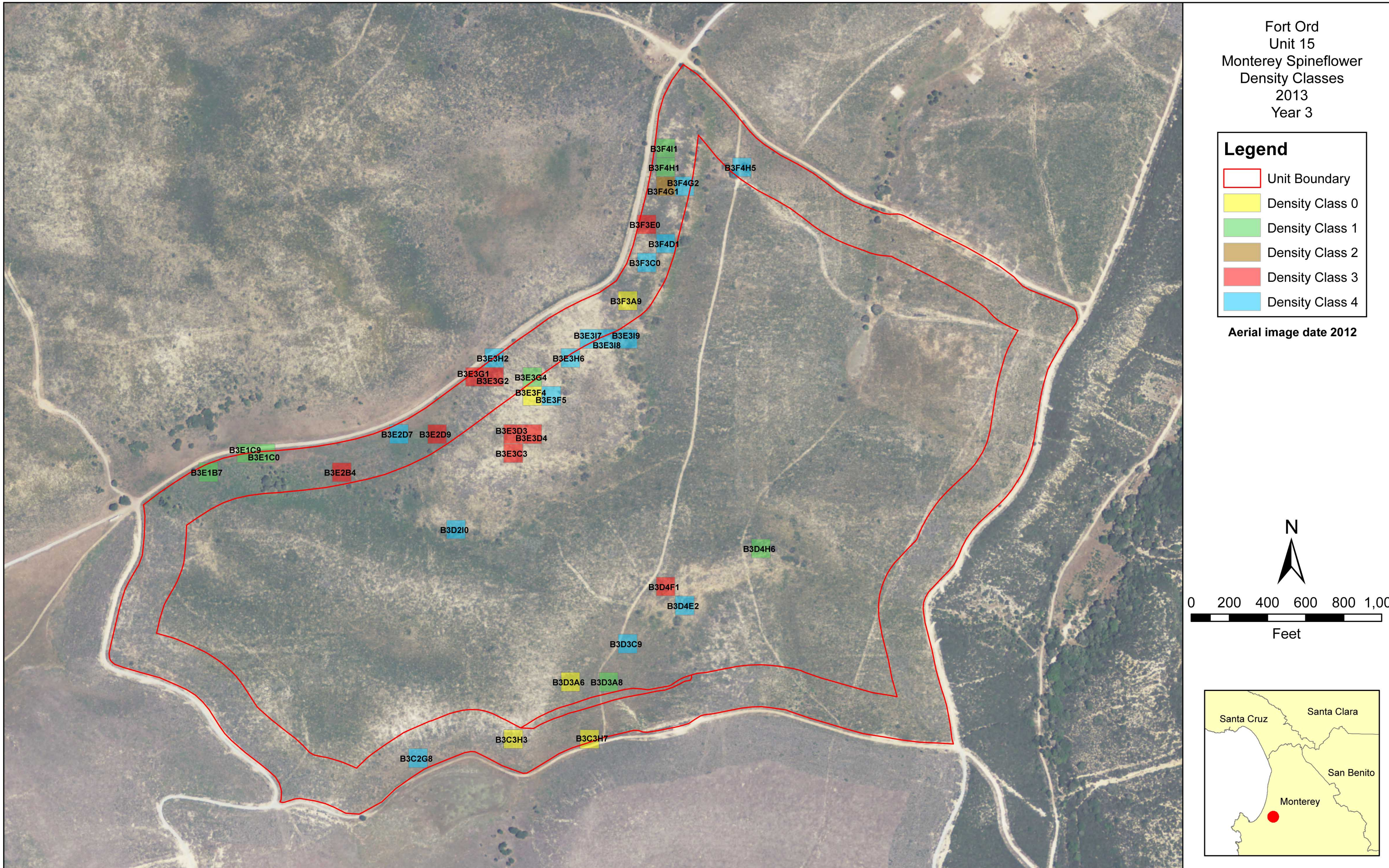
B3D3A8
B3C3H3
B3C3H7
B3C2G8

Map A2-2


Fort Ord
Unit 15
Monterey Spineflower
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Classes 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0
200
400
600
800
1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3F4I1
B3F4H1
B3F4G2
B3F4G1
B3F4H5
B3F3E0
B3F4D1
B3F3C0
B3F3A9
B3E3I7
B3E3I9
B3E3I8
B3E3H2
B3E3H6
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B3E3F5
B3E2D7
B3E2D9
B3E3D3
B3E3D4
B3E3C3
B3E1C9
B3E1C0
B3E1B7
B3E2B4
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B3D4H6
B3D4F1
B3D4E2
B3D3C9
B3D3A6
B3D3A8
B3C3H3
B3C3H7
B3C2G8

Map A2-3

Fort Ord
Unit 15
Vegetation Transect Locations
2013
Year 3
Legend
Vegetation Transect
Unit Boundary
Aerial image date 2012
N
0 200 400 600 800 1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
15-1
15-2
15-3
15-4
15-5
15-6
15-7
15-8
15-9
15-10
15-11
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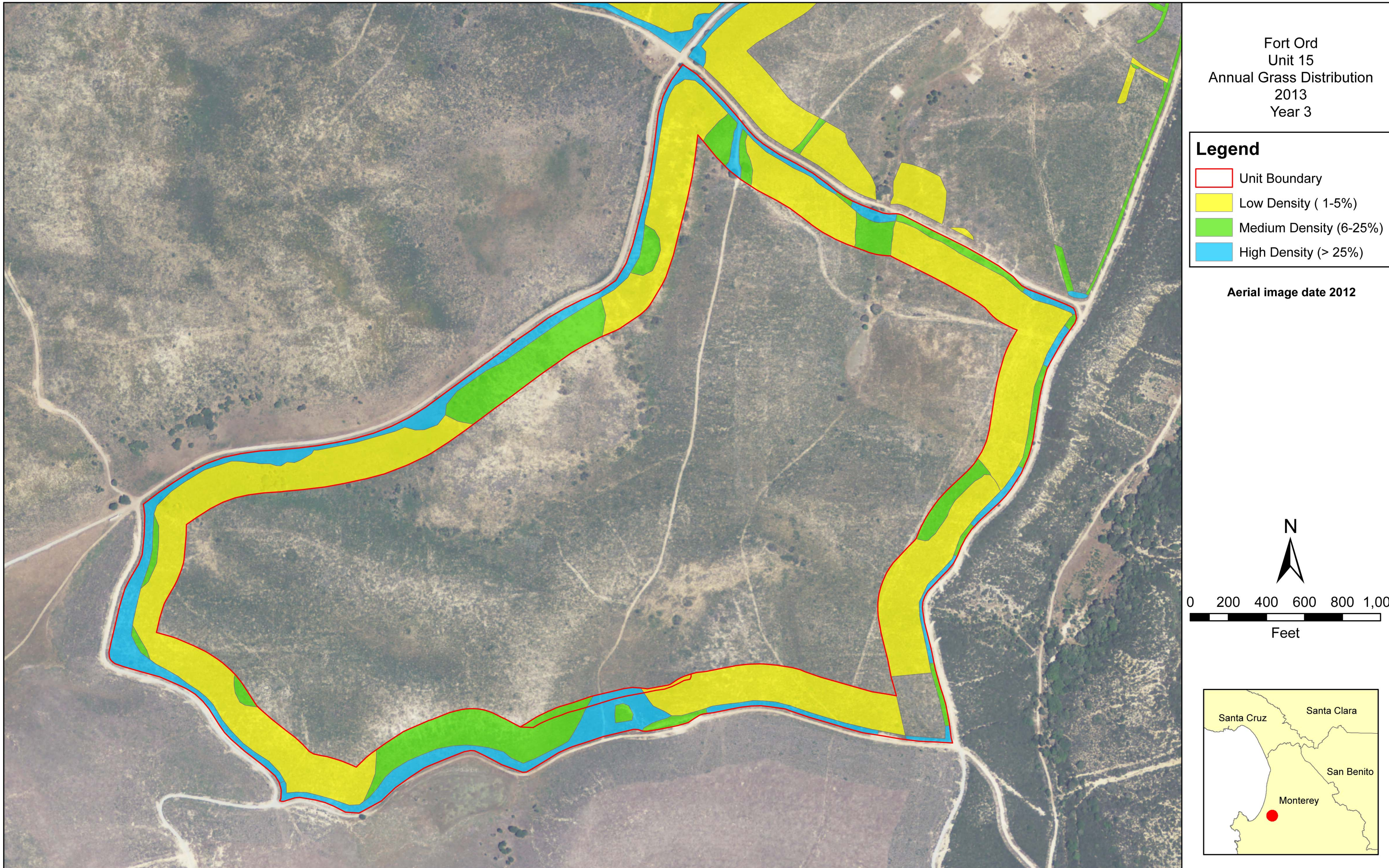
15-15
15-16
15-17
15-18
15-19
15-20
15-21

Map A2-4


Fort Ord
Unit 15
Annual Grass Distribution
2013
Year 3
Legend
Unit Boundary
Low Density (1-5%)
Medium Density (6-25%)
High Density (> 25%)
Aerial image date 2012
N
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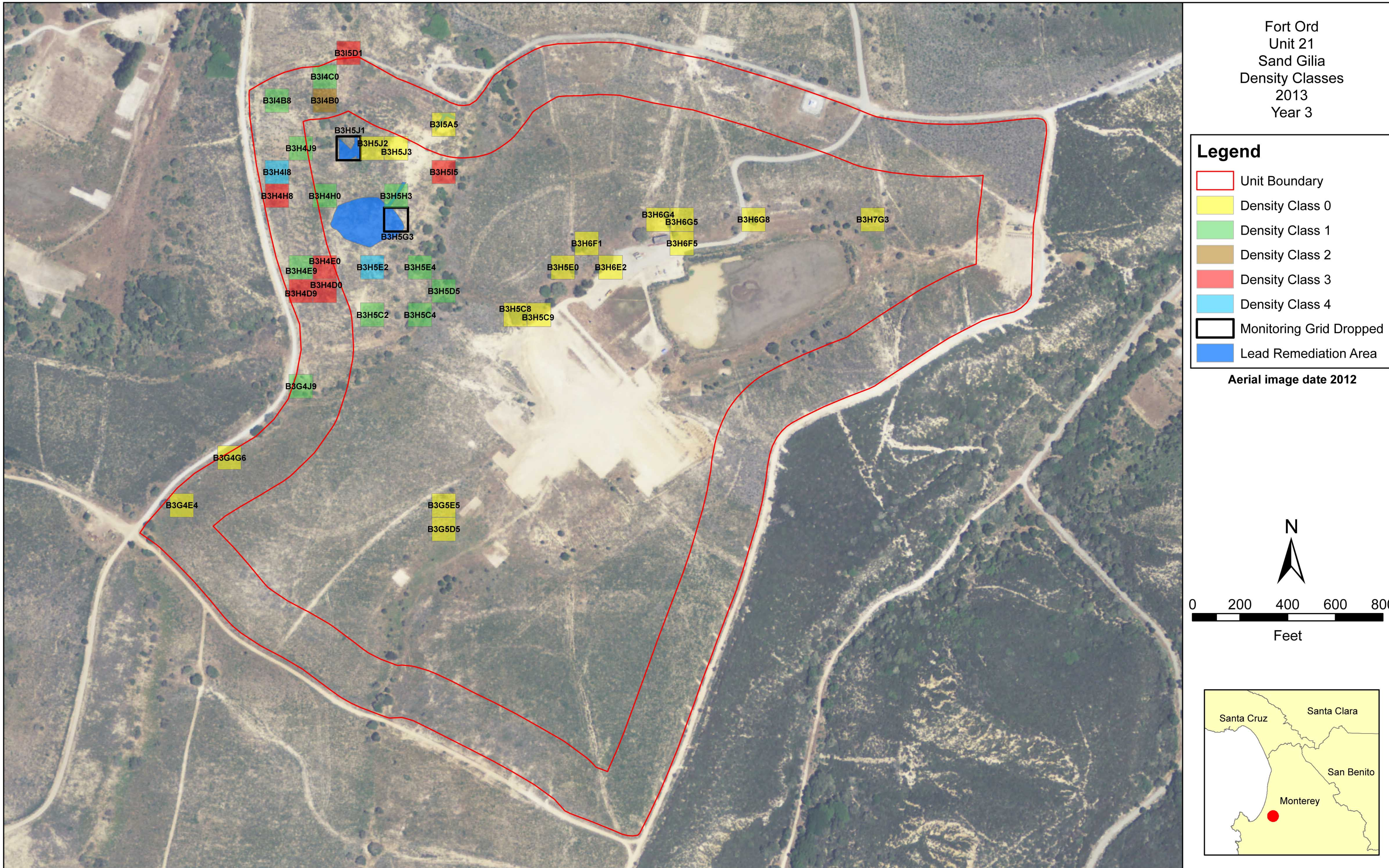
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A2-5


Fort Ord
Unit 21
Sand Gilia
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Monitoring Grid Dropped
Lead Remediation Area
Aerial image date 2012
N
0
200
400
600
800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3I5D1
B3I4C0
B3I4B8
B3I4B0
B3I5A5
B3H5J1
B3H5J2
B3H5J3
B3H4J9
B3H4I8
B3H5I5
B3H4H8
B3H4H0
B3H5H3
B3H5G3
B3H4E0
B3H4E9
B3H5E2
B3H5E4
B3H4D0
B3H4D9
B3H5D5
B3H5C2
B3H5C4
B3H5C8
B3H5C9
B3H6G4
B3H6G5
B3H6G8
B3H7G3
B3H6F1
B3H6F5
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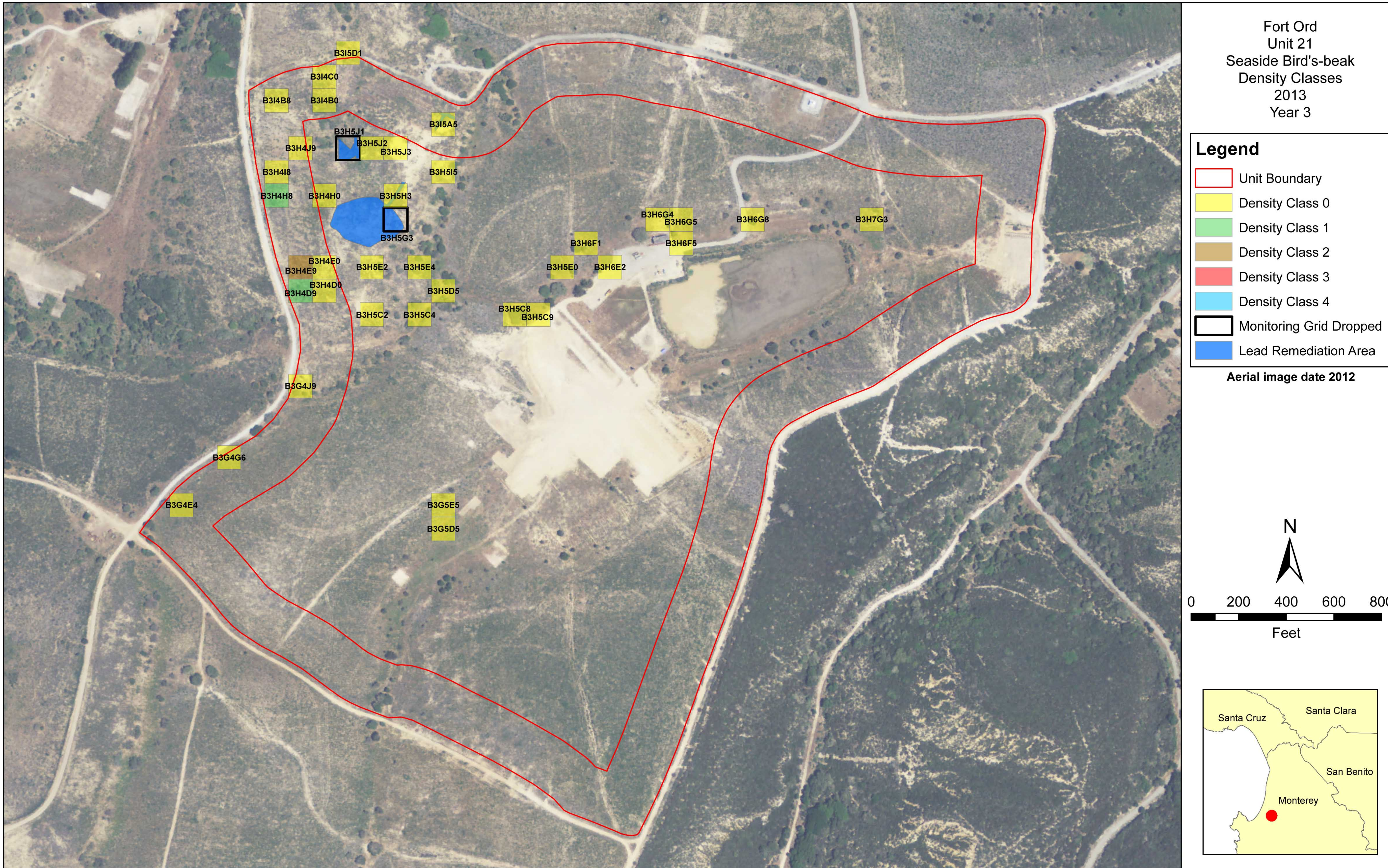
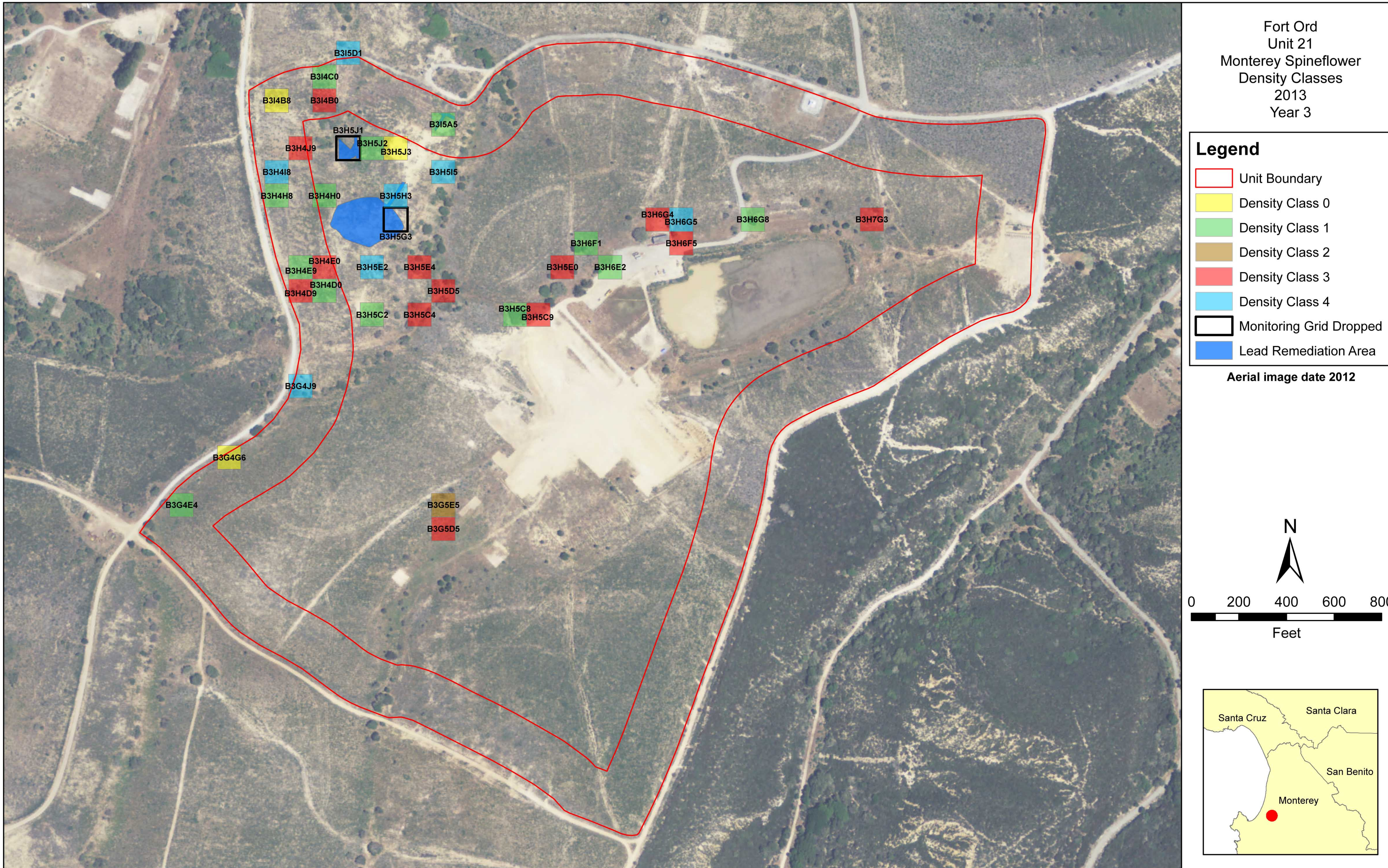
B3G5D5

Map A2-6


Fort Ord
Unit 21
Seaside Bird's-beak
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Monitoring Grid Dropped
Lead Remediation Area
Aerial image date 2012
N
0
200
400
600
800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3I5D1
B3I4C0
B3I4B8
B3I4B0
B3I5A5
B3H5J1
B3H5J2
B3H5J3
B3H4J9
B3H4I8
B3H5I5
B3H4H8
B3H4H0
B3H5H3
B3H5G3
B3H6G4
B3H6G5
B3H6G8
B3H7G3
B3H6F1
B3H6F5
B3H4E0
B3H4E9
B3H5E2
B3H5E4
B3H5E0
B3H6E2
B3H4D0
B3H4D9
B3H5D5
B3H5C8
B3H5C9
B3H5C2
B3H5C4
B3G4J9
B3G4G6
B3G4E4
B3G5E5
B3G5D5

Map A2-7



Fort Ord
Unit 21
Monterey Spineflower
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Monitoring Grid Dropped
Lead Remediation Area
Aerial image date 2012
N
0 200 400 600 800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3I5D1
B3I4C0
B3I4B8
B3I4B0
B3I5A5
B3H5J1
B3H4J9
B3H5J2
B3H5J3
B3H4I8
B3H5I5
B3H4H8
B3H4H0
B3H5H3
B3H5G3
B3H6G4
B3H6G5
B3H6G8
B3H7G3
B3H6F1
B3H6F5
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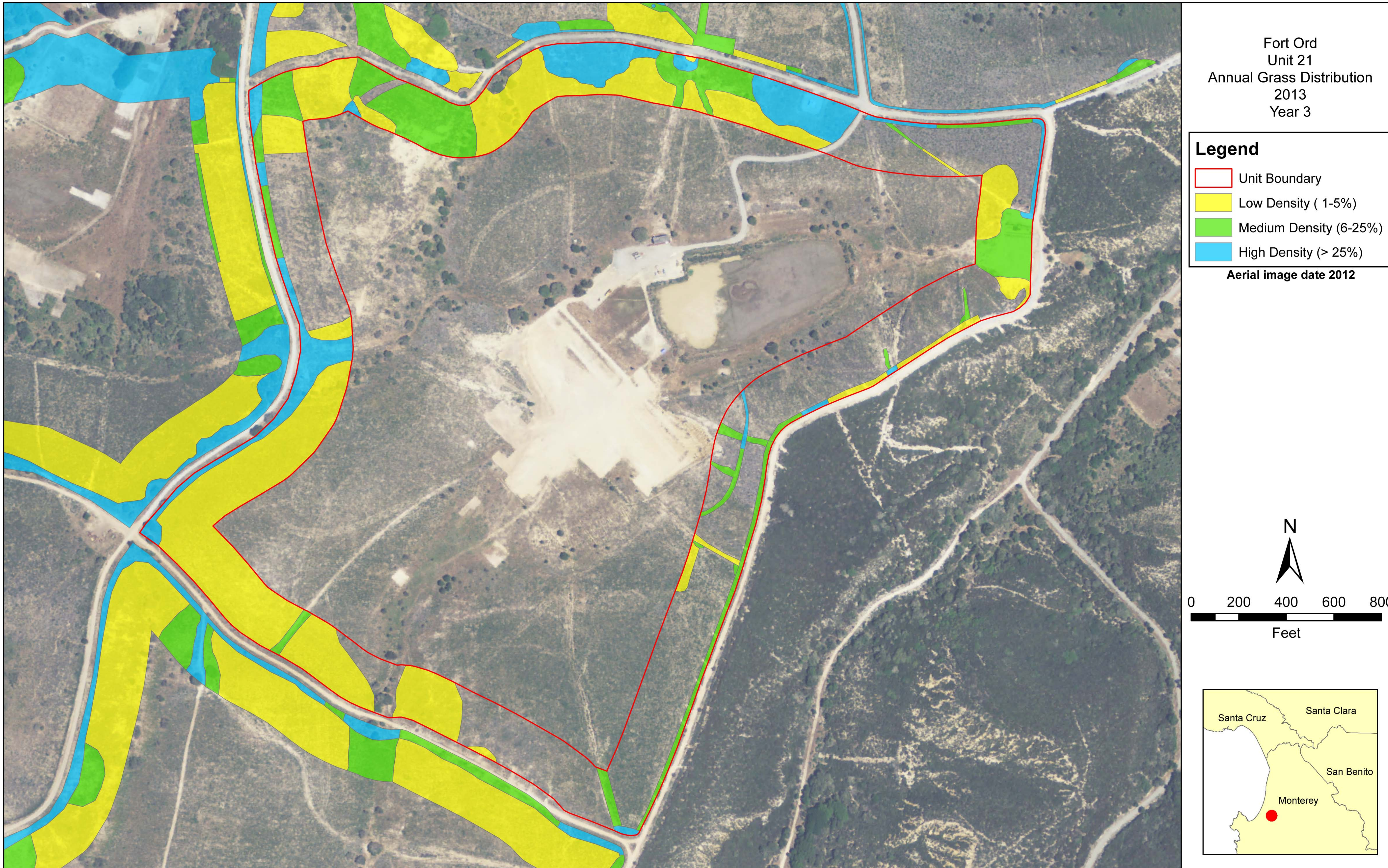
B3H4E9
B3H5E2
B3H5E4
B3H5E0
B3H6E2
B3H4D0
B3H4D9
B3H5D5
B3H5C2
B3H5C4
B3H5C8
B3H5C9
B3G4J9
B3G4G6
B3G4E4
B3G5E5
B3G5D5

Map A2-8


Fort Ord
Unit 21
Vegetation Transect Locations
2013
Year 3
Legend
Vegetation Transect
Unit Boundary
Aerial image date 2012
N
0 200 400 600 800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
21-1
21-2
21-3
21-4
21-5
21-6
21-7
21-8
21-9
21-10
21-11
21-12
21-13
21-14
21-15

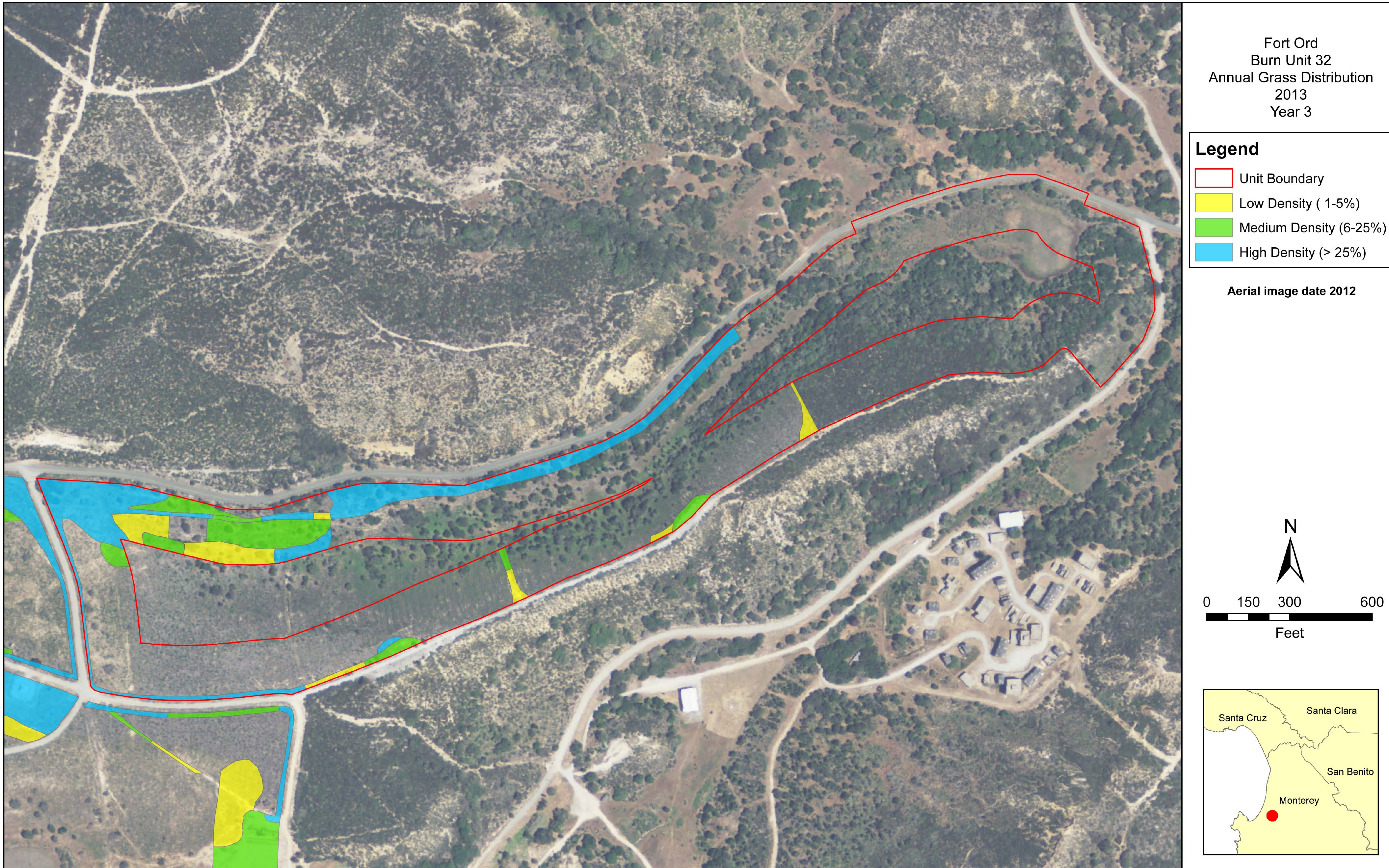
Map A2-9


Fort Ord
Unit 21
Annual Grass Distribution
2013
Year 3
Legend
Unit Boundary
Low Density (1-5%)
Medium Density (6-25%)
High Density (> 25%)
Aerial image date 2012
N
0
200
400
600
800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A2-10


32-1
32-2
32-3
32-4
32-5
Fort Ord
Burn Unit 32
Vegetation Transect Locations
2013
Year 3
Legend
Vegetation Transect
Unit Boundary
Aerial image date 2012
N
0
150
300
600
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A2-11



Fort Ord
Burn Unit 32
Annual Grass Distribution
2013
Year 3
Legend
Unit Boundary
Low Density (1-5%)
Medium Density (6-25%)
High Density (> 25%)
Aerial image date 2012
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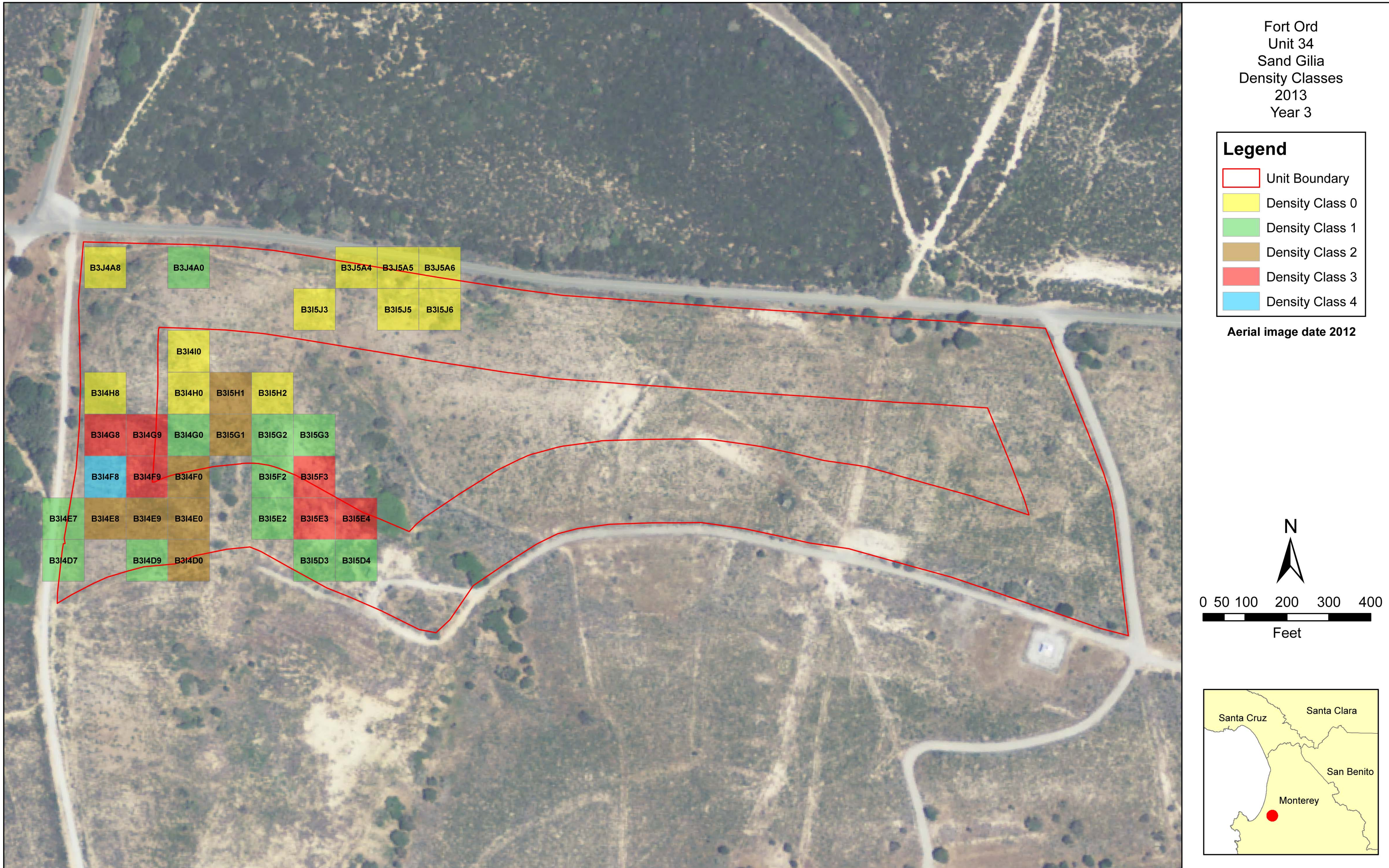
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A2-12


Fort Ord
Unit 34
Sand Gilia
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 50 100 200 300 400
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3J4A8
B3J4A0
B3J5A4
B3J5A5
B3J5A6
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B3I5J6
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B3I4H8
B3I4H0
B3I5H1
B3I5H2
B3I4G8
B3I4G9
B3I4G0
B3I5G1
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B3I4F9
B3I4F0
B3I5F2
B3I5F3
B3I4E7
B3I4E8
B3I4E9
B3I4E0
B3I5E2
B3I5E3
B3I5E4
B3I4D7
B3I4D9
B3I4D0
B3I5D3
B3I5D4

Map A2-13


Fort Ord
Unit 34
Seaside Bird's-beak
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 50 100 200 300 400
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
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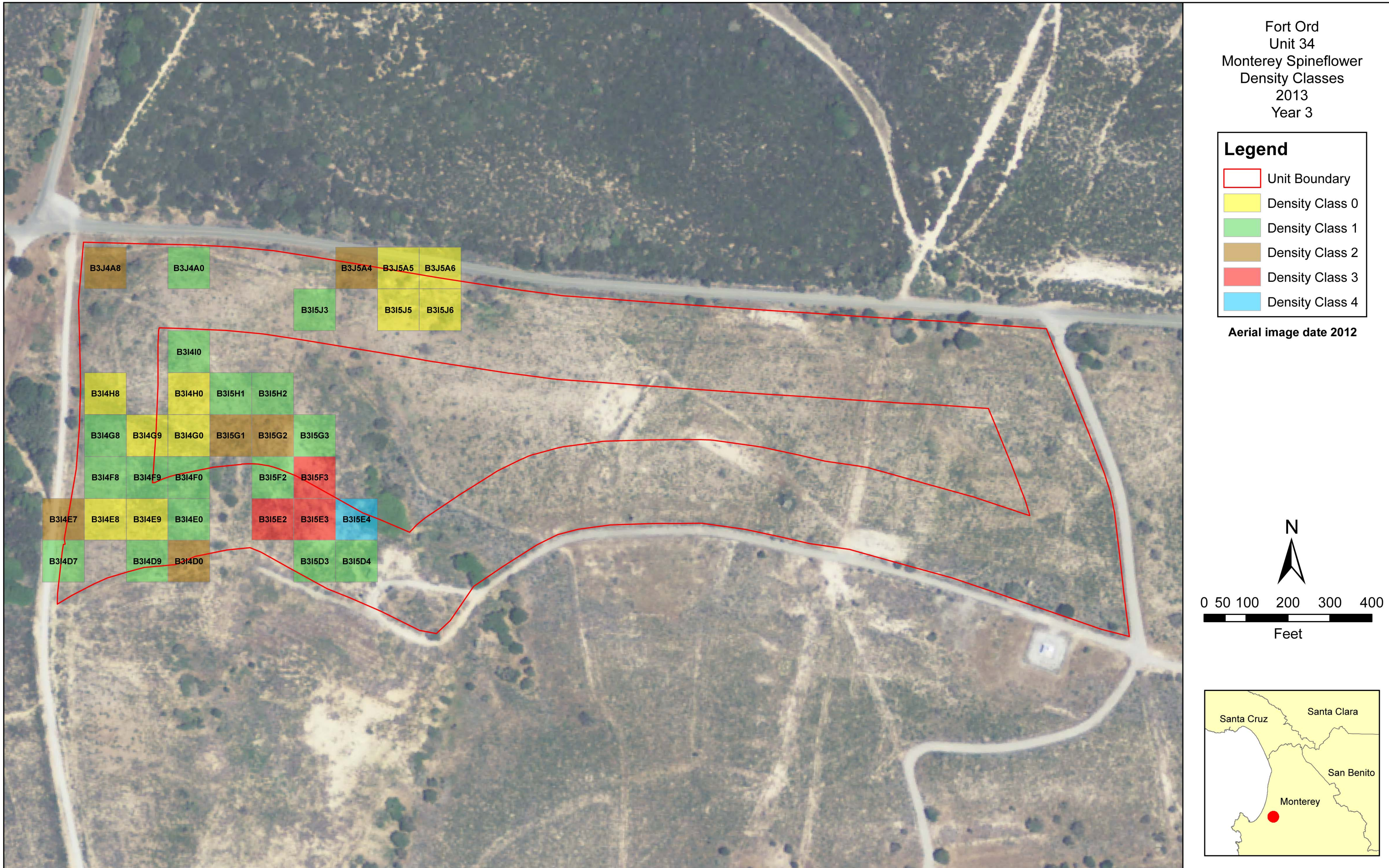
B3J4A0
B3J5A4
B3J5A5
B3J5A6
B3I5J3
B3I5J5
B3I5J6
B3I4I0
B3I4H8
B3I4H0
B3I5H1
B3I5H2
B3I4G8
B3I4G9
B3I4G0
B3I5G1
B3I5G2
B3I5G3
B3I4F8
B3I4F9
B3I4F0
B3I5F2
B3I5F3
B3I4E7
B3I4E8
B3I4E9
B3I4E0
B3I5E2
B3I5E3
B3I5E4
B3I4D7
B3I4D9
B3I4D0
B3I5D3
B3I5D4

Map A2-14

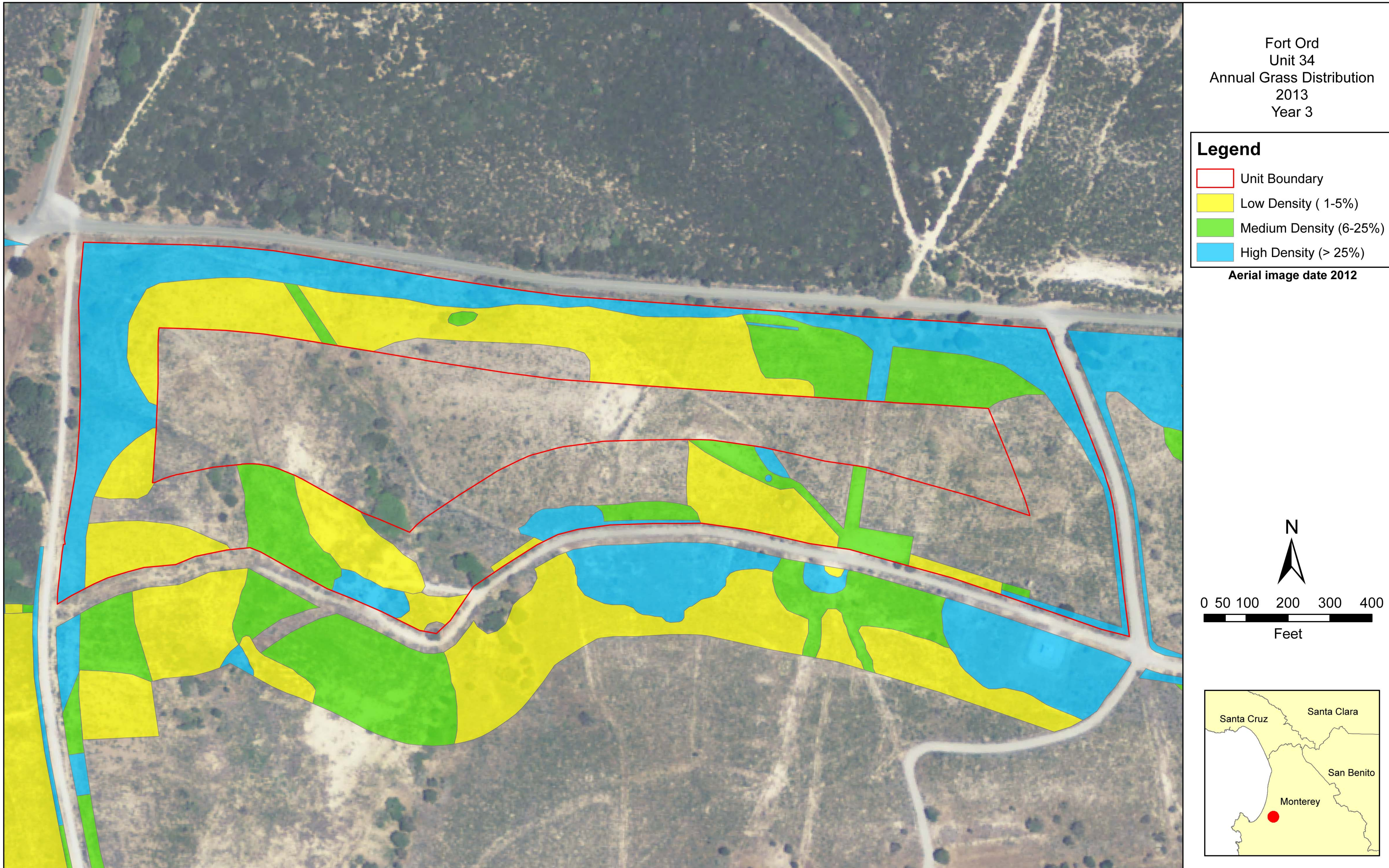


Fort Ord
Unit 34
Monterey Spineflower
Density Classes
2013
Year 3
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 50 100 200 300 400
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3J4A8
B3J4A0
B3J5A4
B3J5A5
B3J5A6
B3I5J3
B3I5J5
B3I5J6
B3I4I0
B3I4H8
B3I4H0
B3I5H1
B3I5H2
B3I4G8
B3I4G9
B3I4G0
B3I5G1
B3I5G2
B3I5G3
B3I4F8
B3I4F9
B3I4F0
B3I5F2
B3I5F3
B3I4E7
B3I4E8
B3I4E9
B3I4E0
B3I5E2
B3I5E3
B3I5E4
B3I4D7
B3I4D9
B3I4D0
B3I5D3
B3I5D4

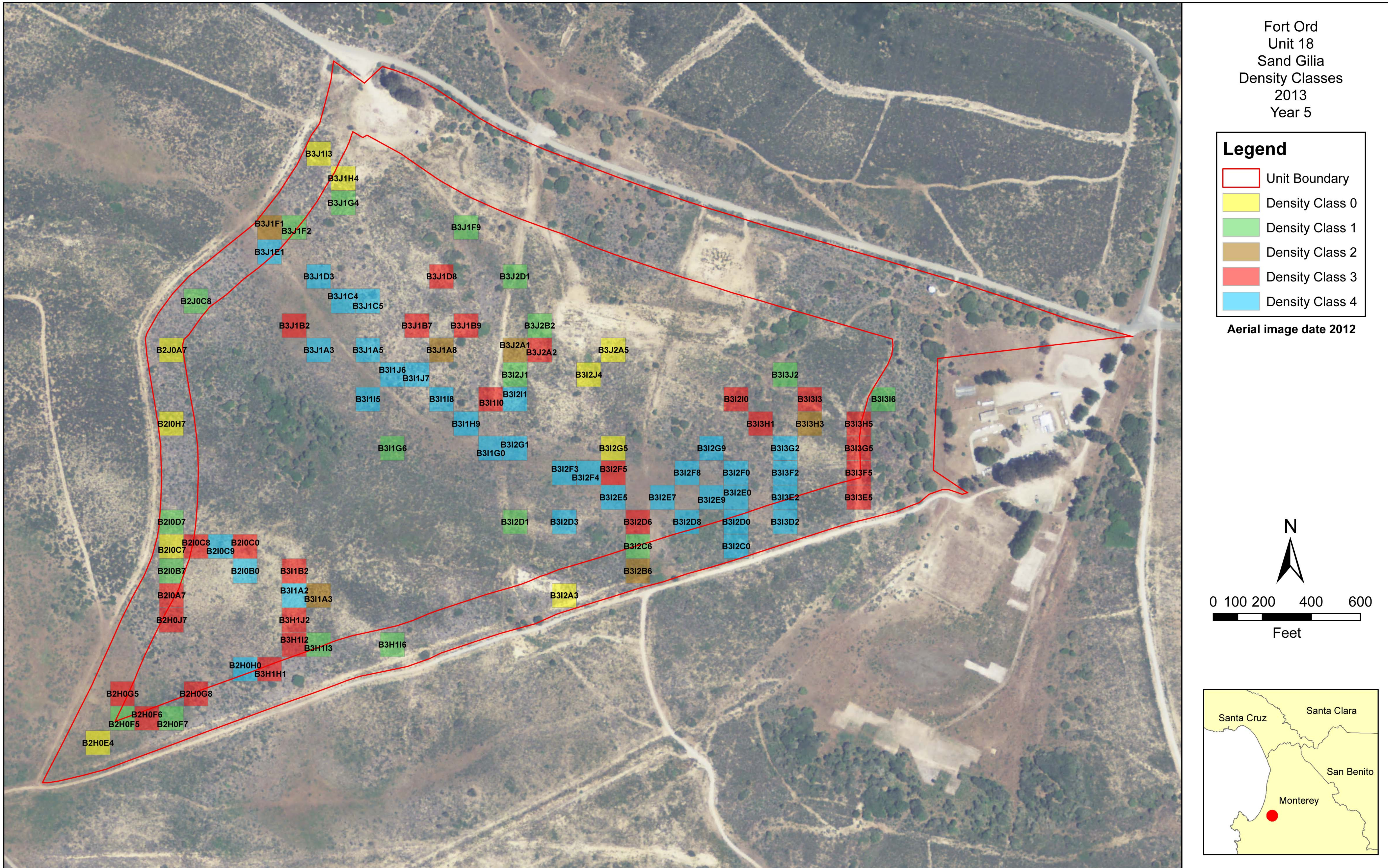
Map A2-15


34-1
34-2
34-4
34-3
Fort Ord
Unit 34
Vegetation Transect Locations
2013
Year 3
Legend
Vegetation Transect
Unit Boundary
Aerial image date 2012
N
0 50 100 200 300 400
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

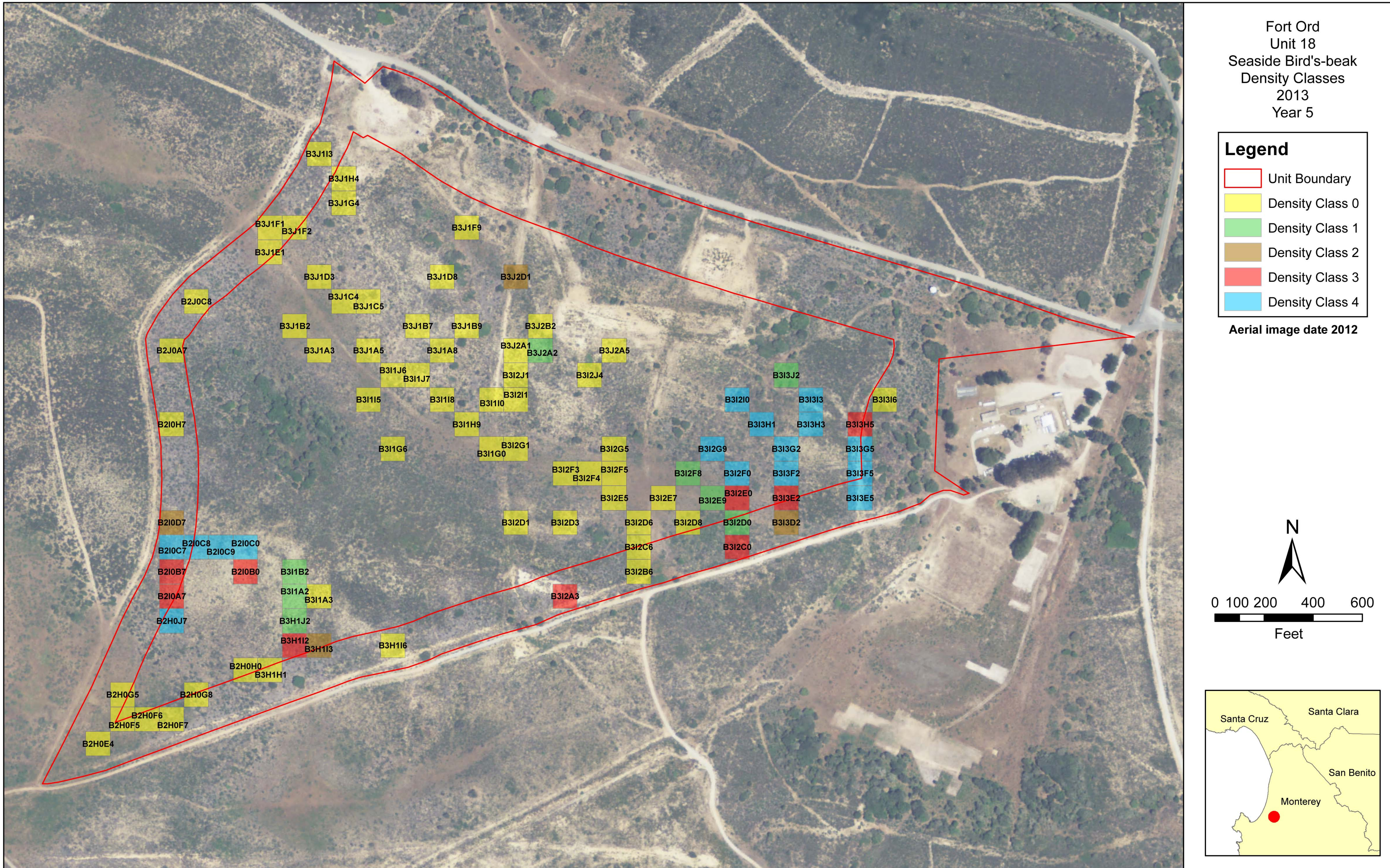
Map A2-16

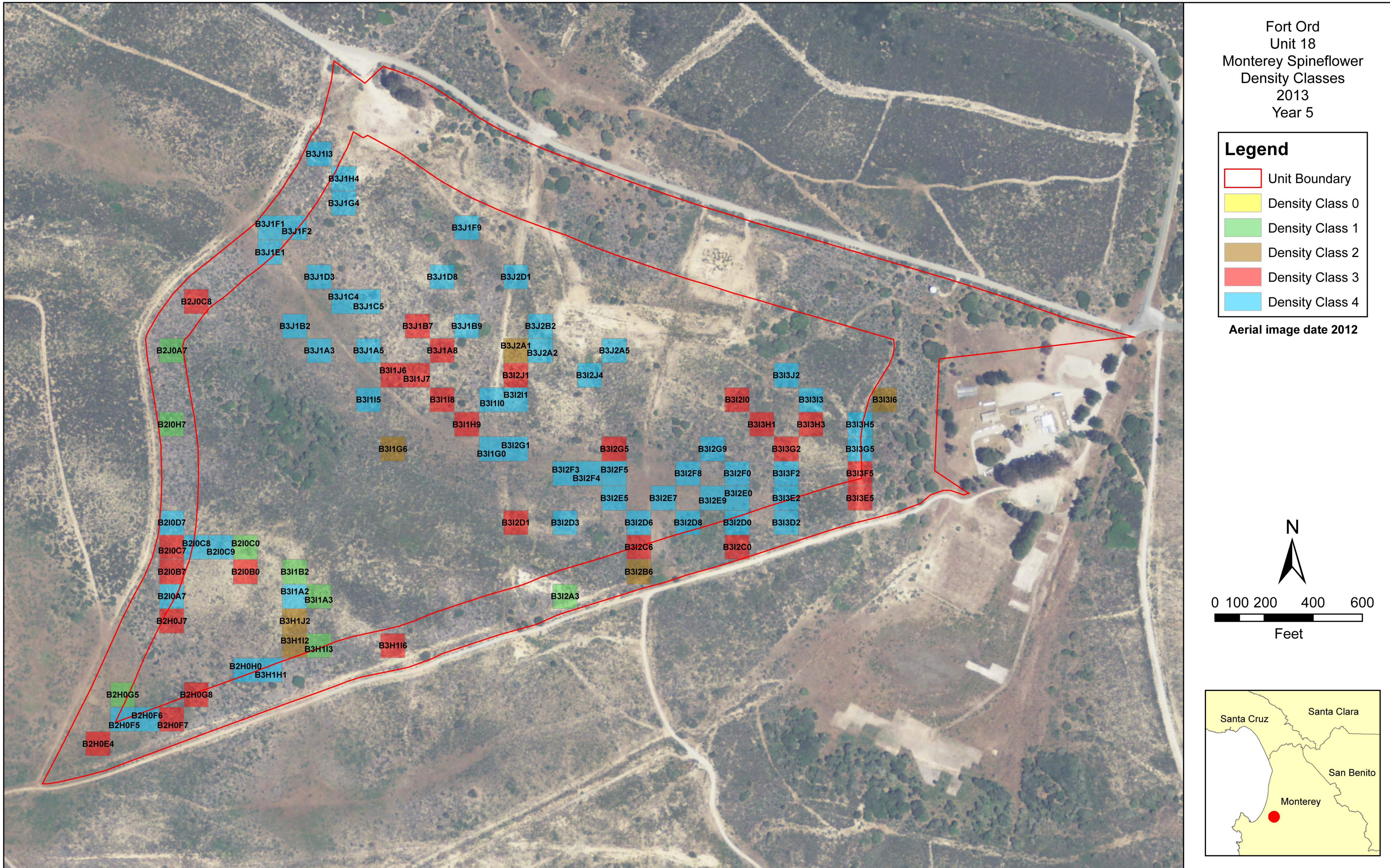

Fort Ord
Unit 34
Annual Grass Distribution
2013
Year 3
Legend
Unit Boundary
Low Density (1-5%)
Medium Density (6-25%)
High Density (> 25%)
Aerial image date 2012
N
0 50 100 200 300 400
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A2-17


Fort Ord
Unit 18
Sand Gilia
Density Classes
2013
Year 5
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 100 200 400 600
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3J1I3
B3J1H4
B3J1G4
B3J1F1
B3J1F2
B3J1E1
B3J1F9
B3J1D3
B3J1D8
B3J2D1
B3J1C4
B3J1C5
B2J0C8
B3J1B2
B3J1B7
B3J1B9
B3J2B2
B2J0A7
B3J1A3
B3J1A5
B3J1A8
B3J2A1
B3J2A2
B3J2A5
B3I1J6
B3I1J7
B3I2J1
B3I2J4
B3I3J2
B3I1I5
B3I1I8
B3I1I0
B3I2I1
B3I2I0
B3I3I3
B3I3I6
B2I0H7
B3I1H9
B3I3H1
B3I3H3
B3I3H5
B3I1G6
B3I1G0
B3I2G1
B3I2G5
B3I2G9
B3I3G2
B3I3G5
B3I2F3
B3I2F4
B3I2F5
B3I2F8
B3I2F0
B3I3F2
B3I3F5
B3I2E5
B3I2E7
B3I2E9
B3I2E0
B3I3E2
B3I3E5
B2I0D7
B3I2D1
B3I2D3
B3I2D6
B3I2D8
B3I2D0
B3I3D2
B2I0C7
B2I0C8
B2I0C9
B2I0C0
B3I2C6
B3I2C0
B2I0B7
B2I0B0
B3I1B2
B3I2B6
B2I0A7
B3I1A2
B3I1A3
B3I2A3
B2H0J7
B3H1J2
B3H1I2
B3H1I3
B3H1I6
B2H0H0
B3H1H1
B2H0G5
B2H0G8
B2H0F6
B2H0F5
B2H0F7
B2H0E4

Map A3-1


Fort Ord
Unit 18
Seaside Bird's-beak
Density Classes
2013
Year 5
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 100 200 400 600
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3J1I3
B3J1H4
B3J1G4
B3J1F1
B3J1F2
B3J1E1
B3J1F9
B3J1D3
B3J1D8
B3J2D1
B2J0C8
B3J1C4
B3J1C5
B3J1B2
B3J1B7
B3J1B9
B3J2B2
B2J0A7
B3J1A3
B3J1A5
B3J1A8
B3J2A1
B3J2A2
B3J2A5
B3I1J6
B3I1J7
B3I2J1
B3I2J4
B3I3J2
B3I1I5
B3I1I8
B3I1I0
B3I2I1
B3I2I0
B3I3I3
B3I3I6
B2I0H7
B3I1H9
B3I3H1
B3I3H3
B3I3H5
B3I1G6
B3I1G0
B3I2G1
B3I2G5
B3I2G9
B3I3G2
B3I3G5
B3I2F3
B3I2F4
B3I2F5
B3I2F8
B3I2F0
B3I3F2
B3I3F5
B3I2E0
B3I2E5
B3I2E7
B3I2E9
B3I3E2
B3I3E5
B2I0D7
B3I2D1
B3I2D3
B3I2D6
B3I2D8
B3I2D0
B3I3D2
B2I0C8
B2I0C0
B2I0C7
B2I0C9
B3I2C6
B3I2C0
B2I0B7
B2I0B0
B3I1B2
B3I2B6
B2I0A7
B3I1A2
B3I1A3
B3I2A3
B2H0J7
B3H1J2
B3H1I2
B3H1I3
B3H1I6
B2H0H0
B3H1H1
B2H0G5
B2H0G8
B2H0F6
B2H0F5
B2H0F7
B2H0E4
Map A3-2



Fort Ord
Unit 18
Monterey Spineflower
Density Classes
2013
Year 5
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 100 200 400 600
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

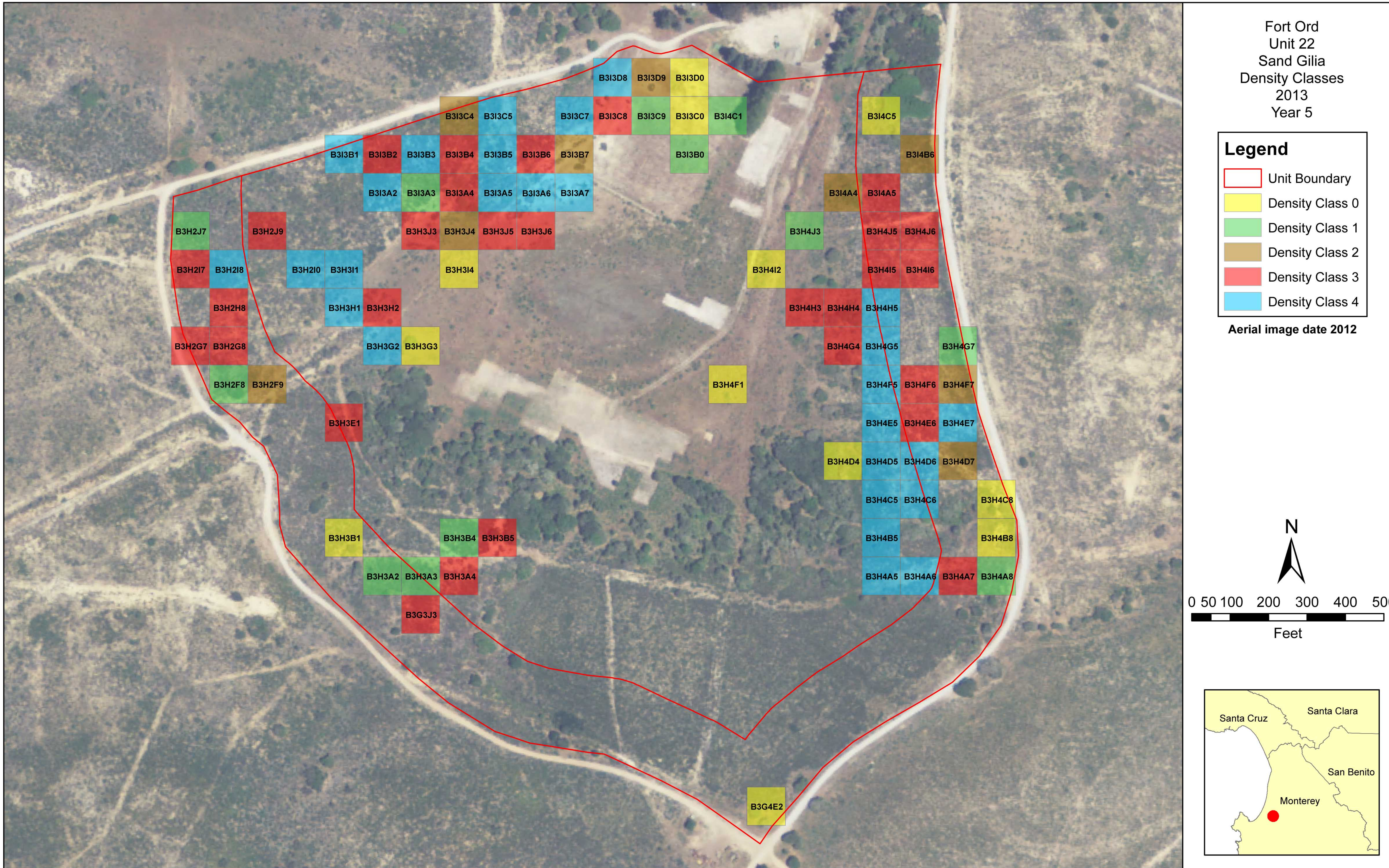
Map A3-3


Fort Ord
Unit 18
Vegetation Transect Locations
2013
Year 5
Legend
Vegetation Transect
Unit Boundary
Aerial image date 2012
N
0 100 200 400 600
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
T1
T2
T3
T4
T6
T7
T8
T10
T11
T19
T20
T21
T22
T23
T24
T25
T32
T33
T34
T35
T36

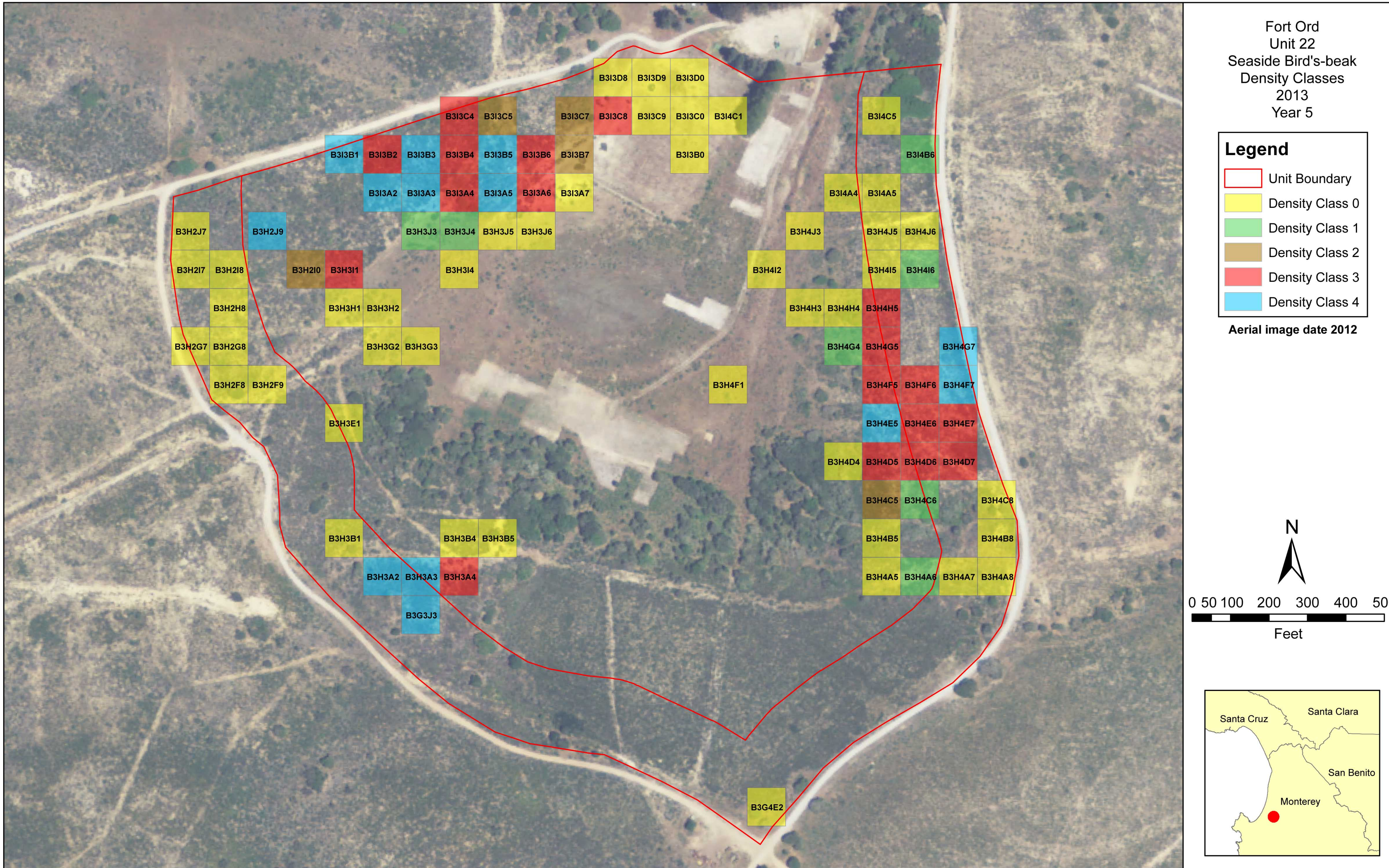
Map A3-4

Fort Ord
Unit 18
Annual Grass Distribution
2013
Year 5
Legend
Unit Boundary
Low Density (1-5%)
Medium Density (6-25%)
High Density (> 25%)
Aerial image date 2012
N
0 100 200 400 600
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

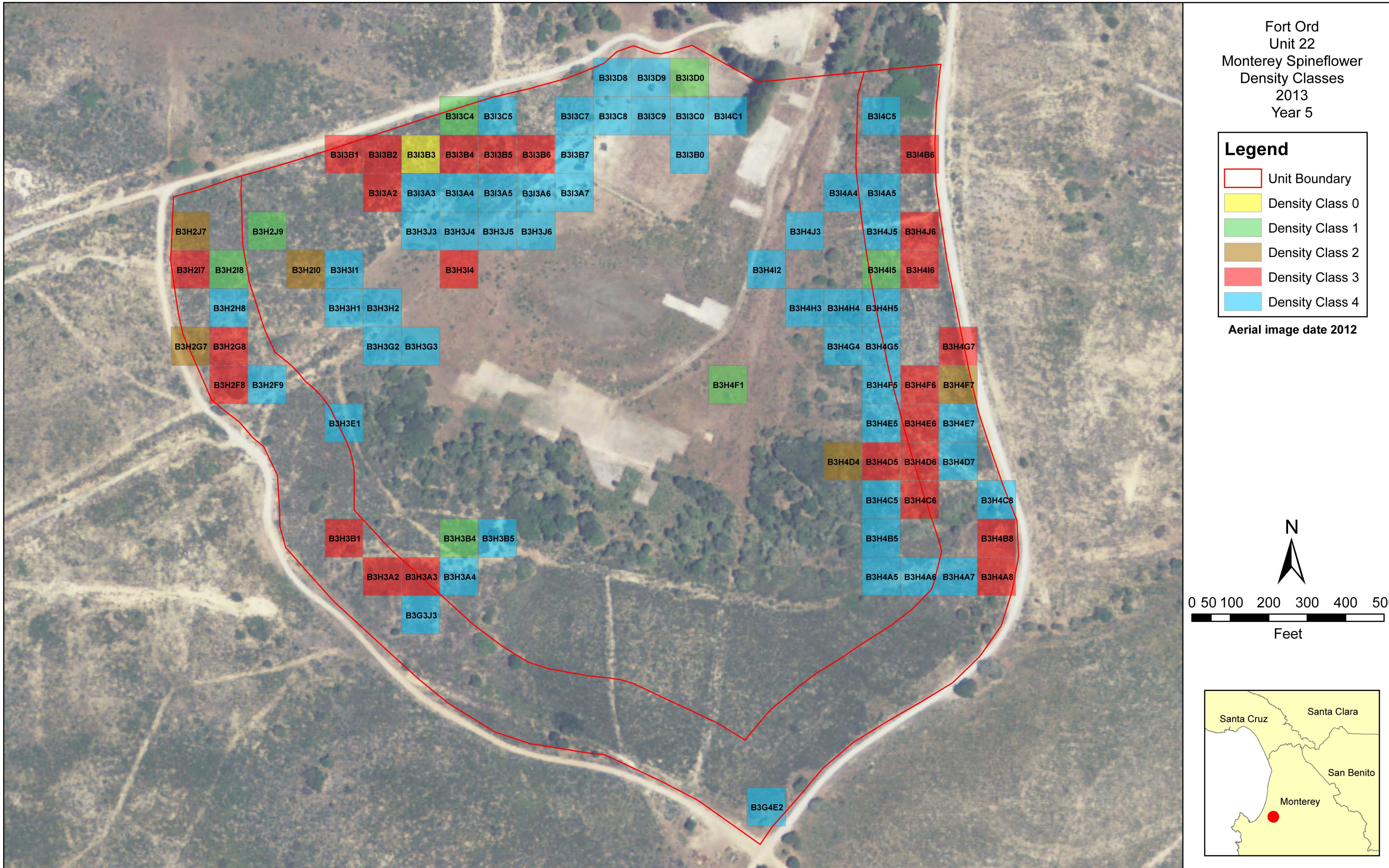
Map A3-5


Fort Ord
Unit 22
Sand Gilia
Density Classes
2013
Year 5
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 50 100 200 300 400 500
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3I3D8
B3I3D9
B3I3D0
B3I3C4
B3I3C5
B3I3C7
B3I3C8
B3I3C9
B3I3C0
B3I4C1
B3I4C5
B3I3B1
B3I3B2
B3I3B3
B3I3B4
B3I3B5
B3I3B6
B3I3B7
B3I3B0
B3I4B6
B3I3A2
B3I3A3
B3I3A4
B3I3A5
B3I3A6
B3I3A7
B3I4A4
B3I4A5
B3H2J7
B3H2J9
B3H3J3
B3H3J4
B3H3J5
B3H3J6
B3H4J3
B3H4J5
B3H4J6
B3H2I7
B3H2I8
B3H2I0
B3H3I1
B3H3I4
B3H4I2
B3H4I5
B3H4I6
B3H2H8
B3H3H1
B3H3H2
B3H4H3
B3H4H4
B3H4H5
B3H2G7
B3H2G8
B3H3G2
B3H3G3
B3H4G4
B3H4G5
B3H4G7
B3H2F8
B3H2F9
B3H4F1
B3H4F5
B3H4F6
B3H4F7
B3H3E1
B3H4E5
B3H4E6
B3H4E7
B3H4D4
B3H4D5
B3H4D6
B3H4D7
B3H4C5
B3H4C6
B3H4C8
B3H3B1
B3H3B4
B3H3B5
B3H4B5
B3H4B8
B3H3A2
B3H3A3
B3H3A4
B3H4A5
B3H4A6
B3H4A7
B3H4A8
B3G3J3
B3G4E2

Map A3-6


Fort Ord
Unit 22
Seaside Bird's-beak
Density Classes
2013
Year 5
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 50 100 200 300 400 500
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3I3D8 B3I3D9 B3I3D0
B3I3C4 B3I3C5 B3I3C7 B3I3C8 B3I3C9 B3I3C0 B3I4C1 B3I4C5
B3I3B1 B3I3B2 B3I3B3 B3I3B4 B3I3B5 B3I3B6 B3I3B7 B3I3B0 B3I4B6
B3I3A2 B3I3A3 B3I3A4 B3I3A5 B3I3A6 B3I3A7 B3I4A4 B3I4A5
B3H2J7 B3H2J9 B3H3J3 B3H3J4 B3H3J5 B3H3J6 B3H4J3 B3H4J5 B3H4J6
B3H2I7 B3H2I8 B3H2I0 B3H3I1 B3H3I4 B3H4I2 B3H4I5 B3H4I6
B3H2H8 B3H3H1 B3H3H2 B3H4H3 B3H4H4 B3H4H5
B3H2G7 B3H2G8 B3H3G2 B3H3G3 B3H4G4 B3H4G5 B3H4G7
B3H2F8 B3H2F9 B3H4F1 B3H4F5 B3H4F6 B3H4F7
B3H3E1 B3H4E5 B3H4E6 B3H4E7
B3H4D4 B3H4D5 B3H4D6 B3H4D7
B3H4C5 B3H4C6 B3H4C8
B3H3B1 B3H3B4 B3H3B5 B3H4B5 B3H4B8
B3H3A2 B3H3A3 B3H3A4 B3H4A5 B3H4A6 B3H4A7 B3H4A8
B3G3J3
B3G4E2

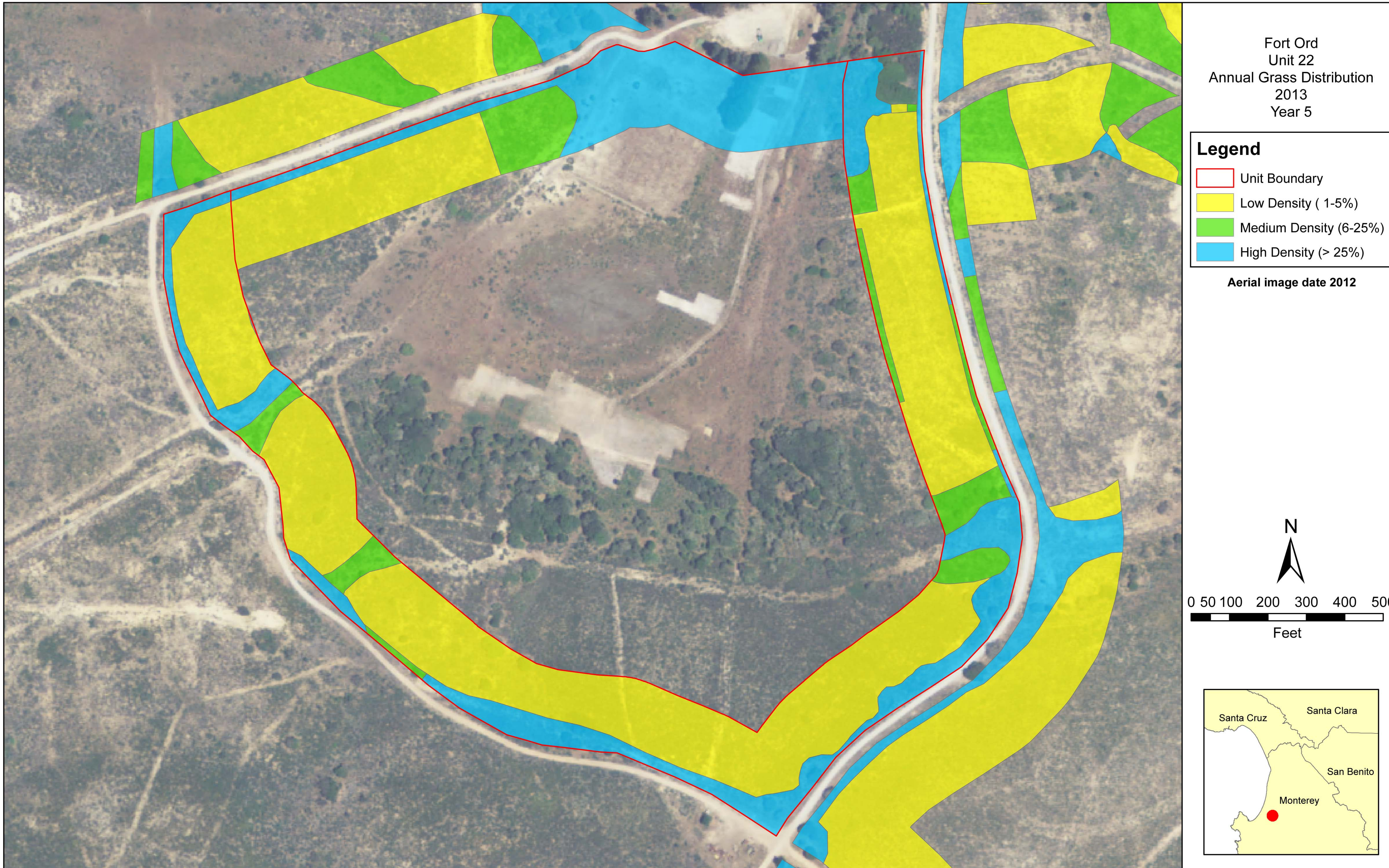
Map A3-7


Fort Ord
Unit 22
Monterey Spineflower
Density Classes
2013
Year 5
Legend
Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 50 100 200 300 400 500
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
B3I3D8
B3I3D9
B3I3D0
B3I3C4
B3I3C5
B3I3C7
B3I3C8
B3I3C9
B3I3C0
B3I4C1
B3I4C5
B3I3B1
B3I3B2
B3I3B3
B3I3B4
B3I3B5
B3I3B6
B3I3B7
B3I3B0
B3I4B6
B3I3A2
B3I3A3
B3I3A4
B3I3A5
B3I3A6
B3I3A7
B3I4A4
B3I4A5
B3H2J7
B3H2J9
B3H3J3
B3H3J4
B3H3J5
B3H3J6
B3H4J3
B3H4J5
B3H4J6
B3H2I7
B3H2I8
B3H2I0
B3H3I1
B3H3I4
B3H4I2
B3H4I5
B3H4I6
B3H2H8
B3H3H1
B3H3H2
B3H4H3
B3H4H4
B3H4H5
B3H2G7
B3H2G8
B3H3G2
B3H3G3
B3H4G4
B3H4G5
B3H4G7
B3H2F8
B3H2F9
B3H4F1
B3H4F5
B3H4F6
B3H4F7
B3H3E1
B3H4E5
B3H4E6
B3H4E7
B3H4D4
B3H4D5
B3H4D6
B3H4D7
B3H4C5
B3H4C6
B3H4C8
B3H3B1
B3H3B4
B3H3B5
B3H4B5
B3H4B8
B3H3A2
B3H3A3
B3H3A4
B3H4A5
B3H4A6
B3H4A7
B3H4A8
B3G3J3
B3G4E2

Map A3-8

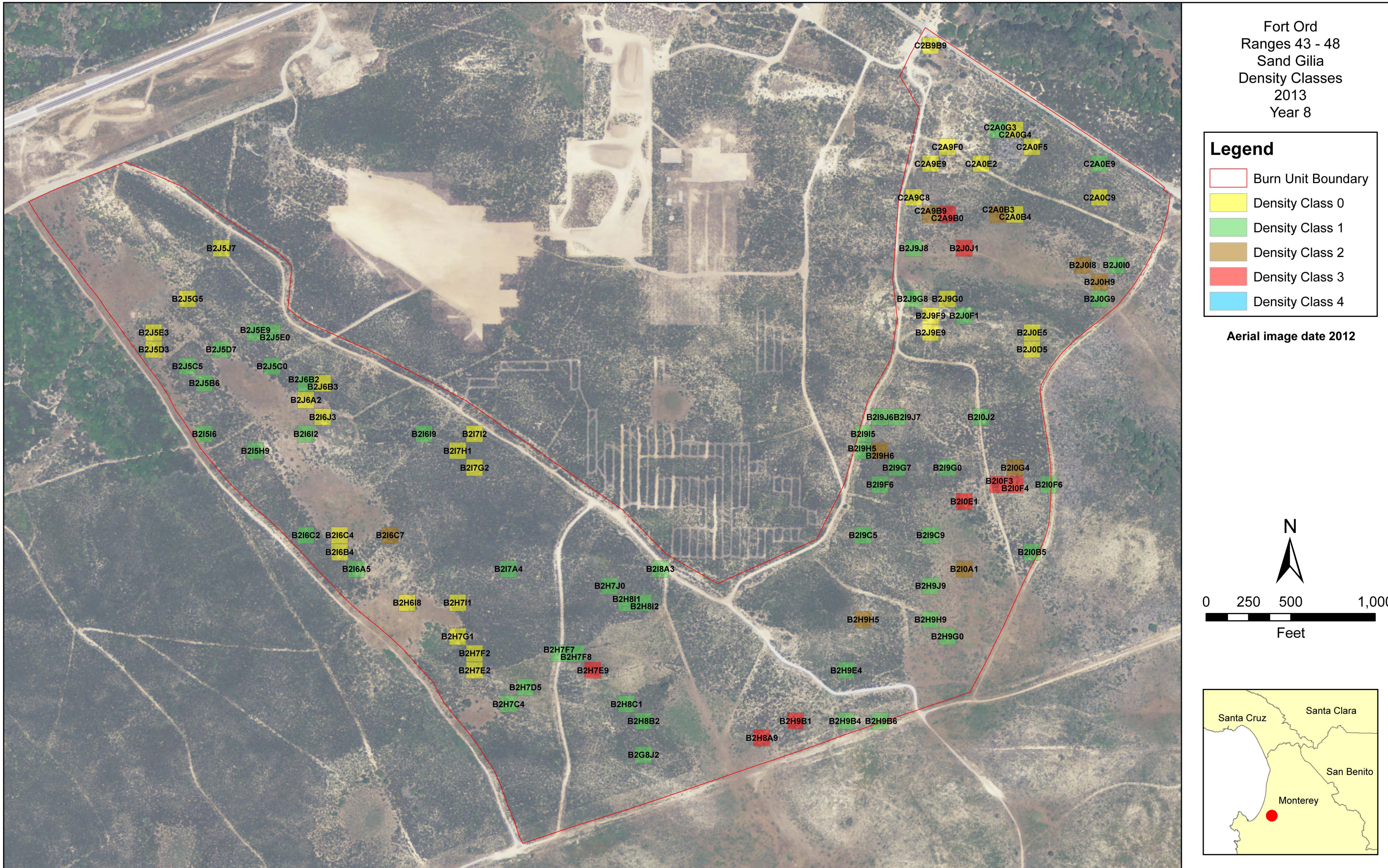

Fort Ord
Unit 22
Vegetation Transect Locations
2013
Year 5
Legend
Vegetation Transect
Unit Boundary
Aerial image date 2012
N
0 50 100 200 300 400 500
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
T9
T12
T13
T14
T15
T16
T17
T18
T26
T27
T28
T29
T30
T31

Map A3-9



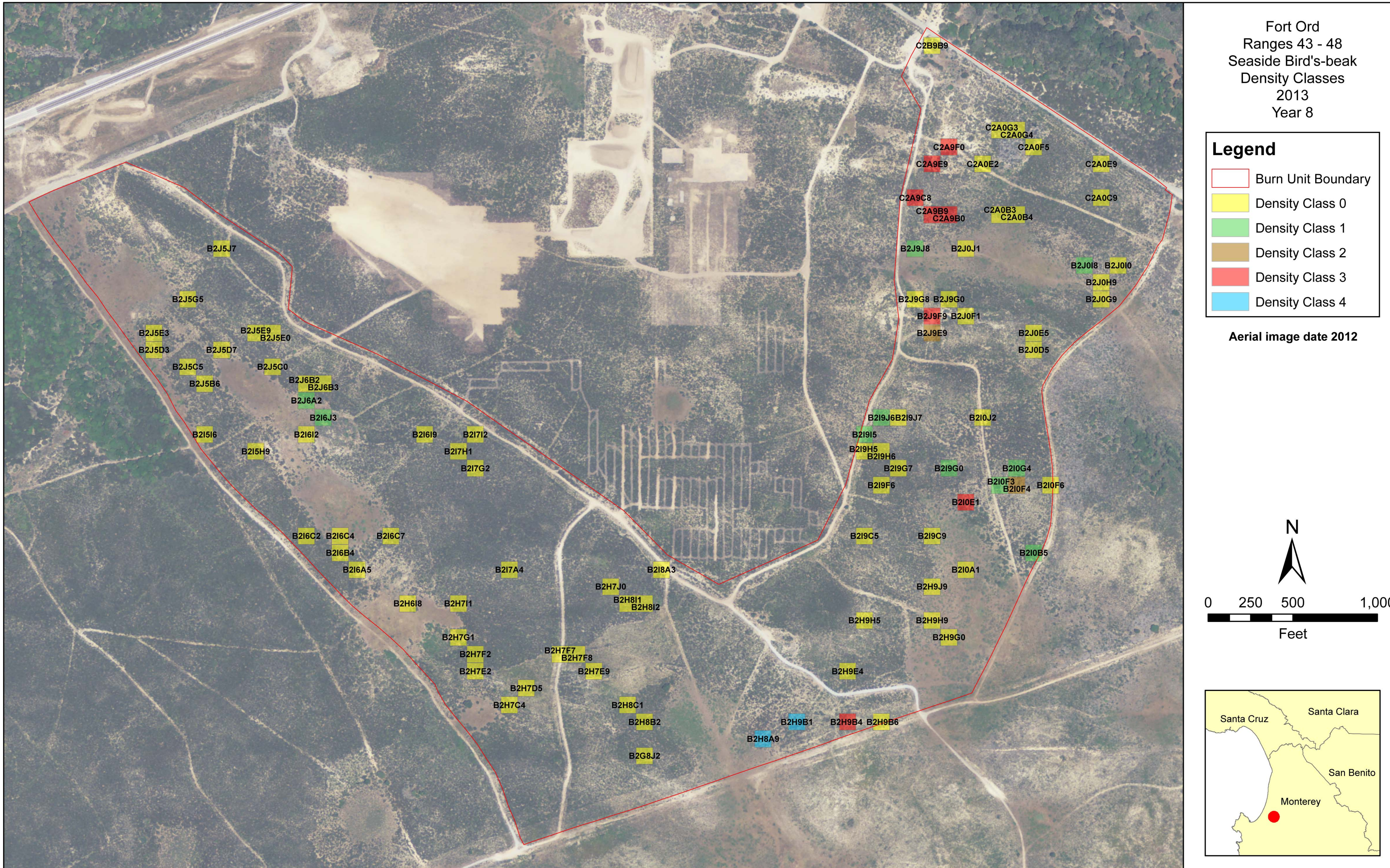
Fort Ord
Unit 22
Annual Grass Distribution
2013
Year 5
Legend
Unit Boundary
Low Density (1-5%)
Medium Density (6-25%)
High Density (> 25%)
Aerial image date 2012
N
0 50 100 200 300 400 500
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A3-10

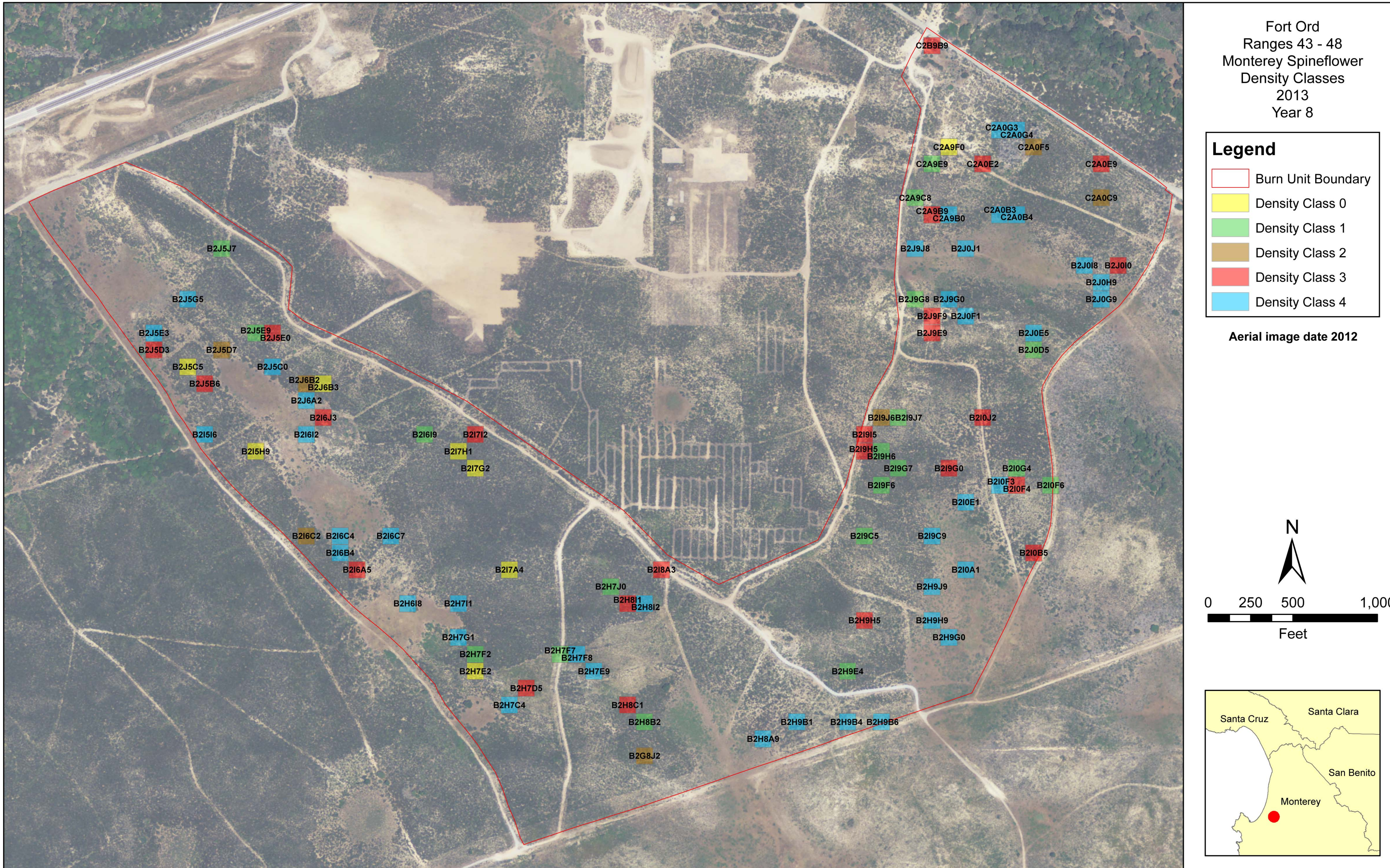


Fort Ord
Ranges 43 - 48
Sand Gilia
Density Classes
2013
Year 8
Legend
Burn Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 250 500 1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A4-1


Fort Ord
Ranges 43 - 48
Seaside Bird's-beak
Density Classes
2013
Year 8
Legend
Burn Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0
250
500
1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
C2B9B9
C2A0G3
C2A0G4
C2A9F0
C2A0F5
C2A9E9
C2A0E2
C2A0E9
C2A9C8
C2A0C9
C2A9B9
C2A9B0
C2A0B3
C2A0B4
B2J9J8
B2J0J1
B2J0I8
B2J0I0
B2J0H9
B2J9G8
B2J9G0
B2J0G9
B2J9F9
B2J0F1
B2J9E9
B2J0E5
B2J0D5
B2J5J7
B2J5G5
B2J5E3
B2J5E9
B2J5E0
B2J5D3
B2J5D7
B2J5C5
B2J5C0
B2J5B6
B2J6B2
B2J6B3
B2J6A2
B2I6J3
B2I5I6
B2I6I2
B2I6I9
B2I7I2
B2I5H9
B2I7H1
B2I7G2
B2I9J6
B2I9J7
B2I0J2
B2I9I5
B2I9H5
B2I9H6
B2I9G7
B2I9G0
B2I0G4
B2I0F3
B2I0F4
B2I0F6
B2I9F6
B2I0E1
B2I6C2
B2I6C4
B2I6C7
B2I6B4
B2I6A5
B2I7A4
B2I8A3
B2I9C5
B2I9C9
B2I0B5
B2I0A1
B2H7J0
B2H9J9
B2H6I8
B2H7I1
B2H8I1
B2H8I2
B2H9H5
B2H9H9
B2H7G1
B2H9G0
B2H7F7
B2H7F8
B2H7F2
B2H7E2
B2H7E9
B2H9E4
B2H7D5
B2H7C4
B2H8C1
B2H8B2
B2H9B1
B2H9B4
B2H9B6
B2H8A9
B2G8J2

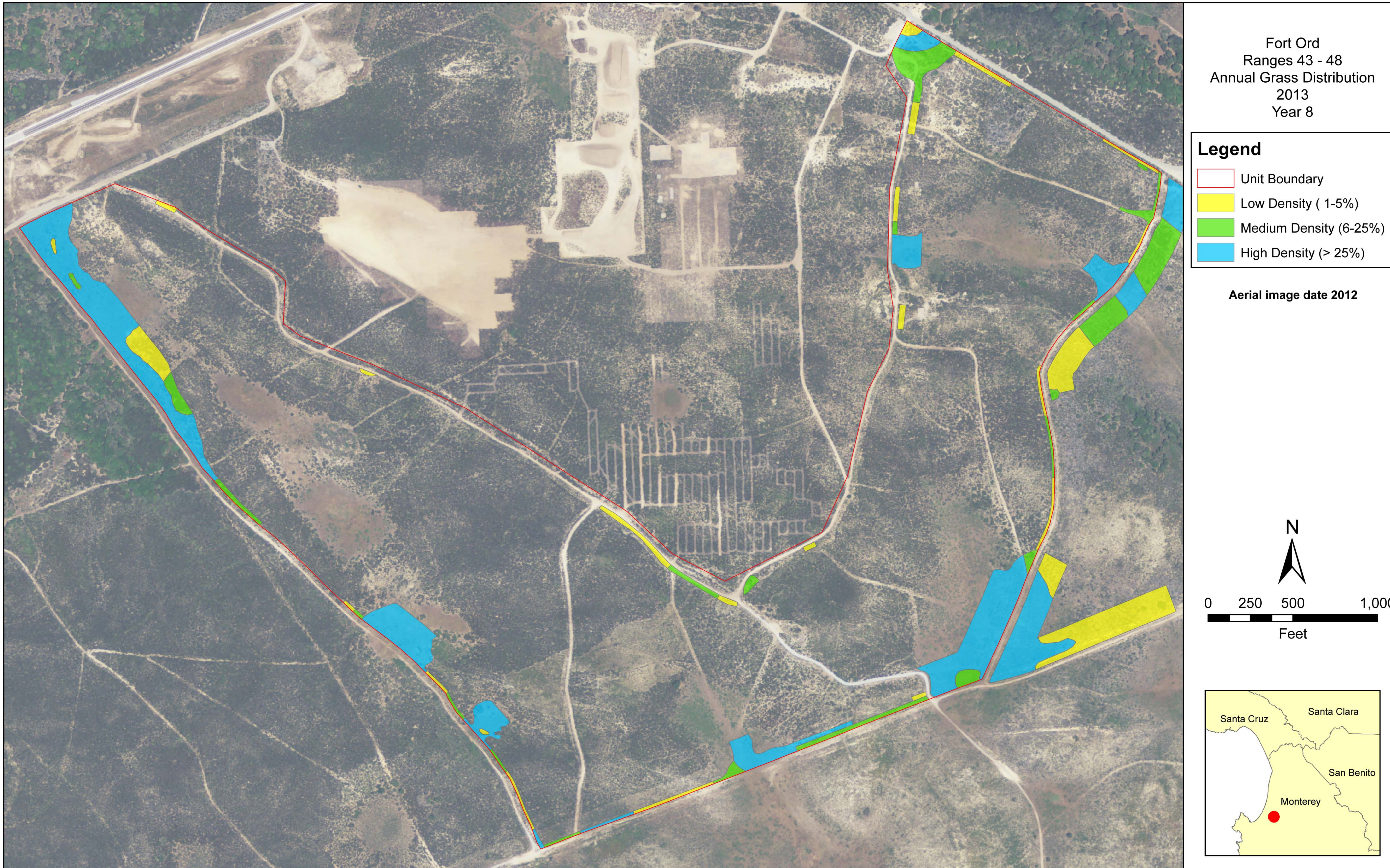
Map A4-2


Fort Ord
Ranges 43 - 48
Monterey Spineflower
Density Classes
2013
Year 8
Legend
Burn Unit Boundary
Density Class 0
Density Class 1
Density Class 2
Density Class 3
Density Class 4
Aerial image date 2012
N
0 250 500 1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A4-3

Fort Ord
Ranges 43 - 48
Vegetation Transect Locations
2013
Year 8
Legend
Vegetation Transect
Burn Unit Boundary
Aerial image date 2012
N
0 250 500 1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
BH1
16-1
16-3
BA9
16-2
BA10
BA6
BA20
1-2
BA4
BA11
BA8
BC3
BA2
BA7
BC5
BG6
BE22
BE6
BE23
20-1
BE4
20-2
BE1
BE3
BE25
BE2
BE8
BE9
BE5
BE21
BE7
1-5
BE24

Map A4-4


Fort Ord
Ranges 43 - 48
Annual Grass Distribution
2013
Year 8
Legend
Unit Boundary
Low Density (1-5%)
Medium Density (6-25%)
High Density (> 25%)
Aerial image date 2012
N
0
250
500
1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A4-5


Fort Ord
Unit 07
Invasive Weeds
2013
Baseline
Legend
Unit Boundary
Pampas Grass
Yellow Star Thistle
Aerial image date 2012
N
0 200 400 600 800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A5-1


Fort Ord
Unit 15
Invasive Weeds
2013
Year 3
Legend
Unit Boundary
Pampas Grass
Yellow Star Thistle
Aerial image date 2012
N
0 200 400 600 800 1,000
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A5-2


Fort Ord
Unit 18
Invasive Weeds
2013
Year 5
Legend
Unit Boundary
Pampas Grass
Yellow Star Thistle
Aerial image date 2012
N
0 100 200 400 600
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A5-3


Fort Ord
Unit 21
Invasive Weeds
2013
Year 3
Legend
Unit Boundary
Pampas Grass
Yellow Star Thistle
Aerial image date 2012
N
0
200
400
600
800
Feet
Santa Cruz
Santa Clara
San Benito
Monterey
Map A5-4


Fort Ord
Unit 34
Invasive Weeds
2013
Year 3
Legend
Unit Boundary
Pampas Grass
Yellow Star Thistle
Aerial image date 2012
N
0 50 100 200 300 400
Feet
Santa Cruz
Santa Clara
San Benito
Monterey

Map A5-5

APPENDIX B

Shrub Transect Data

Appendix B-1
Baseline Transects, Units 5E, 23E and 7

		Unit 5E	Unit 23E	Unit 7				
Code	Species	5E-1	23E-1	7-1	7-2	7-3	7-4	7-5
ADFA	*Adenostoma fasciculatum*	9.80	15.00	9.80	50.60	21.40	5.40	26.80
ARHO	*Arctostaphylos hookeri ssp. hookeri*	42.80	0.00	2.20	0.00	0.00	0.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.00	32.20	0.00
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	27.60	88.20	90.60	35.40	94.40	75.40	46.40
BAPI	*Baccharis pilularis*	0.00	12.00	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	0.00	0.00	0.00	0.40	1.00	0.00	0.00
CERI	*Ceanothus rigidus*	0.00	0.00	0.00	7.60	2.00	0.00	4.20
ERCO	*Eriophyllum confertiflorum*	0.20	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.80	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	3.20	0.00	0.00	7.20	0.00	17.20
HEAR	*Heteromeles arbutifolia*	1.20	0.00	0.00	0.00	0.00	0.00	5.20
HESC	*Helianthemum scoparium*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LECA	*Lepechinia calycina*	0.00	1.80	0.00	0.00	0.00	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.80	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	2.60	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	5.20	10.00	0.40	8.20	4.80	10.60	3.60
TODI	*Toxicodendron diversilobum*	0.80	0.00	0.00	0.00	2.20	0.00	0.00
BG	Bare ground	20.40	3.00	4.00	9.60	1.20	2.20	6.60
HERB	Herbaceous vegetation	0.40	0.00	0.00	0.00	0.00	0.00	0.00

Appendix B-1
Baseline Transects, Units 5E, 23E and 7

		Unit 7						
Code	Species	7-6	7-7	7-8	7-9	7-10	7-11	7-12
ADFA	*Adenostoma fasciculatum*	45.60	65.80	62.60	13.40	25.80	29.40	90.80
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	3.60	0.00	0.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	58.60	53.80	44.80	80.00	44.40	80.80	12.00
BAPI	*Baccharis pilularis*	0.00	2.60	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	0.00	0.00	0.00	1.00	0.20	0.00	0.00
CERI	*Ceanothus rigidus*	3.60	19.40	1.20	1.00	3.20	0.20	10.60
ERCO	*Eriophyllum confertiflorum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	3.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00	0.00	4.60	0.00	2.40	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	4.40	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LECA	*Lepechinia calycina*	0.00	0.00	0.00	1.00	0.00	1.40	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	11.60	12.40	0.60	0.00	11.20	5.40	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.00	9.20	0.00	1.00	0.00
BG	Bare ground	5.60	0.20	18.80	2.40	27.00	1.00	3.60
HERB	Herbaceous vegetation	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix B-1

Baseline Transects, Units 5E, 23E and 7

		Unit 7						
Code	Species	7-13	7-14	7-15	7-16	7-17	7-18	7-19
ADFA	*Adenostoma fasciculatum*	20.80	84.20	46.20	17.60	21.60	47.00	18.20
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	70.20	25.80	45.80	63.60	70.00	37.00	59.40
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	0.80	0.00	0.00	0.00	0.00	0.00	0.00
CERI	*Ceanothus rigidus*	4.60	0.00	9.00	2.80	1.40	3.40	7.60
ERCO	*Eriophyllum confertiflorum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	4.20	0.00	0.00	0.00	0.00	0.00	20.80
HEAR	*Heteromeles arbutifolia*	2.40	0.00	0.00	1.40	1.60	0.00	16.80
HESC	*Helianthemum scoparium*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LECA	*Lepechinia calycina*	1.80	0.00	0.00	0.00	0.00	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	0.00	0.00	0.00	0.00	1.60	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	4.20	0.00	18.00	23.20	7.20	22.00	9.60
TODI	*Toxicodendron diversilobum*	4.60	7.20	0.00	0.40	0.00	0.00	0.00
BG	Bare ground	7.00	1.00	10.80	14.60	11.20	12.40	0.00
HERB	Herbaceous vegetation	0.00	0.00	0.00	0.00	0.20	0.00	0.00

Appendix B-1

Baseline Transects, Units 5E, 23E and 7

		Unit 7						
Code	Species	7-20	7-21	7-22	7-23	7-24	7-25	7-26
ADFA	*Adenostoma fasciculatum*	31.00	29.60	35.80	14.00	34.40	23.20	18.80
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	75.00	58.00	48.20	61.00	67.20	83.60	72.00
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	0.00	0.00	0.00	0.80	0.00	0.00	0.40
CERI	*Ceanothus rigidus*	0.40	5.20	2.00	0.80	3.00	3.60	2.80
ERCO	*Eriophyllum confertiflorum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	7.40	10.80	0.40	0.80	1.40	2.40	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	2.40	13.80	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LECA	*Lepechinia calycina*	0.00	0.00	0.00	1.40	0.00	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.00	9.40	19.60	1.60	12.80	7.00	3.80
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.00	0.40	0.00	0.00	0.00
BG	Bare ground	3.80	7.80	13.80	17.20	11.40	2.20	11.40
HERB	Herbaceous vegetation	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix B-1
Baseline Transects, Units 5E, 23E and 7

		Unit 7				
Code	Species	7-27	7-T2	7-T26-1	7-T26-2	7-T26-3
ADFA	*Adenostoma fasciculatum*	30.40	34.20	45.60	24.40	27.60
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	0.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.00
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.00	0.00	3.40
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	68.40	42.40	14.40	44.80	70.20
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.80
CEDE	*Ceanothus dentatus*	0.00	0.00	1.00	0.00	0.60
CERI	*Ceanothus rigidus*	6.80	0.00	1.80	0.00	8.20
ERCO	*Eriophyllum confertiflorum*	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00	0.00	0.00	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.00	0.00	0.00	0.40	0.00
LECA	*Lepechinia calycina*	0.80	1.60	2.40	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	18.40	9.80	0.00	11.20	9.20
TODI	*Toxicodendron diversilobum*	0.40	0.00	0.00	0.00	0.00
BG	Bare ground	5.20	26.20	40.00	30.60	5.00
HERB	Herbaceous vegetation	0.00	0.00	0.00	0.00	0.00

Appendix B2
Year 3 Transects, Units 15, 21, 32, and 34

		Unit 15							
Code	Species	15-1	15-10	15-11	15-12	15-13	15-14	15-15	15-16
ADFA	*Adenostoma fasciculatum*	10.00	2.00	3.60	18.60	21.40	13.00	0.80	9.20
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARPU	*Arctostaphylos pumila*	6.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	2.20	21.80	21.40	8.40	11.00	17.60	18.20	18.00
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	3.00	0.00	1.00	0.00	0.00	0.20	0.00	0.00
CEDE	*Ceanothus dentatus*	0.00	33.20	7.00	11.60	24.00	19.00	46.60	30.00
CERI	*Ceanothus rigidus*	0.20	0.00	9.80	17.60	13.80	13.40	1.40	6.20
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COJU	*Cortaderia jubata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCA	*Eriodictyon californicum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	2.00	1.20	0.00	8.00	3.80	5.60	4.00	0.20
ERER	*Ericameria ericoides*	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	1.80	10.20	6.20	4.00	0.00	0.20	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	1.60	16.20	6.40	0.40	3.40	7.40	6.40	13.20
LECA	*Lepechinia calycina*	0.00	0.00	0.40	1.80	0.60	0.00	0.00	0.40
LOSC	*Acimispon glaber (=Lotus scoparius)*	11.80	1.40	3.60	0.40	0.00	3.60	1.20	0.80
LUAL	*Lupinus albifrons*	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	2.00	0.00	0.00	0.20	0.00	0.00	1.20	0.00
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROCA	*Rosa californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUUR	*Rubus ursinus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SALA	*Salix lasiolepsis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.40	0.60	0.60	0.40	2.20	4.20	1.40	1.80
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.40	0.00	0.00	1.20	4.80	0.00	0.00	0.00
VAOV	*Vaccinium ovatum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BG	Bare ground	60.00	38.80	46.00	32.00	27.80	31.40	29.40	32.40
HERB	Herbaceous vegetation	2.20	0.00	1.20	1.20	1.40	0.40	1.00	0.20

Appendix B2

Year 3 Transects, Units 15, 21, 32, and 34

		Unit 15							
Code	Species	15-17	15-18	15-19	15-2	15-20	15-21	15-3	15-4
ADFA	*Adenostoma fasciculatum*	13.00	1.20	19.80	1.20	11.20	2.60	8.20	1.80
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	0.00	0.20	0.00	0.00	1.40
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	2.80	0.00	0.00	0.00
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	17.00	14.60	15.00	0.00	10.60	14.60	36.00	8.20
BAPI	*Baccharis pilularis*	0.60	0.00	0.40	0.00	12.80	0.00	0.20	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.60	0.00	1.40	0.00	0.20	1.20
CEDE	*Ceanothus dentatus*	19.60	55.20	29.60	0.00	31.60	59.40	0.80	37.80
CERI	*Ceanothus rigidus*	22.60	2.80	18.00	0.00	25.40	10.80	0.80	1.80
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COJU	*Cortaderia jubata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCA	*Eriodictyon californicum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	0.00	0.20	1.00	2.80	0.40	0.00	3.60	1.80
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	1.00	0.00	0.20	0.00	0.20	0.20	1.00	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	1.80	3.20	1.20	0.80
HESC	*Helianthemum scoparium*	0.60	6.40	12.60	0.00	14.00	6.20	0.20	6.60
LECA	*Lepechinia calycina*	17.60	0.00	3.00	0.00	0.40	0.60	2.80	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	5.60	2.80	0.00	3.40	6.40	0.00	8.60	0.40
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	1.80	0.00	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	0.40	0.00	0.00	0.00	1.20	0.00	0.00	0.00
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROCA	*Rosa californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUUR	*Rubus ursinus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SALA	*Salix lasiolepsis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	1.80	2.00	2.60	0.00	0.60	0.20	6.40	1.80
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	6.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	9.40	1.20	0.00	0.00	0.00	0.00	0.00	0.00
VAOV	*Vaccinium ovatum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BG	Bare ground	18.40	27.40	21.60	76.40	16.40	20.40	34.60	41.20
HERB	Herbaceous vegetation	0.00	0.00	0.00	8.60	0.00	0.00	4.00	2.40

Appendix B2
Year 3 Transects, Units 15, 21, 32, and 34

		Unit 15					Unit 21		
Code	Species	15-5	15-6	15-7	15-8	15-9	21-1	21-10	21-11
ADFA	*Adenostoma fasciculatum*	11.00	7.80	4.60	4.00	26.40	9.00	0.00	3.60
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	19.00	10.80	16.80	11.20	4.60	17.20	4.80	16.40
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.00	0.00	2.60	17.40	8.40
CEDE	*Ceanothus dentatus*	17.40	1.40	21.00	16.80	0.80	13.40	0.00	22.00
CERI	*Ceanothus rigidus*	3.80	0.20	1.20	5.00	12.20	4.60	0.00	18.20
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COJU	*Cortaderia jubata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCA	*Eriodictyon californicum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	4.40	2.00	4.80	4.00	8.20	5.20	1.60	0.40
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00	0.00	1.00	0.00	2.00	0.00	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	3.80	5.60	18.60	13.40	16.60	9.00	4.00	14.00
LECA	*Lepechinia calycina*	0.80	0.00	0.00	1.20	2.40	3.20	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.20	14.00	1.40	11.80	40.00	1.80	20.00	0.60
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROCA	*Rosa californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUUR	*Rubus ursinus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SALA	*Salix lasiolepsis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.80	0.20	1.60	3.60	0.20	0.60	1.60	0.40
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.00	0.00	0.40	1.20	0.00	0.00
VAOV	*Vaccinium ovatum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BG	Bare ground	42.60	58.20	39.20	38.80	18.80	43.60	46.20	26.20
HERB	Herbaceous vegetation	2.20	3.80	1.20	0.40	3.80	3.00	10.80	2.40

Appendix B2
Year 3 Transects, Units 15, 21, 32, and 34

Code	Species	Unit 21							
		21-12	21-13	21-14	21-15	21-2	21-3	21-4	21-5
ADFA	*Adenostoma fasciculatum*	3.60	4.00	9.60	12.60	7.60	2.60	6.80	29.00
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	0.00	0.00	0.00	0.60	1.80
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.00	0.00	2.20	4.00	18.40	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	22.80	14.00	19.20	6.80	0.00	3.00	0.00	13.60
BAPI	*Baccharis pilularis*	0.00	0.00	0.40	0.60	0.00	0.00	0.00	0.60
CAED	*Carpobrotus edulis*	0.00	0.40	0.00	0.00	0.40	1.40	0.00	0.00
CEDE	*Ceanothus dentatus*	49.00	37.00	40.00	29.20	0.00	0.00	14.60	0.00
CERI	*Ceanothus rigidus*	3.20	2.60	2.80	1.00	0.00	0.00	0.20	0.40
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COJU	*Cortaderia jubata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCA	*Eriodictyon californicum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	4.80	4.60	2.00	2.80	1.60	1.40	1.40	9.40
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	7.80	0.00	0.00	3.40	0.00	0.00	4.00	8.40
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	1.20	14.20	32.00	13.80	0.40	3.00	3.60	0.60
LECA	*Lepechinia calycina*	1.00	0.20	0.40	0.60	0.00	0.00	0.20	8.20
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	1.40	2.80	5.00	17.60	15.40	0.00	9.80
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	0.00	0.00	0.00	0.00	3.20	0.40	0.00	2.40
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	6.20	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROCA	*Rosa californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUUR	*Rubus ursinus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SALA	*Salix lasiolepsis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	3.20	0.00	0.00	4.60	0.00	0.00	0.00	8.60
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.20	1.60	8.20	0.00	0.00	2.40
VAOV	*Vaccinium ovatum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BG	Bare ground	19.80	27.00	15.80	29.20	57.60	67.80	53.20	32.40
HERB	Herbaceous vegetation	3.60	5.20	1.20	4.40	6.60	2.20	2.00	3.60

Appendix B2
Year 3 Transects, Units 15, 21, 32, and 34

		Unit 21				Unit 32			
Code	Species	21-6	21-7	21-8	21-9	32-1	32-2	32-3	32-4
ADFA	*Adenostoma fasciculatum*	21.20	0.00	1.60	1.80	8.80	5.20	4.80	5.80
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00
ARPU	*Arctostaphylos pumila*	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	1.40	18.40	11.40	12.00	9.80	29.20	38.60	29.60
BAPI	*Baccharis pilularis*	0.20	0.60	0.00	0.00	3.60	1.00	0.00	0.80
CAED	*Carpobrotus edulis*	9.40	0.40	0.40	4.40	3.40	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	0.00	27.40	20.60	25.20	12.00	4.00	0.00	0.20
CERI	*Ceanothus rigidus*	31.40	3.00	1.20	7.40	0.40	0.60	0.00	0.60
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COJU	*Cortaderia jubata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCA	*Eriodictyon californicum*	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	0.00	0.00	5.20	0.00	1.00	0.80	2.00	0.60
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
GAEL	*Garrya elliptica*	0.00	10.40	2.80	1.60	6.00	1.00	0.00	0.40
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	3.80	6.00	8.40	20.40	1.20	2.60	0.00	0.40
LECA	*Lepechinia calycina*	2.00	1.40	1.00	0.00	0.00	0.00	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	4.80	2.20	11.40	4.80	1.80	0.00	1.60	3.80
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	1.00	0.00	0.00	0.40	0.00	0.00	0.00	1.20
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	0.00	12.00	0.00	0.60
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	1.00	4.00
ROCA	*Rosa californica*	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
RUUR	*Rubus ursinus*	0.00	0.00	0.00	0.00	5.00	2.80	0.20	0.00
SALA	*Salix lasiolepsis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.00	0.00	1.60	0.00	1.40	4.00	0.00	0.00
SOUM	*Solanum umbeliiferum*	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	2.60	0.00	0.00	0.00	3.40	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.80	1.20	0.00	0.00	0.00	0.00	0.00	0.00
VAOV	*Vaccinium ovatum*	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00
BG	Bare ground	31.20	37.40	41.00	34.40	42.00	43.00	42.40	43.20
HERB	Herbaceous vegetation	6.00	2.60	6.00	0.40	14.00	1.20	14.60	18.00

Appendix B2

Year 3 Transects, Units 15, 21, 32, and 34

Code	Species	Unit 34			
		34-1	34-2	34-3	34-4
ADFA	*Adenostoma fasciculatum*	0.20	1.20	0.40	0.80
ARHO	*Arctostaphylos hookeri ssp. hookeri*	0.00	0.00	1.00	0.00
ARMO	*Arctostaphylos montereyensis*	0.00	0.20	0.60	0.00
ARPU	*Arctostaphylos pumila*	1.80	3.00	0.00	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	2.60	6.00	5.00	10.80
BAPI	*Baccharis pilularis*	0.00	0.00	0.40	0.00
CAED	*Carpobrotus edulis*	4.60	11.20	7.60	0.00
CEDE	*Ceanothus dentatus*	0.00	0.00	37.40	37.20
CERI	*Ceanothus rigidus*	14.00	3.00	5.40	1.80
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.20
COJU	*Cortaderia jubata*	0.00	0.00	0.00	0.60
ERCA	*Eriodictyon californicum*	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	0.20	0.40	1.40	0.00
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00	0.00	3.40
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	3.80	7.20	12.20	14.00
LECA	*Lepechinia calycina*	0.00	0.00	2.80	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	1.60	2.80	0.20	0.00
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	0.00	0.00	0.00	0.00
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00
ROCA	*Rosa californica*	0.00	0.00	0.00	0.00
RUUR	*Rubus ursinus*	0.20	0.00	0.00	0.00
SALA	*Salix lasiolepsis*	0.00	0.00	0.00	0.60
SAME	*Salvia mellifera*	0.00	0.00	0.00	0.00
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.00	0.00
VAOV	*Vaccinium ovatum*	0.00	0.00	0.00	0.00
BG	Bare ground	61.40	61.80	31.40	39.20
HERB	Herbaceous vegetation	13.00	3.20	10.00	3.20

Appendix B3

Year 5 Transects, Units 18 and 22

Code	Species	Unit 18						
		T1	T10	T11	T19	T2	T20	T21
ADFA	*Adenostoma fasciculatum*	7.20	3.80	8.60	2.60	0.00	2.20	1.80
ARPU	*Arctostaphylos pumila*	5.80	0.00	4.80	8.00	14.80	1.40	1.40
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	5.20	1.40	32.80	17.60	3.40	3.00	22.60
BAPI	*Baccharis pilularis*	0.00	0.00	1.00	0.00	0.00	0.80	2.80
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.00	0.00	3.00	0.00
CEDE	*Ceanothus dentatus*	0.00	0.00	0.00	1.40	3.40	5.60	0.00
CERI	*Ceanothus rigidus*	0.00	0.00	3.60	2.20	0.00	2.40	0.00
ERCO	*Eriophyllum confertiflorum*	1.40	2.40	1.40	4.00	1.60	2.00	0.00
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	3.20	0.00	0.00	0.00	0.00	0.00	0.20
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.00	1.40	4.40	4.20	3.40	21.80	0.00
LECA	*Lepechinia calycina*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.40	2.80	0.60	4.20	2.40	8.60	0.00
LUAL	*Lupinus albifrons*	15.20	3.40	0.00	0.00	0.00	0.00	0.20
MIAU	*Mimulus aurantiacus*	0.00	0.00	1.00	1.40	0.00	0.60	0.60
QUAG	*Quercus agrifolia*	0.40	0.00	15.00	0.00	0.00	0.00	9.40
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.00	3.80	3.80	0.40	0.00	0.00	0.00
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00	0.00	0.00	11.40
TODI	*Toxicodendron diversilobum*	2.40	1.80	0.00	2.40	0.00	0.00	0.00
BG	Bare ground	51.00	59.00	29.80	50.20	69.80	51.00	45.80
HERB	Herbaceous vegetation	15.80	21.80	0.80	8.40	1.20	3.40	20.80

Appendix B3
Year 5 Transects, Units 18 and 22

		Unit 18						
Code	Species	T22	T23	T24	T25	T3	T32	T33
ADFA	*Adenostoma fasciculatum*	8.80	16.20	25.80	24.60	6.20	3.00	9.60
ARPU	*Arctostaphylos pumila*	10.00	0.00	2.60	6.60	3.60	4.40	2.40
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	17.20	3.60	18.00	0.00	12.40	13.40	7.20
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.20	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	0.80	0.00	0.00	0.00	7.00	0.00	0.00
CERI	*Ceanothus rigidus*	4.40	0.00	8.00	4.00	4.80	0.00	7.00
ERCO	*Eriophyllum confertiflorum*	6.80	0.40	1.60	1.60	2.80	0.00	2.80
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.00	1.80
GAEL	*Garrya elliptica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.00	0.00	0.00	3.80	0.00	0.00	2.60
LECA	*Lepechinia calycina*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	9.20	5.80	0.20	10.80	1.40	0.00	1.80
LUAL	*Lupinus albifrons*	0.00	3.20	1.80	0.00	0.00	1.20	3.40
MIAU	*Mimulus aurantiacus*	0.00	1.40	0.00	1.80	0.40	0.00	0.00
QUAG	*Quercus agrifolia*	0.00	8.80	0.00	2.60	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	3.80	3.20	0.00	0.00	2.00	0.00	0.00
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.20	0.00	0.00	0.40	0.00
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00	0.00	0.60	0.00
TODI	*Toxicodendron diversilobum*	2.60	0.00	0.00	0.00	0.00	4.60	1.80
BG	Bare ground	47.60	55.20	43.00	47.60	61.80	56.20	64.60
HERB	Herbaceous vegetation	0.80	5.80	7.20	0.00	2.40	20.00	0.20

Appendix B3
Year 5 Transects, Units 18 and 22

		Unit 18						
Code	Species	T34	T35	T36	T4	T6	T7	T8
ADFA	*Adenostoma fasciculatum*	24.20	3.40	8.80	0.60	10.80	4.60	0.00
ARPU	*Arctostaphylos pumila*	2.40	0.20	0.40	8.40	1.40	1.20	10.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	26.40	0.60	4.00	0.00	33.20	26.00	38.80
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	3.80	4.20	0.00	0.00	1.60	13.20	0.00
CERI	*Ceanothus rigidus*	6.00	2.20	5.00	3.60	0.00	5.00	1.80
ERCO	*Eriophyllum confertiflorum*	1.80	4.40	3.00	0.00	0.20	0.00	1.00
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.80	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00	0.00	0.00	0.00	3.40	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	8.60	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.60	20.60	9.40	0.00	1.40	3.60	0.00
LECA	*Lepechinia calycina*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	7.20	1.40	0.00	0.80	1.60	0.00
LUAL	*Lupinus albifrons*	0.00	0.60	0.00	0.00	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	0.00	0.00	1.40	0.00	0.00	0.00	0.00
QUAG	*Quercus agrifolia*	0.00	0.00	1.20	0.00	0.00	1.80	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	2.40	0.00	0.00	1.20
SAME	*Salvia mellifera*	0.00	5.80	0.00	0.00	0.00	0.20	0.00
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	4.40	0.00	0.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	3.00	0.00	12.60	0.00	0.00
BG	Bare ground	39.60	51.60	55.80	53.80	49.40	44.40	46.00
HERB	Herbaceous vegetation	2.40	6.80	4.40	30.60	3.20	0.00	3.60

Appendix B3
Year 5 Transects, Units 18 and 22

		Unit 22						
Code	Species	T12	T13	T14	T15	T16	T17	T22-18
ADFA	*Adenostoma fasciculatum*	1.40	18.20	15.20	8.80	55.60	4.20	54.40
ARPU	*Arctostaphylos pumila*	3.40	0.00	13.60	7.00	0.00	0.00	0.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	19.80	9.80	7.60	8.20	6.40	30.80	10.00
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	2.20	0.00	1.40
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	0.00	0.00	0.00	0.00	0.00	5.20	0.00
CERI	*Ceanothus rigidus*	0.00	2.20	0.00	0.00	34.80	6.80	33.20
ERCO	*Eriophyllum confertiflorum*	3.40	0.40	0.80	1.20	0.00	0.40	1.40
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00	0.00	0.00	0.20	0.00	0.00
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	3.80	2.20	0.00	1.00	0.00	8.00	0.20
LECA	*Lepechinia calycina*	0.00	0.00	0.00	0.00	0.20	3.40	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	16.80	0.00	11.60	4.00	0.60	6.60	0.60
LUAL	*Lupinus albifrons*	1.00	0.00	0.40	10.40	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	1.40	6.00	0.00	0.00	0.80	0.00	0.20
QUAG	*Quercus agrifolia*	0.00	2.20	0.00	0.00	0.60	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.00	12.40	0.00	1.20	0.00	17.40	0.00
SOUM	*Solanum umbeliiferum*	0.00	0.20	0.00	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00	0.80	0.00	0.00
TODI	*Toxicodendron diversilobum*	4.60	6.60	0.00	0.00	0.40	0.00	0.00
BG	Bare ground	46.00	41.00	48.00	48.80	17.60	26.60	11.60
HERB	Herbaceous vegetation	10.60	12.60	3.20	15.00	1.20	6.80	2.40

Appendix B3
Year 5 Transects, Units 18 and 22

Code	Species	Unit 22 T26	T27	T28	T29	T30	T31	T9
ADFA	*Adenostoma fasciculatum*	31.20	32.40	45.60	0.00	8.80	14.00	11.80
ARPU	*Arctostaphylos pumila*	0.00	0.00	0.20	7.00	1.80	3.60	0.80
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	33.20	27.00	7.60	10.00	15.20	28.00	28.60
BAPI	*Baccharis pilularis*	3.00	0.00	0.00	0.00	0.00	0.40	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	3.60	0.00	0.00	0.00	0.00	0.00	0.00
CERI	*Ceanothus rigidus*	18.20	20.60	22.60	0.60	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	1.60	1.40	3.40	6.60	2.20	3.00	6.80
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.40	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00	0.00	0.00	0.00	5.20	1.20
HEAR	*Heteromeles arbutifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.00	0.00	2.00	13.00	0.60	0.00	0.40
LECA	*Lepechinia calycina*	0.00	0.00	0.60	0.00	0.00	0.00	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	5.60	0.20	1.60	4.00	1.20	0.40	6.40
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	0.00	11.40	0.00	0.20
MIAU	*Mimulus aurantiacus*	0.20	0.00	0.00	0.60	0.00	0.00	1.20
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.00	0.00	0.00	3.40	0.00	0.00	0.00
SOUM	*Solanum umbeliiferum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYMO	*Symphoricarpos mollis*	12.00	0.00	0.00	0.00	0.00	8.60	3.20
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.00	2.00	3.80	2.00	6.00
BG	Bare ground	19.20	39.80	23.40	49.60	55.40	53.80	45.40
HERB	Herbaceous vegetation	3.20	0.00	1.00	5.80	6.00	5.20	1.80

Appendix B4

Year 10 Transects, Ranges 43-48

Code	Species	1-2	1-5	16-1	16-2	16-3	20-1	20-2
ADFA	*Adenostoma fasciculatum*	21.40	8.00	1.00	4.00	4.00	0.40	6.20
ARPU	*Arctostaphylos hookeri ssp. hookeri*	9.20	3.00	7.80	3.00	8.40	36.20	13.80
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	10.20	22.40	29.60	32.60	0.00	8.40	12.40
BAPI	*Baccharis pilularis*	0.60	2.00	0.00	0.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.20	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	3.20	24.80	5.20	8.40	28.00	7.20	3.80
CERI	*Ceanothus rigidus*	32.20	4.40	21.40	15.00	31.20	2.20	21.60
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	0.00	0.00	0.00	0.00	0.00	0.40	0.20
ERER	*Ericameria ericoides*	4.40	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	1.60	0.00	2.60	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.00	7.80	0.60	0.20	1.00	0.20	0.80
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	2.80	0.60	0.00	0.00	0.00	0.00
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	0.00	3.20	2.20	0.00
MIAU	*Mimulus aurantiacus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	1.20	0.00
SAME	*Salvia mellifera*	0.00	0.00	0.00	9.00	0.00	6.20	3.80
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BG	Bare ground	32.60	33.00	38.20	33.00	36.60	44.40	47.60
HERB	Herbaceous vegetation	0.00	6.20	0.00	0.00	7.20	1.00	2.00

Appendix B4
Year 10 Transects, Ranges 43-48

Code	Species	BA10	BA11	BA2	BA20	BA4	BA6
ADFA	*Adenostoma fasciculatum*	36.40	21.80	18.80	13.60	7.20	11.20
ARPU	*Arctostaphylos hookeri ssp. hookeri*	0.00	5.00	3.20	4.80	3.00	5.20
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	6.40	16.60	37.00	28.20	37.40	29.60
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	1.20	0.20	0.00
CEDE	*Ceanothus dentatus*	2.80	4.20	4.40	19.20	11.60	24.00
CERI	*Ceanothus rigidus*	25.40	22.60	30.40	7.60	4.60	9.40
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	0.20	0.00	0.00	0.00	0.00	0.00
ERER	*Ericameria ericoides*	0.00	0.60	5.40	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.40
GAEL	*Garrya elliptica*	0.00	0.00	0.00	0.60	6.60	0.00
HESC	*Helianthemum scoparium*	2.00	0.00	0.00	1.20	2.20	1.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.20	0.00	0.00	0.00	0.60	0.00
LUAL	*Lupinus albifrons*	6.80	0.00	0.00	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	0.00	0.00	0.00	0.20	0.40	0.00
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	0.00
SAME	*Salvia mellifera*	0.00	0.00	0.00	2.60	6.00	6.00
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.40	0.00	0.00	0.00
BG	Bare ground	31.40	39.60	16.80	34.20	31.60	28.80
HERB	Herbaceous vegetation	0.60	0.00	0.00	0.00	0.60	0.00

Appendix B4

Year 10 Transects, Ranges 43-48

Code	Species	BA7	BA8	BA9	BC3	BC5	BE1
ADFA	*Adenostoma fasciculatum*	8.60	3.60	3.20	1.20	7.20	11.40
ARPU	*Arctostaphylos hookeri ssp. hookeri*	1.80	19.40	0.40	5.80	4.00	20.40
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	26.40	23.20	60.80	18.80	26.40	16.80
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	12.80	4.60	0.00	23.80	3.40	0.00
CERI	*Ceanothus rigidus*	21.20	28.40	10.40	5.40	19.40	29.20
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.40
ERCO	*Eriophyllum confertiflorum*	0.00	0.00	0.00	0.00	0.20	0.00
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	4.00	0.00	0.00	0.00	0.00
HESC	*Helianthemum scoparium*	0.00	0.00	0.00	5.00	1.40	0.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	0.00	0.00	0.80	5.20	0.60
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	0.00	0.00	0.80
MIAU	*Mimulus aurantiacus*	0.00	0.00	0.00	0.00	0.00	0.00
QUAG	*Quercus agrifolia*	0.00	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00	0.00	0.00	0.00	1.40
SAME	*Salvia mellifera*	5.80	0.00	10.80	11.40	8.00	0.00
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.00	0.00	0.00	4.00
BG	Bare ground	32.60	28.20	28.00	39.00	33.20	32.20
HERB	Herbaceous vegetation	0.00	0.00	0.00	0.40	0.20	0.20

Appendix B4
Year 10 Transects, Ranges 43-48

Code	Species	BE2	BE21	BE22	BE23	BE24	BE25
ADFA	*Adenostoma fasciculatum*	5.80	22.80	30.40	15.00	3.00	2.20
ARPU	*Arctostaphylos hookeri ssp. hookeri*	6.60	2.40	3.80	0.00	0.00	13.60
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	19.00	25.00	36.60	37.20	38.00	5.80
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.00	0.00	1.00
CEDE	*Ceanothus dentatus*	0.00	1.20	0.00	33.60	10.80	14.80
CERI	*Ceanothus rigidus*	42.00	33.40	14.80	12.00	13.20	19.00
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	0.00	0.00	0.20	0.00	0.00	0.20
ERER	*Ericameria ericoides*	1.00	0.00	0.00	0.00	0.00	0.00
ERFA	*Ericameria fasciculata*	0.80	0.00	0.00	0.00	0.00	0.20
GAEL	*Garrya elliptica*	0.00	0.00	0.00	0.40	1.20	0.00
HESC	*Helianthemum scoparium*	0.00	0.00	0.00	2.40	0.20	6.00
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	0.00	0.00	0.60	0.00	0.60
LUAL	*Lupinus albifrons*	0.80	2.40	0.00	0.00	0.00	0.00
MIAU	*Mimulus aurantiacus*	0.00	0.00	0.00	0.00	0.00	0.00
QUAG	*Quercus agrifolia*	2.40	0.00	0.00	0.00	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	4.40	0.00	0.00	0.00	0.20
SAME	*Salvia mellifera*	0.00	0.00	0.80	5.40	0.00	8.00
SYMO	*Symphoricarpos mollis*	1.40	0.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	15.20	3.80	0.00	0.00
BG	Bare ground	31.40	35.80	22.20	20.40	24.00	39.00
HERB	Herbaceous vegetation	0.20	0.00	0.00	0.00	0.60	3.00

Appendix B4

Year 10 Transects, Ranges 43-48

Code	Species	BE3	BE4	BE5	BE6	BE7	BE8	BE9
ADFA	*Adenostoma fasciculatum*	14.40	2.40	4.00	34.20	14.60	12.60	21.40
ARPU	*Arctostaphylos hookeri ssp. hookeri*	3.20	20.80	0.00	9.00	4.80	4.00	5.00
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	10.80	19.80	24.60	20.20	23.60	19.20	18.20
BAPI	*Baccharis pilularis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CEDE	*Ceanothus dentatus*	24.00	12.80	13.40	0.00	1.20	25.20	13.60
CERI	*Ceanothus rigidus*	21.60	18.40	20.60	0.60	28.40	13.20	13.40
CETH	*Ceanothus thyrsiflorus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	0.80	0.00	0.20	0.40	0.00	0.00	0.00
ERER	*Ericameria ericoides*	0.00	0.00	0.00	0.00	0.00	0.00	0.20
ERFA	*Ericameria fasciculata*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00	3.20	2.20	0.00	0.80	0.00
HESC	*Helianthemum scoparium*	3.40	0.00	1.40	1.40	0.40	1.00	8.40
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	0.00	0.60	3.40	0.00	0.20	0.00
LUAL	*Lupinus albifrons*	0.00	0.00	0.00	2.00	0.00	0.00	1.80
MIAU	*Mimulus aurantiacus*	0.00	0.00	0.00	0.00	0.00	0.20	0.00
QUAG	*Quercus agrifolia*	6.00	0.00	0.00	0.00	0.00	3.20	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	1.40	0.00	0.00	0.00	0.00	0.20
SAME	*Salvia mellifera*	2.60	4.40	2.00	0.20	0.00	3.40	8.80
SYMO	*Symphoricarpos mollis*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TODI	*Toxicodendron diversilobum*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BG	Bare ground	34.60	35.20	32.60	32.20	30.80	37.00	27.20
HERB	Herbaceous vegetation	4.00	0.00	0.00	1.00	0.60	0.00	0.20

Appendix B4
Year 10 Transects, Ranges 43-48

Code	Species	BG6	BH1
ADFA	*Adenostoma fasciculatum*	14.80	2.20
ARPU	*Arctostaphylos hookeri ssp. hookeri*	1.40	25.40
ARTO	*Arctostaphylos tormentosa ssp. tormentosa*	32.80	15.60
BAPI	*Baccharis pilularis*	0.00	0.00
CAED	*Carpobrotus edulis*	0.00	0.00
CEDE	*Ceanothus dentatus*	17.00	16.60
CERI	*Ceanothus rigidus*	10.60	12.00
CETH	*Ceanothus thyrsiflorus*	0.00	0.00
ERCO	*Eriophyllum confertiflorum*	0.00	0.00
ERER	*Ericameria ericoides*	0.00	0.00
ERFA	*Ericameria fasciculata*	0.00	0.00
GAEL	*Garrya elliptica*	0.00	0.00
HESC	*Helianthemum scoparium*	0.40	0.60
LOSC	*Acimispon glaber (=Lotus scoparius)*	0.00	1.80
LUAL	*Lupinus albifrons*	0.00	0.00
MIAU	*Mimulus aurantiacus*	0.00	0.00
QUAG	*Quercus agrifolia*	0.00	0.00
RHCA	*Frangula (Rhamnus) californica*	0.00	0.00
SAME	*Salvia mellifera*	1.20	0.20
SYMO	*Symphoricarpos mollis*	0.00	0.00
TODI	*Toxicodendron diversilobum*	2.80	0.00
BG	Bare ground	31.20	38.40
HERB	Herbaceous vegetation	0.20	0.00

APPENDIX C

2013 California Tiger Salamander and California Fairy Shrimp, Aquatic Sampling

2013 California Tiger Salamander and California Fairy Shrimp Aquatic Sampling Former Fort Ord

Prepared for

Department of the Army
U.S. Army Corps of Engineers

Sacramento District
1325 J Street
Sacramento, CA 95814-2922

September 2013

2013 California Tiger Salamander and California Fairy Shrimp Aquatic Sampling Former Fort Ord

FINAL

Prepared for

Department of the Army
U.S. Army Corps of Engineers

Sacramento District
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September 2013

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SECTION 1

Introduction

This report presents the results of monthly surveys of six vernal pools on the former Fort Ord between November 2012 and May 2013. These pools were monitored for hydrology and presence of California tiger salamander (CTS) (*Ambystoma californiense*) and California fairy shrimp (*Linderiella californica*). Monitoring of CTS breeding sites, as well as monitoring for the occurrence of California fairy shrimp following remediation actions at the former Fort Ord is a requirement of the U.S. Fish and Wildlife Service's 2005 Biological Opinion (USFWS 2005) and the *Wetland Monitoring and Restoration Plan for Munitions and Contaminated Soil Remedial Activities at Former Fort Ord* (Burleson Consulting, Inc. 2006).

Spring aquatic surveys for California tiger salamander (CTS) (*Ambystoma californiense*) larvae were performed from March through May 2013, to monitor known CTS breeding pools, following on-going munitions and lead remediation activities performed by the U.S. Army Corps of Engineers (COE) in and around the pools. Monthly hydrology monitoring visits to assess the size, depth, and water quality of the pools were conducted following the first significant rainfall in November 2012 through completion of CTS/fairy shrimp monitoring from March to May 2013. Most recent surveys for CTS larvae were performed in 2007, 2009 and 2010 prior to remediation activities by Denise Duffy & Associates (DD&A, 2007, 2009, 2010). These surveys included three control pools, where no remediation activities were planned (DD&A 2007, 2009 and 2010). The Army also conducted wetland surveys in 1992, 1994, 1995, and 1996 (Jones and Stokes Wetland Restoration Plan for Unexploded Ordnance Removal Activities at Former Fort Ord, 1997). Additionally, surveys for CTS were conducted on BLM lands in 2003 by students and faculty of UC Davis (Biological Evaluation of Army Actions that May Affect California Tiger Salamander and Contra Costa Goldfields Critical Habitat, Former Fort Ord, Monterey County). All of the control and two of the remediation pools are known to have supported CTS prior to remediation.

The ability of the pools to support successful CTS reproduction was limited due to the rainfall pattern during the 2012–2013 rainy season. Precipitation in the project vicinity during the 2012–2013 rain year was below normal, despite early heavy rainfall in November and December (Department of Meteorology, Naval Postgraduate School (NPS) website). Monthly rainfall totals fell significantly from January through March, which was the second driest three-month period recorded at the National Weather Service Climate Station in Monterey. Relevant weather stations at Fort Ord NPS (just north of Marina Municipal Airport), Marina (southeast end of Marina) and the National Weather Service Climate Office at the Monterey Airport recorded 8.84, 8.89 and 10.72 inches for the rain year, respectively. At the Marina station, the rainfall totals were estimated at 61.4 percent of normal (Department of Meteorology, Naval Postgraduate School 2013).

SECTION 2

Methods

The CTS spring larval survey methods followed the US Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW) protocol, *Interim Guidance on Site Assessment for Determining the Presence or a Negative Finding of the California Tiger Salamander, October 2003* (USFWS and CDFW 2003), and the methods employed in the DD&A baseline surveys. Bryan Mori, the lead biologist, presently holds a US Fish and Wildlife Service (USFWS) Recovery Permit (TE-78668-8) and California Department of Fish and Wildlife (CDFW) Scientific Collection Permit/MOU (No. 001912) for CTS. Justin Davilla (Biologist, Ecosystems West Consulting Group) and Bart Kowalski (Biologist, Chenega Global Services) assisted with aquatic sampling, under the direct supervision of Mr. Mori. The USFWS and CDFW were notified prior to start of the study of the intended sampling.

The purpose of monthly hydrology monitoring was to determine whether vernal pools at remediation and control sites were ponded at a depth and duration necessary to support breeding CTS and California fairy shrimp. In general, successful CTS breeding requires a minimum pool depth of 20 cm for at least four to five months (Shaffer and Trenham 2005), whereas California fairy shrimp require a minimum pool depth of 10 cm for at least 18 consecutive days. The hydrology monitoring also served to determine whether remediation activities had altered the functional capabilities of pools to support these and other aquatic species, and to assess water quality of the pools using a calibrated multi-parameter water quality meter.

Inundated surface area and maximum ponded depth were measured at each of the six pools during each of the seven monthly surveys. Pool depth was measured visually at one meter staff gauges positioned in the deepest portion of the pools. Surface area of pool inundation was mapped using a hand-held, resource grade GPS unit with sub-foot accuracy, and acreage was calculated using the Xtools extension for ArcGIS software. Only three of the six original pool sites (Pools 10, 30B/30C and 56) were sampled for water quality during this study due to the lack of water in the remaining pools; Pools 10, 30B/30C were post-remediation sites and Pool 56 was a control site. Water quality (temperature, pH, turbidity, and dissolved oxygen) was assessed on two occasions (February 25 and March 15) in these three pools using a calibrated multi-parameter digital water quality meter.

Sampling for CTS was conducted on three separate occasions (15 March, 12 April, and 10 May 2013) in order to assess habitat variability throughout the sampling period, and determine larval growth and survival. All sites were sampled using dipnets only in order to minimize the disturbances to aquatic habitats and to provide comparable results between sampling sites and between sampling years. Unlike previous surveys which used seines, seines were not used in this survey as they are considered disruptive to the habitat. The dipnets were of standard length (5 ft) with a mesh size of 1/8 inch (3.2 mm). Depending on the extent of aquatic habitat present, one to three biologists sampled each site. Small pools, such as at Pools 30B/30C and 56, were sampled in their entirety, while a minimum of 30% of the surface area was sampled for Pool 10, which was greater than one acre in size. Sampling at Pool 10 was limited to 2-person hours per visit. Up to 30 individual CTS per site were measured for total length and photographed.

Although not required as part of the restoration and monitoring plan, authorization from the USFWS was obtained to take CTS tissue samples from Pool 30C for DNA analysis. The decision to take tissue samples was made because the site was drying quickly and would result in the stranding of CTS larvae. Therefore, rather than lose the individuals to predators, it was determined that DNA analysis would supplement existing information on the spread of CTS hybridization on Fort Ord. The procedures for obtaining tissue samples specified in the Recovery Permit were followed. Tissue samples were shipped to Dr. Brad Shaffer, Department of Ecology and Evolutionary Biology, University of California, Los Angeles for DNA analysis.

The presence/absence of California fairy shrimp also was assessed concurrently with CTS sampling, following recommendations in the monitoring and restoration plan (Burleson Consulting, Inc. 2006). The timing of the fairy shrimp surveys were based on those used for the 2009 and 1010 DD&A baseline studies, which sampled for fairy shrimp at the same time as CTS sampling, rather than earlier in winter, as in the DD&A 2007 study. Sampling for fairy shrimp concurrently with CTS sampling was selected for efficiency and because the timing would be less disruptive to CTS eggs, which are more likely to be present earlier in winter. In addition to the dipnets used during CTS larval sampling, a dipnet with fine mesh (1 mm) for invertebrate sampling was utilized, following the DD&A (2009, 2010) method of 5–10 sweeps per pool.

As part of CTS and fairy shrimp sampling, all captured amphibians and, where practical, aquatic invertebrates were identified and recorded on data sheets.

SECTION 3

Results

3.1. Site Hydrology

The 2012–2013 rain year began with a series of heavy storms and above average monthly rainfall totals prior to January 2013. This allowed most of the monitored vernal pools to support standing water and provide early season aquatic habitat (Table 3-1). However, the remainder of the 2013 rainy season was characterized by a significant drought and most pools receded significantly and/or dried by the first CTS larval sampling visit on 15 March 2013. The nearby Marina, CA weather station indicated that rainfall totals were approximately 61.4 percent of normal for 2012–2013.

Water quality measurements from the February and March surveys are provided in Table 3-2. Only three pools retained enough water in February and March to allow water quality sampling during sampling for CTS and California fairy shrimp.

Of the three control site pools, only Pool 56 supported aquatic habitat suitable for CTS and fairy shrimp sampling. Pool 10 was the only original remediation site pool to provide aquatic habitat suitable for sampling for CTS and fairy shrimp. This was expected because this large feature is recognized as one of the most significant CTS breeding pools in the region. Pools 30B and 30C that were formed recently as a result of remediation activities also supported small pools of standing water that remained inundated into the CTS and fairy shrimp sampling period.

Table 3-1
Depth and Surface Area of Monitored Vernal Pools at Former Fort Ord

Pool	11/26/2012		12/19/2012		1/22/2013		2/25/2013		3/15/2013		4/12/2013		5/10/2013	
	Depth (cm)	**Area (acres)**	**Depth (cm)**	**Area (acres)**	**Depth (cm)**	**Area (acres)**	**Depth (cm)**	**Area (acres)**	**Depth (cm)**	**Area (acres)**	**Depth (cm)**	**Area (acres)**	**Depth (cm)**	**Area (acres)**
5	0	0	0*	0.011	11	0.91	0	0	0	0	0	0	0	0
56	0	0	24	0.046	46	0.30	42.5	0.227	39	0.18	20	0.002	0	0
101E	0	0	0	0	11	0.075	0	0	0	0	0	0	0	0
8	0	0	8	2 ft^2	17	10 ft^2	0	0	0	0	0	0	0	0
10	Damp	0	54	2.06	66	4.99	63.5	4.86	60	4.43	51	1.9	40	1.53
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30B	0	0	> 6**	0.009	> 10**	0.006	> 10**	0.006	8	0.002	0	0	0	0
30C	0	0	> 6**	0.04	> 10**	0.049	> 10**	0.036	16	0.029	5	60 ft^2	0	0

* Approximately 10 cm depth in two small puddles immediately west of staff gauge.

** Did not measure exact depth of 30B and 30C until 3/15/2013 site visit.

Table 3-2
Vernal Pool Water Quality Measurements for Vernal Pools Sampled for CTS and California Fairy Shrimp at Former Fort Ord

Pool	Temperature (Fahrenheit)		pH		Turbidity (NTU)		Dissolved Oxygen (mg/L)	
	2/25/2013	3/15/2013	2/25/2013	3/15/2013	2/25/2013	3/15/2013	2/25/2013	3/15/2013
56	50.6	55.3	6.6	6.31	11.6	22.7	11.34	12.48
10	49.5	61.7	7.07	7.04	642	633	9.82	8.98
30B	66.7	N/A*	6.9	N/A	606	N/A	9.66	N/A
30C	65.8	76.1	7.05	7.29	590	821	9.55	9.35

* Too shallow and mucky for water quality meter.

3.1.1. Control Pools: Pools 5, 56 and 101E

The control sites consisted of vernal pools located within a mosaic of oak woodland, coyote brush scrub, annual grassland, and maritime chaparral with varying mixes of these habitats surrounding each site (Figure 3-1; Appendix A). Spikerush (*Eleocharis macrostachya*) was dominant in and along the margin of Pools 5 and 56, whereas curly dock (*Rumex crispus*) and a variety of annual grasses were the dominant plant species at Pool 101E. Pool 56 was the only control site that supported standing water after February during the study. Physiognomic conditions of the control site pools, as well as specific aquatic sampling conditions of Pool 56 are described below.

Pool 5. Surface water was limited to two very small puddles on 15 March and the pool was completely dry by 12 April 2013. Although this pool was 11 cm deep and 0.91 acres in size during the January site visit, the hydrology was unsuitable for CTS larvae and was not sampled. Vegetation was dominated by spikerush, with patchy areas of salt grass (*Distichlis spicata*) and curly dock. A thick algal mat covered much of the vegetation in the center portion of the pool, particularly near the location of the staff gauge.

Pool 56. Surface water was present on 15 March and covered an area of 0.18 acres with a maximum depth of 39 cm (Table 3-1). The water was tea-colored but had very low turbidity. By 12 April, aquatic habitat consisted mainly of a small pooled area within a remnant tire track, with scattered puddles elsewhere. Surface water covered approximately 100 ft^2 (0.002 acre), with a maximum depth of 20 cm. Surface water was absent by the 10 May sampling date. Vegetation within the pool was dominated by spikerush and salt grass with widely scattered alkali mallow (*Malvella leprosa*), rabbitfoot grass (*Polypogon monspeliensis*), and clustered dock (*Rumex conglomeratus*).

Pool 101E. Surface water was present on 22 January 2013. Otherwise this pool was marginally saturated or dry during monthly hydrology monitoring visits and was not sampled for presence of CTS or fairy shrimp. The vegetation within the pool was dominated by curly dock, with rabbitfoot grass, spikerush, and alkali mallow becoming co-dominant later in the growing season.

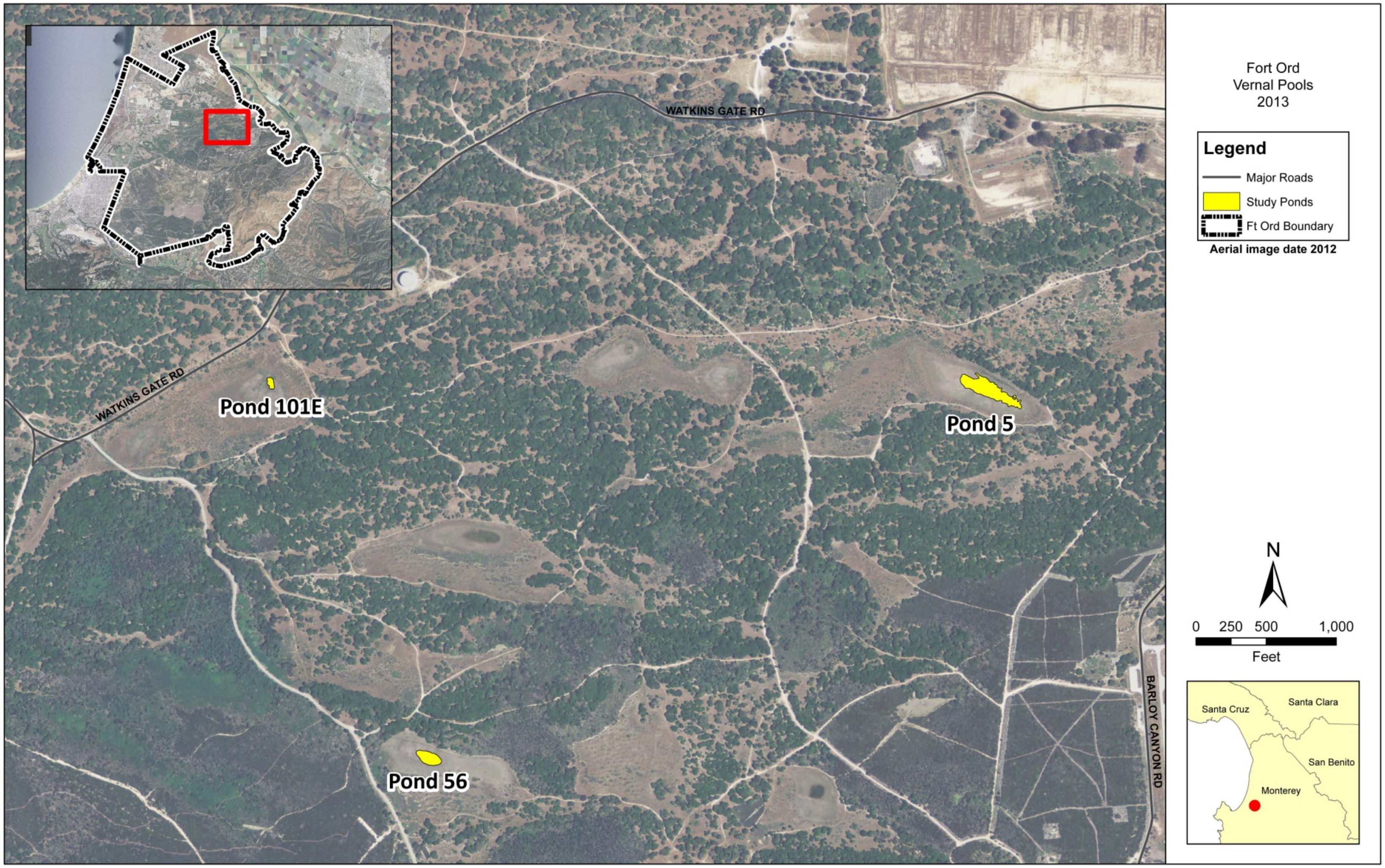

Figure 3-1 Control vernal pool sampling sites, Fort Ord, California.

3.1.2. Remediation Pools: Pools 8, 10, 30, and 30B/30C

The remediation sampling sites, like the control sites, are all vernal pools (Figure 3-2; photos are provided in Appendix A). Whereas oak woodland was a prominent feature in the surrounding landscape of the control sites, the habitat mosaic surrounding the post-remediation sites was dominated by coyote brush scrub and maritime chaparral, with oak woodland being a minor component. Spikerush was dominant at Pools 10 and 30; however, geranium and annual grasses were the main species at Pool 8. Pool 10 was the only remediation site that supported standing water during this study. Two recently excavated depressions adjacent to Pool 30, contained standing water during this study and were included in the sampling scheme; these pools were identified as 30B and 30C. Physiognomic conditions for all remediation pools, including specific aquatic sampling conditions of Pools 10 and 30B/30C, are described below. Details of monthly hydrology monitoring visits to remediation site vernal pools are presented Table 3-1.

Pool 8. This feature consists of a relatively flat grassy meadow that did not support standing water during the study and a small pit depression that was inundated to a maximum depth of 17 cm and surface area of 10 ft^2 during the 22 January 2013 hydrology monitoring visit (Table 3-1). The pit was completely dry by the 25 February visit and was not sampled for CTS or fairy shrimp. The meadow portion is arguably no longer a functioning wetland as evidenced by a preponderance of upland grasses and forbs including soft chess (*Bromus hordeaceus*), ripgut brome (*Bromus diandrus*), sheep sorrel (*Rumex acetosella*), filaree (*Erodium* sp.), and cutleaf geranium (*Geranium dissectum*). Vegetation with the pit was sparse and comprised primarily of rabbitfoot grass, alkali mallow, and spikerush.

Pool 10. Vernal pool 10 has been altered by previous earth-moving activities when Fort Ord was an active military installation. An artificial berm surrounded the west and northwest margins of the pool and the head of the pool appears to have been scraped, increasing its depth. This end contains the main area of standing water. Surface water was present throughout the sampling period from 15 March through 10 May (Table 3-1). During this period, surface water covered an area of 4.43 acres on 15 March, much of which was shallow surface water extending from the main pool into the spikerush dominated, upper-half of the pool; maximum water depth was 60 cm. By 12 April, the surface water was contained only within the head of the pool, and by 10 May surface water was reduced to 1.53 acres, with a maximum depth of 51 cm. The water was highly turbid throughout the sampling period. The vegetation within and immediately adjacent to the pool is dependent on depth and duration of inundation. The shallower east portion is dominated by spikerush with cattails and bulrush present in several deeper trenched areas. The deeper west portion is mostly unvegetated with a small patch of water smartweed (*Persicaria* sp.) near the north bank and spikerush, curly dock, rabbitfoot grass, and alkali mallow common along the pool margins.

Pool 30. Similar to Pool 8, this feature consists of a relatively flat meadow that did not support standing water during the 2012–2013 rain year. The pool is intact despite close proximity to lead remediation activities. The pool was dominated by a mix of upland and wetland vegetation including spikerush, curly dock, soft chess, filaree, groundsel (*Scenecio sylvaticus*), bull thistle (*Cirsium vulgare*), and hood canarygrass (*Phalaris paradoxa*).

Pool 30B/30C. Pools 30B and 30C are within remnant depressions from munitions remediation activities adjacent to and west of vernal Pool 30. Based on aerial photo interpretations, the area previously supported a mix of moderately-dense maritime chaparral and non-native grassland. The area is presently mostly barren, except for regenerating and pioneering plants.

Pool 30B only ponded water through the first sampling date on 15 March 2013. At that time, surface water covered approximately 100 ft^2 (0.002 acre) and was only 8 cm deep. The water was highly turbid. Vegetation cover was very sparse due to recent remediation activities and was comprised of widely scattered spikerush and rabbitfoot grass.

Pool 30C supported surface water during two sampling periods. On 15 March, surface water covered 0.029 acres and the maximum depth was 16 cm. By 12 April, the pool was reduced to a shallow puddle that covered 60 ft^2 and was only 5 cm deep. During a supplemental visit on 16 April 2013 the puddle area was confined within several boot prints from previous sampling visits (see Photo 9). Similar to Pool 30B, the vegetation was sparse due to recent scraping and was comprised of spikerush and rabbitfoot grass.

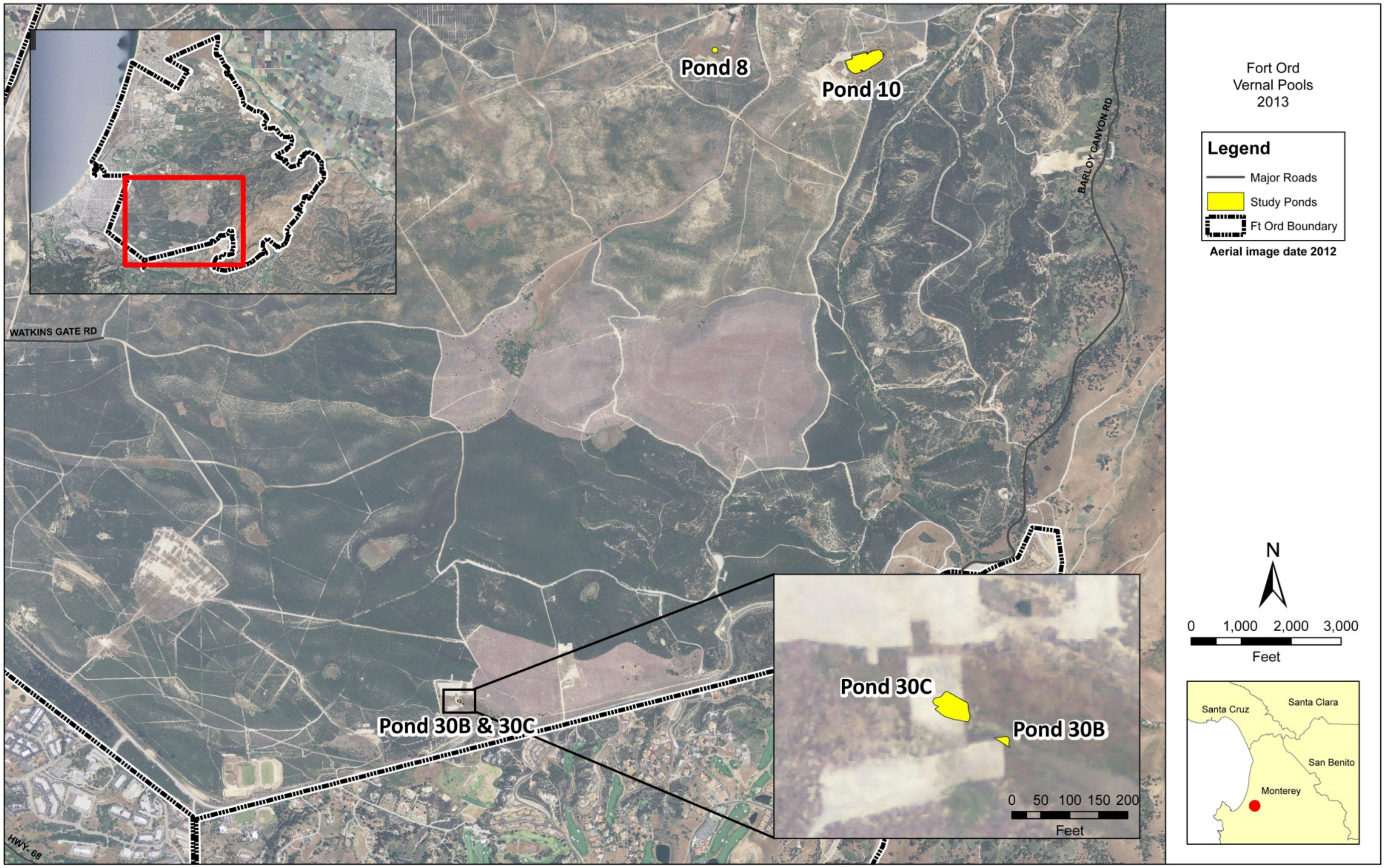

Figure 3-2 Remediation vernal pool sampling sites, Fort Ord, California.

3.2. California Tiger Salamander

CTS were present at remediation sampling Pools 10 and 30C. No CTS were observed at control Pool 56 or remediation Pool 30B (Table 3-3).

At Pool 10, the number of larvae captured ranged from a high of 421 on 15 March to a low of 59 on 10 May (Figure 3-3). Mean total length in March was 39 mm and increased to 64.5 mm by May (Figure 3-4). Other amphibians observed included Pacific chorus-frog (*Pseudacris regilla*) tadpoles, which were uncommon, and an egg mass of Coast Range newt (*Taricha torosa*).

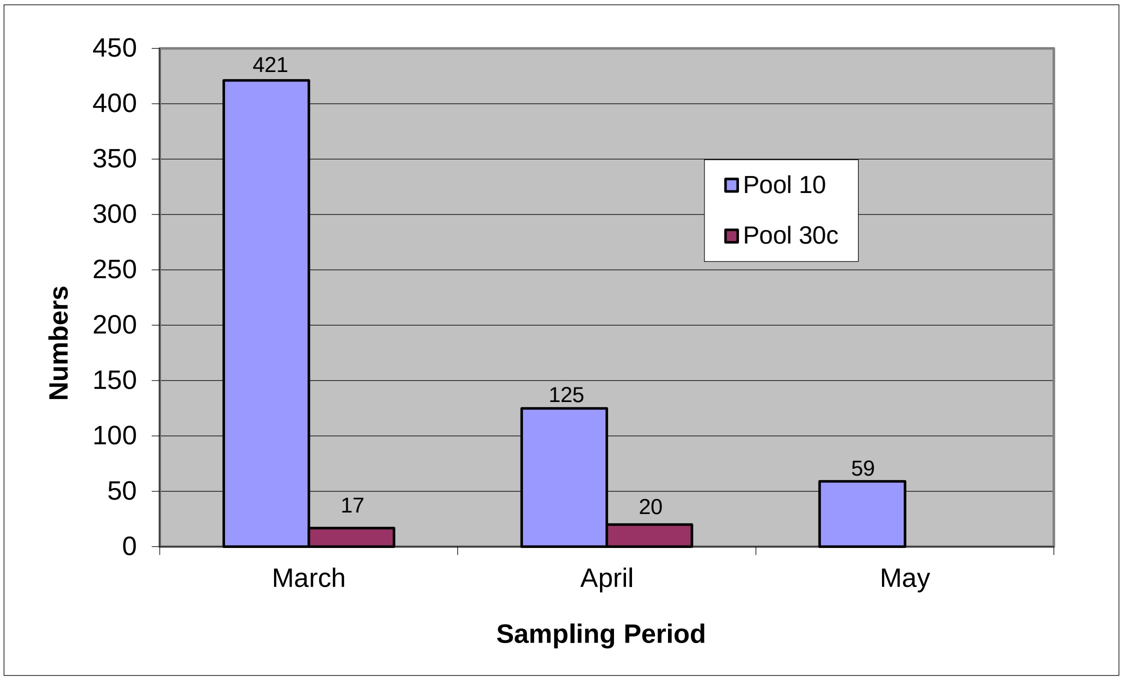

Figure 3-3 Number of California tiger salamander larvae recorded in Pool 10 and Pool 30C during spring 2013 surveys.

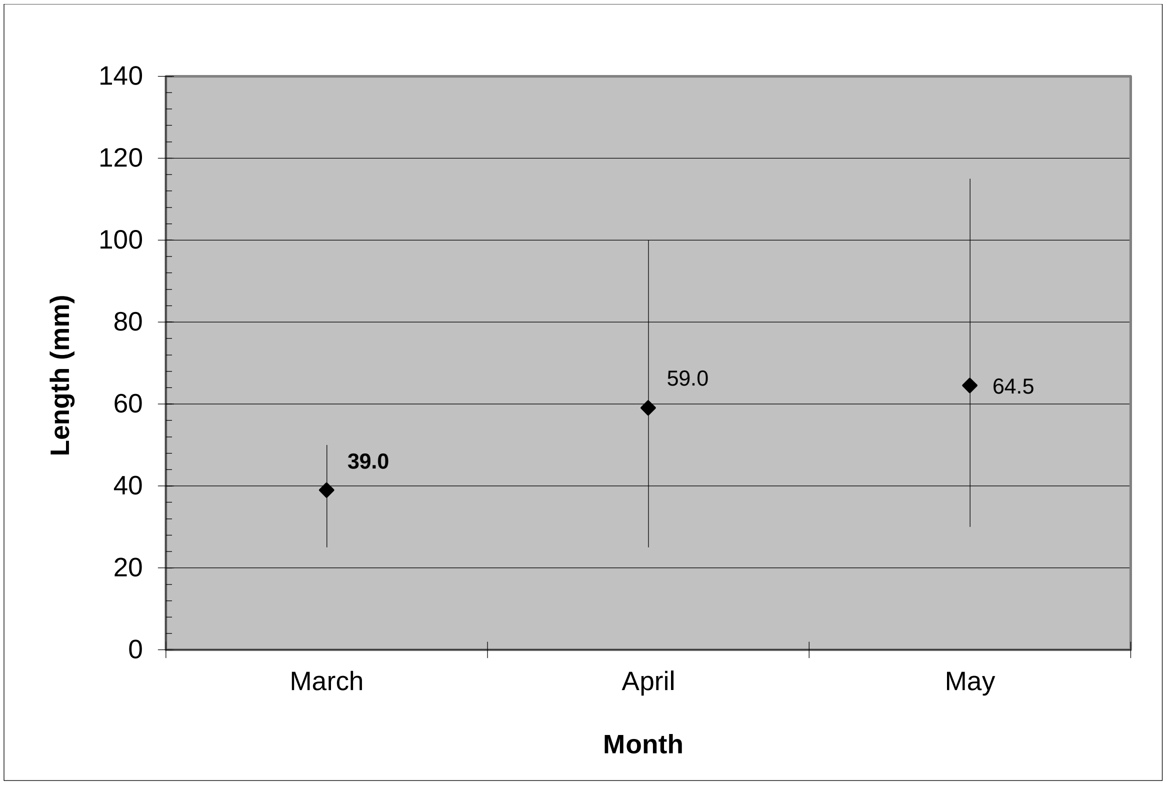

Figure 3-4 Mean total length of California tiger salamander larvae in Pool 10 during spring 2013 surveys. Bars represent the range of sizes measured. Thirty individuals were measured each month.

At remediation Pool 30C, the numbers of CTS larvae ranged from seventeen (17) on 15 March to twenty (20) on 12 April (Figure 3-3). The complete count for this site, however, was determined to be twenty-one (21) larvae. Eighteen (18) larvae were collected for tissue samples and three desiccated larvae were collected from remnant puddles within boot prints on 16 April (see Appendix A, Photo 9). The mean total length of larvae in March was 36.8 mm and increased to 71.3 mm in April (Figure **3-5**). Pacific chorus frog tadpoles and egg masses were common on 15 March at both Pools 30B and 30C.

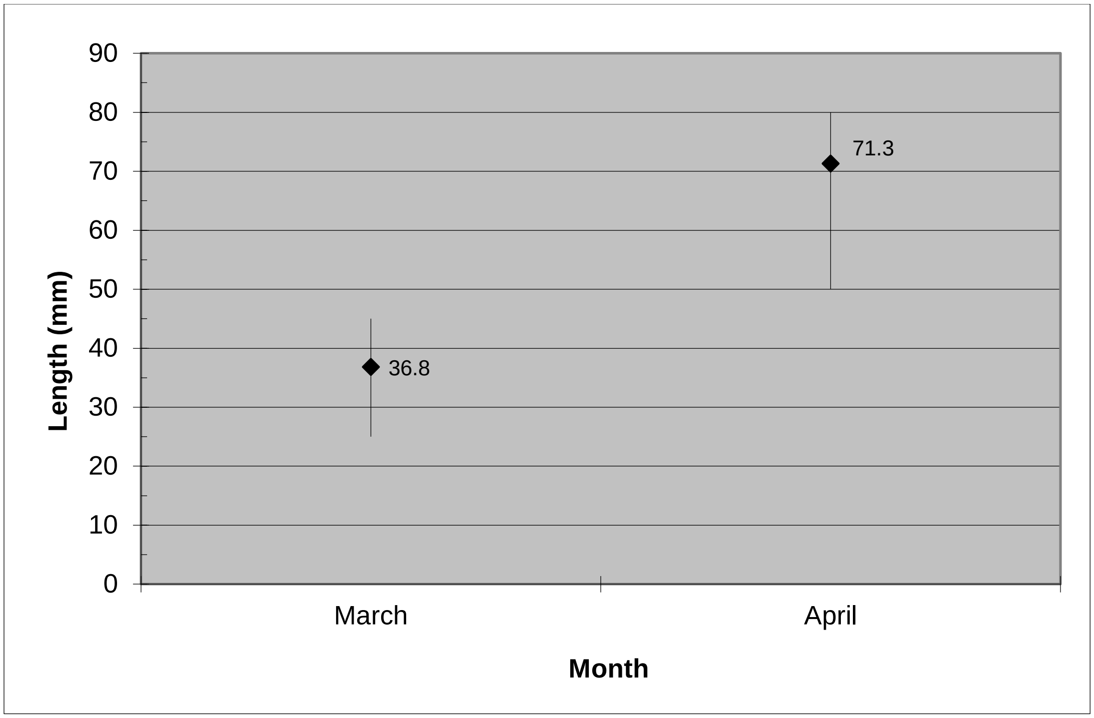

Figure 3-5 **Mean total length of California tiger salamander larvae in Pool 30C during spring 2013 surveys. Bars represent the range of sizes measured. Seventeen individuals were measured in March. Twenty individuals were measured in April.**

Table 3-3
Summary of CTS Aquatic Sampling Results, Spring 2013, Fort Ord, California

Pool	Aquatic Habitat	Method/ Effort	CTS	Notes
5	Puddles	None		Control site. Not sampled. Habitat did not support suitable standing water during the study. Only two small puddles in a saturated area of the vernal pool were observed on 15 March.
56	Pool	Dipnet (100%)		Control site. Sampled in March and April. Two biologists sampled the entire site on 15 March. By 12 April standing water was limited to only a small, pooled area within a remnant tire track. Pacific chorus frog tadpoles were abundant.
101E	Dry			Control site. Not sampled. Habitat did not support standing water during the study.
8	Dry			Remediation site. Not sampled. Habitat did not support standing water during the study.
10	Pool	Dipnet (2-person hrs)	Y	Remediation site. Sampled in March through May. Three biologists sampled for 2-person hours, with greater than 30% of the site sampled, during each visit. CTS larvae were captured during each survey with a high of 421 captured on 15 March. Pacific chorus frog tadpoles were notably uncommon. One newt egg mass was observed, but no newt larvae were captured.
30	Dry	None		Remediation site. Not sampled. Habitat did not support standing water during the study.
30B	Pool	Dipnet (100%)		Remediation site. Pool is an excavated depression resulting from remediation activities near Pool 30. The site was sampled in March only, when the pool supported a broad, shallow puddle approximately 8 cm deep. Recently hatched chorus frog tadpoles were abundant and viable egg masses still present. Site was dry on 12 April.
30C	Pool	Dipnet (100%)	Y	Remediation site. Pool is an excavated depression resulting from remediation activities near Pool 30. The pool was sampled in March and April. One biologist sampled the entire pool in March. Recently hatched chorus frog tadpoles were abundant and viable egg masses were present. By 12 April, standing water was limited to a broad, shallow puddle approximately 5 cm deep. Tissue samples were collected from 23 individual CTS larvae stranded in boot print puddles on 16 April.

3.3. California Fairy Shrimp

California fairy shrimp were not observed in any of the sampled pools during the surveys. However, fairy shrimp were observed at control site Pool 56 during a pre-survey reconnaissance of the sampling sites. A variety of aquatic invertebrates were observed at the sampled pools, and included snails, daphnia, seed shrimp, clam shrimp, damselfly nymphs, diving beetles, water boatmen, and mosquitoes (Table 3-4).

Table 3-4
Aquatic Invertebrates Observed at Vernal Pool Sampling Sites

Species	Pool 10	Pool 30B/30C	Pool 56
California Fairy Shrimp (*Linderiella californica*)			X
Clam Shrimp (Order Conchostraca)	X	X	X
Water Fleas (Daphnia sp.)	X	X	X
Seed Shrimp (Order Ostracoda)		X	X
Copepods (Order Eu-copepoda)			X
Scuds (Order Amphipoda)		X	
Mayfly (Order Ephemeroptera)	X	X	
Dragonfly (Order Anisoptera)			X
Damselfly (Order Zygoptera)	X		X
Waterboatmen (Family Corixidae)	X	X	
Backswimmer (Family Corixidae)	X	X	X
Predaceous Diving Beetle (Family Dytiscidae)	X	X	X
Water Scavenger Beetle (Family Hydrophilidae)	X		X
Mosquito (Family Culicidae)			X
Dipteran Larvae	X	X	X
Snails (Planorbidae)	X		

SECTION 4
Discussion

The wetland monitoring and restoration plan (Burleson 2006) considers wetland function at sites following remediation activities to be acceptable, if the monitoring results show that the wetlands, which supported CTS and California fairy shrimp prior to remediation, continued to support these species. The success standard used in the monitoring plan is based on species presence/absence. Table 4-1 and Table 4-2 present the results from this study and the 2007, 2009 and 2010 DD&A baseline aquatic surveys. Beyond the presence/absence standard, direct comparisons are difficult to make between the results from this study and the baseline studies, due to differences in methods and, presumably, changes in upland habitat conditions.

Wetland function with respect to CTS and California fairy shrimp presence was evaluated for remediation site Pool 10, but could not be assessed for the remaining remediation sites, due to drought conditions and the lack of aquatic habitats in 2013. The low rainfall totals caused several pools that may have otherwise ponded water to remain too dry to sample for CTS or fairy shrimp. Both Pools 8 and 30 were dry during the sampling period. It is impossible to assess based on the 2012–2013 hydrology monitoring visits whether the portions of Pool 8 or Pool 30 that were not inundated with standing water would have supported aquatic habitat during a normal rain year. Remediation activities do not appear to have significantly altered the non-inundated (i.e. meadow) portions of the poolsIn general, water quality measurements indicate that CTS can tolerate wide variations in water temperature and high levels of turbidity (Table 3-2). The sampled pools had consistently neutral pH readings and similar levels of dissolved oxygen as well.

Table 4-1
Comparison of CTS Abundances from Baseline Surveys and the 2013 Post-remediation Monitoring

Pool	2007 Baseline	2009 Baseline	2010 Baseline	2013
5	0	–	11–100 (2)	Dry
56	0	–	–	0
101E	0	–	11–100 (2)	Dry
8	dry	–	0	Dry
10	101+ (1)	–	–	421 (3)
30	Dry	–	0	21 (4)

Key: (1) = “abundant” category (DD&A 2007); (2) = “common” category (DD&A 2010); (3) = 421 represents the high count; (4) = captured at site 30C. Categories as defined by DD&A (2010).

Table 4-2
Comparison of California Fairy Shrimp Abundances from Baseline Surveys and the 2013 Post-remediation Monitoring

Pool	2007 Baseline	2009 Baseline	2010 Baseline	2013
5	0	–	0	Dry
56	11–100 (1)	–	–	Present (2)
101E	0	–	0	Dry
8	dry	–	1–10 (3)	Dry
10	0	–	–	0
30	Dry	–	0	Dry

Key: (1) = “moderate” category (DD&A 2007); (2) = observed only during a pre-survey reconnaissance; (3) = “low” category (DD&A 2010).

4.1. California Tiger Salamander

4.1.1. Control Pools: Pools 5, 56 and 101E

Pool 5: This pool did not support suitable standing water during the study. Only two small puddles in a saturated area of the vernal pool were observed on 15 March.

Pool 56: Of special interest was the lack of CTS at control Pool 56 in 2013. Suitable aquatic habitat was present, at least during the first survey on 15 March. CTS larvae were detected at this pool in 2003 (Biological Evaluation of Army Actions 2004), although none were observed during the 2007 DD&A surveys. Since this site was not sampled in 2009 or 2010, it cannot be determined if the absence of CTS in 2013 is a natural condition or due to the lack of rain in 2012–2013.

Pool 101E: No CTS larvae were present as this pool did not contain standing water during the study.

4.1.2. Remediation Pools: Pools 8, 10, 30, and 30B/30C

Pool 8: No CTS larvae were present as this pool did not contain standing water during the study.

Pool 10: Compared with the DD&A baseline aquatic surveys (DD&A 2007, 2009, 2010), the 2013 results show that the success standard for remediation Pool 10 was met for the first monitoring year, as CTS larvae were present. With over one acre of surface water still present on 10 May, CTS reproduction at Pool 10 was likely successful, with larvae metamorphosing into juveniles before the pool dried. Pool 10 is probably one of the most reliable vernal pool CTS breeding sites on Fort Ord, given the volume of water present during drought conditions.

Although in-depth comparisons with the DD&A studies cannot be made, the relative abundance of larvae at Pool 10, between 2007 and 2013, were likely similar, as 421 larvae were observed in 2013 and larvae were categorized as “abundant” (i.e., 101+) in 2007 (DD&A 2007). However, the DD&A study (2007) indicated that CTS larvae remained “abundant” through May, whereas the numbers captured in 2013 dropped substantially as the season progressed. A decline is to be expected over time due to predation, cannibalism, and early metamorphosis. A decline in numbers was likely recorded in 2007 surveys as well, but the actual numbers captured were not provided in the 2007 report to allow determination of whether a seasonal trend was present.

Pools 30, 30A, 30B: These pools did not contain standing water during the study and therefore did not support CTS larvae.

Pool 30C: CTS were present in the excavated depression at Pool 30C, adjacent to Pool 30. This occurrence suggests that adult CTS migrated towards Pool 30, despite the extreme drought conditions, and would have bred at Pool 30, if aquatic habitat were present. This presumption may be somewhat tenuous, since CTS were not recorded in Pool 30 during the surveys in 2010 (Table 4-1).

4.2. California Fairy Shrimp

4.2.1. Control Pools: Pools 5, 56 and 101E

California fairy shrimp were observed at control Pool 56, although only during a pre-survey reconnaissance, not during actual aquatic surveys. The lack of fairy shrimp observations at Pool 56 during the aquatic surveys may have been the result of differences in the timing of sampling between the DD&A baseline studies and the 2013 surveys and/or due to annual variations in fairy shrimp occurrence in response to rainfall patterns. For example, heavy rainfall early may have led to early fairy shrimp emergence and since fairy shrimp generally mature quickly, the adults may have died off prior to the 2013 sampling efforts.

Pools 5 and 101E were dry during the sampling period and therefore did not support fairy shrimp.

4.2.2. Remediation Pools: Pools 8, 10, 30, and 30B/30C

The wetland function success standard (i.e., presence of fairy shrimp) was impossible to assess at Pools 8 and 30 relative to the California fairy shrimp, due to the current drought conditions and the lack of suitable aquatic habitat in 2013. Both remediation Pools 8 and 30 were dry during the sampling period. No fairy shrimp were observed at Pool 10 in 2013, despite suitable aquatic conditions throughout the sampling period (Table 4-2). However, no fairy shrimp were observed during the 2007 DD&A survey in Pool 10, nor in 1992 baseline surveys.

4.3. Monitoring Conclusions

One objective of the wetlands restoration and monitoring plan is to ensure that vernal pools that supported CTS and California fairy shrimp, prior to remediation activities, continue to support these species following such activities (i.e., exhibit similar wetlands functions). Where this standard is met, a remediation site would be considered successful. This determination would be made following the evaluation of baseline and post-remediation trends.

There is insufficient information to identify trends, due to small sample sizes and lack of consistent sampling. For instance, control Pool 56 and remediation Pools 8, 10 and 30 were only sampled once during the baseline 2007, 2009 and 2010 surveys (DD&A 2007, 2009, 2010). In addition, one or both of the CTS or California fairy shrimp were not recorded in these pools during the earlier baseline one-year sampling efforts. Hence it is not possible to determine whether these pools ever supported CTS or California fairy shrimp. Under these circumstances, a determination of wetland function success at these remediation sites cannot be made when comparing monitoring results only with the baseline studies.

SECTION 5

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APPENDIX A

Photos of Sampling Sites

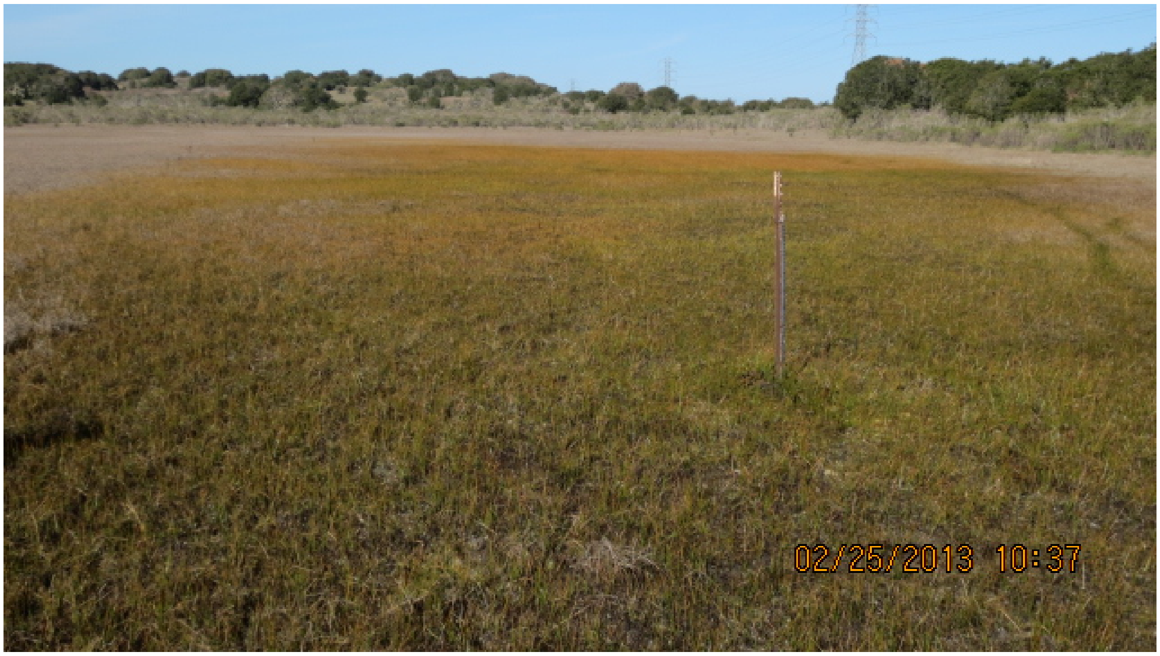

Photo 1 Control Pool 5 on 25 February 2013. Note lack of surface water.

Photo 2 Control Pool 56 on 25 February 2013. Surface water present.

Photo 3 **Control Pool 101E on 25 February 2013. Note lack of surface water.**

Photo 4 **Remediation Pool 8 on 25 February 2013. Note lack of surface water.**

Photo 5 **Remediation Pool 10 on 25 February 2013. Surface water present.**

Photo 6 **Remediation Pool 30 on 25 February 2013. Note lack of surface water.**

Photo 7. **Remediation excavation depression Pool 30B on 25 February 2013. Water present.**

Photo 8 **Remediation excavation depression Pool 30C on 25 February 2013. Water present.**

Photo 9 **Remediation Pool 30C on 16 April 2013. Note desiccated larva to the right of boot print puddle. The backs of CTS larvae are barely visible in puddle.**