Biological Report on Braunton's Milk-Vetch Habitat

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1.0 INTRODUCTION

MWH Americas, Inc. (MWH), under contract with The Boeing Company (Boeing), was asked to evaluate the potential impacts of a critical habitat designation for Braunton's milk-vetch (*Astragalus brauntonii*), a federally listed endangered species, on portions of the Santa Susana Field Laboratory (SSFL) in Ventura County, California. The purpose of this document is to describe the results of the field surveys conducted for those areas identified in the Code of Federal Regulations (CFR) Title 50 as Braunton's milk-vetch critical habitats (referred to as Units 1D and 2F) (Figure 1). The biosurvey was conducted in June and July, 2006, by SWCA Environmental Consultants. This study and corresponding figures reflect the results of the survey conducted for the portions of the identified critical habitats within the SSFL property boundary, not the entire habitat identified in CFR Title 50.

Unit 1D is situated primarily in SSFL Area IV along a ridge system located between Burro Flats and a large, unnamed mountain valley to the west; Unit 2F is on a ridge system between Dayton and Bell Canyons, and includes the southeastern corner of the SSFL Southern Buffer Area south of Area I (Figure 1). Unit 1D is also located near the headwaters of Las Virgenes Creek, which drains into Malibu Canyon. The portion of Unit 2F that occurs on within the SSFL property boundary includes an area of steep hillside overlooking a seasonal drainage that flows into Dayton Canyon. Vegetation in the area generally includes chaparral and oak woodlands along the slopes and ridge tops and grasslands in the flatter areas. Soils within Unit 1D generally contain sandy and clay loams; soils within Unit 2F generally contain sandy and shaly loams. A detailed discussion of the vegetation and soil within these two units is presented in Section 3.0 Results.

Species Account

Braunton's milk-vetch (*Astragalus brauntonii [A. brauntonii]*; Photographs 1 and 2) was listed as endangered by the U.S. Fish and Wildlife Service (USFWS) on January 29, 1997 (62 FR 4172). It occurs in chaparral and coastal sage scrub communities of southern California. It was historically found in gravelly clay soils overlaying granite sandstone, but now appears to be restricted to carbonate soils derived from scattered limestone lenses, or on non-carbonate soils at down-wash sites (Skinner 1991; USFWS 1999). This species generally occurs on the tops of knolls between 800 and 2,100 feet (244 to 640 meters) in elevation. Because it is not shade-tolerant and can be crowded out by other chaparral plants, it is typically associated with bare ground.

One of the tallest members of the pea family (Fabaceae), Braunton's milk-vetch is a perennial herb that can grow to a height of 1.5 meters (USFWS 1999). A thick taproot and woody basal stem give rise to several white stems with pale to greenish, pinnately compound leaves. Light purple flowers grow in clusters in racemes at the ends of the stems (Photograph 2). The stems are covered with fine, entangled or densely matted hairs, which sets this species apart from *A. trichopodus*, another perennial species of the same genus that occurs in the area. Also, the pods of the Braunton's milk-vetch are two-chambered instead of one-chambered as in *A. trichopodus*.

Braunton's milk-vetch is self-fertile, but it also produces seed through cross-pollination (USFWS 1999). Megachilid bees (Family Megachilidae) and bumblebees (Family Apidae) are likely pollinators of the plant (Fotheringham and Keeley 1998). The seeds have dense hairy pods that attach to animals, vehicle tires, and other moving objects that aid in dispersal. Dispersal may also be achieved by wildlife eating the seeds and rainfall events washing the seeds

downstream. The lifespan of Braunton's milk-vetch is typically two to three years, but it may live up to five years.

Because of the short fire return interval in chaparral communities (20 to 100 years; less than 20 years in the Santa Monica Mountains), Braunton's milk-vetch is well adapted to regenerate after fire (USFWS 1999; 70 FR 68983). The seeds have a thickened coat that allows them to persist in the soil for many years prior to a disturbance (i.e., heat or physical scarification of the seed) that initiates germination. Though seedling recruitment is often stimulated by such major disturbances, some seeds (those produced in the front section of the pod) may germinate with minimal or no disturbances. Disturbances that are known to stimulate germination by breaking, scratching, or mechanically altering the seed coat include fire, rainfall or flooding, erosion, and human activities. Following a chaparral fire, mature Braunton's milk-vetch plants may persist for several years before senescing or becoming crowded out by developing vegetation (Skinner 1991).

Braunton's milk-vetch occurs at 20 known locations in five disjunct geographic areas in southern California (70 FR 68984). These locations include the Simi Hills in eastern Ventura and western Los Angeles counties; eastern Santa Monica Mountains in Los Angeles County; western Santa Monica Mountains near Pacific Palisades in Los Angeles County; San Gabriel Mountains in Monrovia, Los Angeles County; and Santa Ana Mountains in Orange County. The number of plants observed at each location varies from just a few individuals to more than 200. The estimate of individual plants also varies each year, depending on the extent of disturbances. Braunton's milk-vetch is often more abundant following a fire event.

Urban development is considered the most significant threat to the species, primarily because all known occurrences are near existing and planned development and many of the occurrences are on private or local agency land (70 FR 68984). Other threats to the species include cattle grazing, equestrian and foot traffic, fire suppression, and frequent disturbances that remove plants. Although disturbances benefit the plant by stimulating seed germination, frequent disturbances, such as annual road maintenance and development, may remove plants before they can replenish the seed bank. Also, fire suppression activities may adversely affect the plant by promoting the establishment of denser shrub communities, which can crowd out Braunton's milk-vetch.

2.0 METHODOLOGY

The evaluation process for determining areas of appropriate Braunton's milk-vetch habitat within Units 1D and 2F included characterizing the vegetation communities and soils and assessing the Braunton's milk-vetch population parameters (where present). The field studies were conducted using guidelines recommended by the USFWS (USFWS 1999). Fieldwork was only conducted on those portions of the two units within the SSFL; conditions on adjacent properties were noted by visual observations.

Vegetation Community Mapping

SWCA biologists mapped vegetation communities within Units 1D and 2F using a combination of field surveying and GIS mapping. Aerial maps of the project site were created prior to the survey. Vegetation communities were delineated based on the aerial maps; these delineations were verified and refined in the field during surveys conducted in June and July, 2006. Field data were digitized using ArcGIS software to produce community maps within the two units. The entire area of Unit 1D was mapped, including areas outside of the SSFL boundary, which were mapped from a hilltop overlooking the adjacent private property. Within Unit 2F, vegetation mapping was conducted only within the portion of the unit that occurs within the SSFL property boundary.

Natural vegetation communities were described using the California List of Terrestrial Natural Communities (California Department of Fish and Game [CDFG] 2003). When possible, Holland (1986) and Sawyer and Keeler-Wolf (1995) equivalents were assigned. Plant nomenclature followed *The Jepson Manual of Higher Plants of California* (Hickman 1993).

Soils Mapping

Soils within Units 1D and 2F were mapped using data from the Natural Resources Conservation Service soil survey (Edwards et al. 1970). Soils were delineated and described in terms of their potential to support Braunton's milk-vetch. The acreages of each soil map unit within Units 1D and 2F were calculated using ArcGIS software. Field surveys did not involve soil testing or sampling to characterize soil types.

Braunton's Milk-vetch Occurrence Survey

The areas within Units 1D and 2F that overlap with SSFL property were surveyed for the presence of Braunton's milk-vetch. The surveys included pedestrian transects spaced at no more than 10 meters for complete visual coverage of the areas. Braunton's milk-vetch occurrences were marked in the field and recorded using global positioning system (GPS) technology. Single points were recorded for isolated individuals. The edges of populations were marked with pin flags and flagging tape; GPS technology was used to record the boundaries of the population on within the SSFL property boundary.

Braunton's Milk-vetch Population Assessment

SWCA biologists conducted an assessment of the Braunton's milk-vetch population within Unit 1D in June 2006. The purpose of the fieldwork was to estimate the extent, size, and structure of the Braunton's milk-vetch population in Unit 1D that falls within the SSFL property boundary.

The population survey was conducted along four randomized belt transects within the extent of the population in Unit 1D within the SSFL property boundary. Sampling methodology included a

modification of techniques used during previous Braunton's milk-vetch population surveys conducted elsewhere (Anderson 2004). The four belt-transects varied in length from 20 to 80 meters. Between one and four 20x20 meter quadrats were randomly placed on either the north or south side of each transect. A total of ten quadrats were ultimately established along the transects, for a total coverage of 400 square meters (approximately 1 acre). The goal of the sampling was to establish enough quadrats to cover at least five percent of the area occupied by Braunton's milk-vetch in Unit 1D within the SSFL property boundary. A Braunton's milk-vetch count was conducted within each of the quadrats, and plants were placed into one of four arbitrarily chosen categories based on plant height (0-10 cm, 11 to 35 cm, 36 to 70 cm, and greater than 70 cm). Along each of the transects, a single quadrat was randomly chosen for a complete vegetation profile survey in which a complete vascular plant species list was generated. Data were documented with photographs, field notes, and GPS coordinates.

Pollinator Occurrence

A focused survey for pollinators of Braunton's milk-vetch was not performed, but a list of potential pollinators was generated during work conducted within the two units. Pollinators observed in the vicinity of the study area were recorded during vegetation mapping and Braunton's milk-vetch population surveys.

3.0 RESULTS

Vegetation Community Mapping (Unit 1D)

The entire Unit 1D area (76 acres) was mapped using aerial imagery, visual observations, and field verification (within the SSFL property boundary). Vegetation communities identified in the survey area include chaparral, oak woodland, Mexican elderberry shrubland, and grassland. These communities are described below,; a summary of the communities with acreage and percent cover within Unit 1D is provided in Table 1 (note that data were digitized using aerial photography and field observations; portions of Unit 1D on adjacent private property were not field verified). A map of the vegetation communities is presented in Figure 2.

Table 1. Summary of vegetation communities in Unit 1D

Vegetation Community[1]	Acreage[2]	Acreage on SSFL	Percent Cover[3]
Chamise-Chaparral Yucca Series	22.66	16.4	29.58%
Sumac Shrub	0.56	0.56	0.73%
Oak Woodland	15.69	15.4	20.48%
Mexican Elderberry Shrubland	0.32	0.32	0.42%
Non-native Grassland	27.81	27.2	36.31%
Purple Needlegrass Grassland	9.57	9.5	12.48%
Total	**76.55**	**69.38**	**100%**

[1] Vegetation communities based on CDFG (2003), Holland (1986), and/or Sawyer and Keeler-Wolf (1995)
[2] Acreage and percent cover estimated from digitized data using ArcGIS (Figure 2)
[3] Percent cover is for entire area in Unit 1D (SSFL and adjacent private property); estimated from digitized data

Chaparral

The majority of the chaparral community within Unit 1D is characterized as mixed chaparral. Because the chaparral had recently burned (in October 2005; Photograph 3), percent cover of the various dominant shrub species could not be accurately assessed. Dominant shrubs identified in this community include chamise (*Adenostoma fasciculatum*), hollyleaf redberry (*Rhamnus ilicifolia*), sugarbush (*Rhus ovata*), toyon (*Heteromeles arbutifolia*), and hoaryleaf ceanothus (*Ceanothus crassifolius*). Chamise is the most commonly occurring species on site; the most common associates are chaparral yucca (*Hesperoyucca whipplei*) and hoaryleaf ceanothus. This description most closely matches that of the southern mixed chaparral (Holland 1986), chamise-hoaryleaf ceanothus series (Sawyer and Keeler-Wolf 1995), and chamise-chaparral yucca series (CDFG 2003). Braunton's milk-vetch is common in Unit 1D within this vegetation type (Figure 2). A list of species observed in this series is presented in Table 2. Approximately 22.66 acres, approximately 30 % of the total area within Unit 1D, were mapped as this vegetation type. Approximately 16.4 acres of the total mapped area are within the SSFL property boundary.

A small area of chaparral vegetation in the northeastern portion of Unit 1D does not contain chamise, but rather is dominated by laurel sumac (*Malosma laurina*). This stand also contains hollyleaf redberry, toyon, and sugarbush. The stand most closely matches that of the southern mixed chaparral (Holland 1986), sumac scrub (CDFG 2003), and sumac series (Sawyer and Keeler-Wolf 1995). Braunton's milk-vetch was not observed in this area. A list of species observed in this series is presented in Table 3. The sumac series occurs on approximately 0.56-acre, approximately 0.7 % of the total area in Unit 1D; this series occurs only within the SSFL property boundary.

Table 2. Species observed in the chamise-chaparral yucca series within Unit 1D

Common Name	Scientific Name
Chamise	*Adenostoma fasciculatum*
Bigberry manzanita	*Arctostaphylos glauca*
Prickly poppy	*Argemone munita*
Slim Aster	*Aster subulatus*
Braunton's milk-vetch	*Astragalus brauntonii*
Wild oats	*Avena* sp.
Coyote brush	*Baccharis pilularis*
Oregon grape	*Berberis aquifolium*
Black mustard	*Brassica nigra*
Red brome	*Bromus madritensis* ssp. *rubens*
Catalina mariposa lily	*Calochortus catalinae*
Coast morning glory	*Calystegia macrostegia*
Hoaryleaf ceanothus	*Ceanothus crassifolius*
Wedgeleaf ceanothus	*Ceanothus cuneatus*
Tocalote	*Centaurea melitensis*
White pincushion	*Chaenactis artemisiifolia*
Cobwebby thistle	*Cirsium occidentale*
Bull thistle	*Cirsium vulgare*
Canadian horseweed	*Conyza canadensis*
Rigid bird's beak	*Cordylanthus rigidus*
Yellow bleeding heart	*Dicentra ochroleuca*
Wild cucumber	*Echinocystis lobata*
Whispering bells	*Emmenanthe penduliflora*
Thickleaf yerba santa	*Eriodictyon crassifolium*
Death camas	*Zigadenus fremontii*
Phlox-leaved bedstraw	*Galium andrewsii*
Slender-leaved sunflower	*Helianthus gracilentus*
Chaparral yucca	*Hesperoyucca whipplei*
Toyon	*Heteromeles arbutifolia*
Giant wild rye	*Leymus cinereus*
Shiny biscuitroot	*Lomatium lucidum*
Bird's-foot trefoil	*Lotus corniculatus*
Cliff desertdandelion	*Malacothrix saxatilis*
Laurel sumac	*Malosma laurina*
Horehound	*Marrubium vulgare*
San Luis blazing star	*Mentzelia micrantha*
Douglas' sandwort	*Minuartia douglasii*
California peony	*Paeonia californica*
Indian warrior	*Pedicularis densiflora*
Hollyleaf redberry	*Rhamnus ilicifolia*
Sugarbush	*Rhus ovata*
Purple sage	*Salvia leucophylla*
Black sage	*Salvia mellifera*

Table 2. Species observed in the chamise-chaparral yucca series within Unit 1D

Common Name	Scientific Name
Milk thistle	*Silybum marianum*
Purple nightshade	*Solanum xanti*
Prickly sow thistle	*Sonchus asper* ssp. *asper*
Poison oak	*Toxicodendron diversilobum*
Woolly bluecurl	*Trichostema lanatum*
Sour clover	*Trifolium fucatum*
Hairy vetch	*Vicia villosa*

Table 3. Species observed in the sumac series within Unit 1D

Common Name	Scientific Name
Prickly poppy	*Argemone munita*
California sagebrush	*Artemisia californica*
Narrow-leaved milkweed	*Asclepias fascicularis*
Wild oats	*Avena* sp.
Coyote brush	*Baccharis pilularis*
Black mustard	*Brassica nigra*
Red brome	*Bromus madritensis* ssp. *rubens*
Catalina mariposa lily	*Calochortus catalinae*
Club-haired mariposa lily	*Calochortus clavatus* var. *clavatus*
Plummer's mariposa lily	*Calochortus plummerae*
Coast morning glory	*Calystegia macrostegia*
Bull thistle	*Cirsium vulgare*
Wild cucumber	*Echinocystis lobata*
Redstem filaree	*Erodium cicutarium*
Heart-leaf penstemon	*Keckiella cordifolia*
Giant wild rye	*Leymus cinereus*
Chaparral honeysuckle	*Lonicera interrupta*
Arroyo lupine	*Lupinus succulentus*
Cliff desertdandelion	*Malacothrix saxatilis*
Laurel sumac	*Malosma laurina*
Sticky monkeyflower	*Mimulus aurantiacus*
Purple needlegrass	*Nassella pulchra*
Fiesta flower	*Pholistoma auritum*
Smilo grass	*Piptatherum miliaceum*
Hollyleaf redberry	*Rhamnus ilicifolia*
Fuchsia-flowered gooseberry	*Ribes speciosum*
Purple sage	*Salvia leucophylla*
Mexican elderberry	*Sambucus mexicana*
Blue-eyed grass	*Sisyrinchium bellum*
Purple nightshade	*Solanum xanti*

Oak Woodland

Significant portions of Unit 1D are vegetated in oak woodland, which is dominated by coast live oak (*Quercus agrifolia*). Common associates include black walnut (*Juglans nigra*), Mexican elderberry (*Sambucus mexicanus*), laurel sumac, and poison oak (*Toxicodendron diversilobum*). This community most closely matches the coast live oak woodland (Holland 1986; CDFG 2003) and coast live oak series (Sawyer and Keeler-Wolf 1995). Braunton's milk-vetch was observed within the oak woodland in the north-central portion of Unit 1D, which is adjacent to and downslope from a chaparral stand containing chamise (Figure 2). The Braunton's milk-vetch plants are generally sparsely distributed within the woodland; however, several dense stands were observed in more open areas and at the edges of the woodland. A list of species observed in coast live oak woodland is presented in Table 4. This vegetation type occurs on approximately 15.67 acres, approximately 20 % of the total area within Unit 1D. Approximately 15.4 acres of the total mapped area are within the SSFL property boundary.

Table 4. Species observed in the coast live oak woodland within Unit 1D

Common Name	Scientific Name
Braunton's milk-vetch	*Astragalus brauntonii*
Wild oats	*Avena* sp.
Oregon grape	*Berberis aquifolium*
Red brome	*Bromus madritensis* ssp. *rubens*
Coast morning glory	*Calystegia macrostegia*
Bull thistle	*Cirsium vulgare*
Canadian horseweed	*Conyza canadensis*
Bleeding hearts	*Dicentra ochroleuca*
Black walnut	*Juglans californica* var. *californica*
Giant wild rye	*Leymus cinereus*
Chaparral honeysuckle	*Lonicera interrupta*
Deerweed	*Lotus scoparius*
Chaparral mallow	*Malacothamnus fasciculatus*
Cliff desertdandelion	*Malacothrix saxatilis*
Laurel sumac	*Malosma laurina*
Sticky monkeyflower	*Mimulus aurantiacus*
California peony	*Paeonia californica*
Indian warrior	*Pedicularis densiflora*
Smilo grass	*Piptatherum miliaceum*
Coast live oak	*Quercus agrifolia*
Fuchsia-flowered gooseberry	*Ribes speciosum*
Mexican elderberry	*Sambucus mexicana*
Milk thistle	*Silybum marianum*
Purple nightshade	*Solanum xanti*
Prickly sow thistle	*Sonchus asper* ssp. *asper*
Creeping snowberry	*Symphoricarpos mollis*
Poison oak	*Toxicodendron diversilobum*

Mexican Elderberry Shrubland

A small area dominated by scattered Mexican elderberry shrubs is present in the western-central portion of Unit 1D. This vegetation type is located between two woodland areas where oaks and walnuts occur, downslope and adjacent to a chaparral stand that contains chamise. The most common associate in this vegetation type is poison oak. A number of non-native grassland species occur between the widely-spaced shrubs. This community most closely matches the elderberry savannah (CDFG 2003) and Mexican elderberry series (Sawyer and Keeler-Wolf 1995). A fairly dense stand of Braunton's milk-vetch was observed in this stand of Mexican elderberry (Figure 2). A list of species observed within this community is presented in Table 5. The Mexican elderberry series occurs on approximately 0.32-acre, approximately 0.4 % of the total area within Unit 1D; this series occurs only within the SSFL property boundary.

Table 5. Species observed in the Mexican elderberry series within Unit 1D

Common Name	Scientific Name
Prickly poppy	*Argemone munita*
Narrow-leaved milkweed	*Asclepias fascicularis*
Braunton's milk-vetch	*Astragalus brauntonii*
Wild oats	*Avena* sp.
Black mustard	*Brassica nigra*
Red brome	*Bromus madritensis* ssp. *rubens*
Coast morning glory	*Calystegia macrostegia*
Bull thistle	*Cirsium vulgare*
Canadian horseweed	*Conyza canadensis*
Bleeding hearts	*Dicentra ochroleuca*
Wild cucumber	*Echinocystis lobata*
Redstem filaree	*Erodium cicutarium*
Deerweed	*Lotus scoparius*
Arroyo lupine	*Lupinus succulentus*
Chaparral mallow	*Malacothamnus fasciculatus*
Cliff desertdandelion	*Malacothrix saxatilis*
Fiesta flower	*Pholistoma auritum*
Smilo grass	*Piptatherum miliaceum*
Mexican elderberry	*Sambucus mexicana*
Milk thistle	*Silybum marianum*
Purple nightshade	*Solanum xanti*
Prickly sow thistle	*Sonchus asper* ssp. *asper*
Poison oak	*Toxicodendron diversilobum*

Grassland

Grasslands occur over a significant portion of Unit 1D and include disturbed areas dominated by non-native grasses and comparatively less disturbed areas dominated by native grasses. Non-native grassland is dominated by soft brome (*Bromus hordeaceus*), rip-gut brome (*Bromus diandrus*), red brome (*Bromus rubens*), wild oats (*Avena* sp.), smilo grass (*Piptatherum miliaceum*), black mustard (*Brassica nigra*), tocalote (*Centaurea melitensis*), bull thistle (*Cirsium vulgare*), milk thistle (*Silybum marianum*), and coast morning glory (*Calystegia macrostegia*).

The non-native grassland varies considerably in composition within Unit 1D, which appears to be dependent on the degree of disturbance. This community most closely matches the non-native grassland (Holland 1986, CDFG 2003) and California annual grassland series (Sawyer and Keeler-Wolf 1995). A fairly dense stand of Braunton's milk-vetch was observed in one small area containing non-native grassland in the western-central portion of Unit 1D adjacent to the chaparral stand containing chamise and the elderberry shrubland (Figure 2). A list of species observed in the non-native grassland is presented in Table 6. This vegetation type occurs on approximately 27.8 acres, approximately 36 % of the total area within Unit 1D. Approximately 27.2 acres of the total mapped area are within the SSFL property boundary.

Table 6. Species observed in the non-native grassland within Unit 1D

Common Name	Scientific Name
Scarlet pimpernel	*Anagallis arvensis*
Prickly poppy	*Argemone munita*
Narrow-leaved milkweed	*Asclepias fascicularis*
Braunton's milk-vetch	*Astragalus brauntonii*
Wild oats	*Avena* sp.
Black mustard	*Brassica nigra*
Rip-gut brome	*Bromus diandrus*
Soft brome	*Bromus hordeaceus*
Red brome	*Bromus madritensis* ssp. *rubens*
Coast morning glory	*Calystegia macrostegia*
Tocalote	*Centaurea melitensis*
Bull thistle	*Cirsium vulgare*
Canadian horseweed	*Conyza canadensis*
Wild cucumber	*Echinocystis lobata*
Turkey mullein	*Eremocarpus setigerus*
Redstem filaree	*Erodium cicutarium*
Slender leaved sunflower	*Helianthus gracilentus*
Prickly lettuce	*Lactuca serriola*
Common California-aster	*Lessingia filaginifolia*
Bird's-foot trefoil	*Lotus corniculatus*
Arroyo lupine	*Lupinus succulentus*
Cliff desertdandelion	*Malacothrix saxatilis*
Horehound	*Marrubium vulgare*
Caterpillar phacelia	*Phacelia cicutaria* var. *cicutaria*
Fiesta flower	*Pholistoma auritum*
Smilo grass	*Piptatherum miliaceum*
Milk thistle	*Silybum marianum*
Purple nightshade	*Solanum xanti*
Field sowthistle	*Sonchus arvensis*
Prickly sow thistle	*Sonchus asper* ssp. *asper*
Sour clover	*Trifolium fucatum*
Hairy vetch	*Vicia villosa*

Native grassland in Unit 1D is dominated by purple needlegrass (*Nassella pulchra*) and other native annuals and subshrubs. A few non-native annual species are present in this grassland, but these species do not dominate to the degree observed in the non-native grassland. This vegetation community most closely matches the valley needlegrass grassland (Holland 1986), foothill needlegrass series (Sawyer and Keeler-Wolf 1995), and purple needlegrass grassland (CDFG 2003). Braunton's milk-vetch was observed in two small areas of this plant community: adjacent to oak woodlands and chamise-chaparral yucca series in the eastern extent of the population and between two areas of chamise-chaparral yucca in the southern portion of the population. A list of species observed within this community is presented in Table 7. Purple needlegrass grassland occurs on approximately 9.6 acres, approximately 12 % of the total area within Unit 1D. Approximately 9.5 acres of the total mapped area are within the SSFL property boundary.

Table 7. Species observed in the purple needlegrass grassland within Unit 1D

Common Name	Scientific Name
Common yarrow	*Achillea millefolium*
California sagebrush	*Artemisia californica*
Braunton's milk-vetch	*Astragalus brauntonii*
Wild oats	*Avena* sp.
Coyote brush	*Baccharis pilularis*
Catalina mariposa lily	*Calochortus catalinae*
Club-haired mariposa lily	*Calochortus clavatus* var.*clavatus*
Plummer's mariposa lily	*Calochortus plummerae*
Elegant clarkia	*Clarkia unguiculata*
Cryptantha	*Cryptantha* sp.
California dodder	*Cuscuta californica*
Santa Susana tarplant	*Hemizonia minthornii*
California fuchsia	*Epilobium canum*
California buckwheat	*Eriogonum fasciculatum*
Golden yarrow	*Eriophyllum confertiflorum*
California poppy	*Eschscholzia californica*
California everlasting	*Gnaphalium californicum*
Everlasting cudweed	*Gnaphalium stramineum*
Chaparral yucca	*Hesperoyucca whipplei*
Common California-aster	*Lessingia filaginifolia*
Deerweed	*Lotus scoparius* var. *scoparius*
Cliff desertdandelion	*Malacothrix saxatilis*
Sticky monkeyflower	*Mimulus aurantiacus*
Caterpillar phacelia	*Phacelia cicutaria* var. *cicutaria*
Annual bluegrass	*Poa annua*
White sage	*Salvia apiana*
Purple sage	*Salvia leucophylla*
Black sage	*Salvia mellifera*
Rattail fescue	*Vulpia myuros*

Vegetation Community Mapping (Unit 2F)

Vegetation mapping was limited to the portion of Unit 2F that occurs within the SSFL property boundary, which consists of 3.97 acres. Vegetation communities identified in this area include chamise chaparral, riparian forest, and grassland. These communities are described below. A summary of the communities with acreage and percent cover within the unit is provided in Table 8.

Table 8. Summary of vegetation communities within the SSFL property boundary in Unit 2F

Vegetation Community[1]	Acreage[2]	Percent Cover[2]
Southern Coast Live Oak Riparian Forest	0.25	6.30%
Southern Mixed Chaparral	1.35	34.00%
Non-native Grassland	2.37	59.70%
Total	**3.97**	**100%**

[1] Vegetation communities based on CDFG (2003), Holland (1986), and/or Sawyer and Keeler-Wolf (1995)
[2] Acreage and percent cover estimated from digitized data using ArcGIS (Figure 3)

Chaparral

The majority of the chaparral community within Unit 2F is characterized as Southern mixed chaparral (Holland 1986). Dominant shrubs identified in this community include wedgeleaf ceanothus (*Ceanothus cuneatus*), birchleaf mountain mahogany (*Cercocarpus betuloides* var. *betuloides*), laurel sumac, chamise, hollyleaf redberry, sugarbush, and toyon. White sage (*Salvia apiana*), California everlasting (*Gnaphalium californicum*), and poison oak are common in the understory. A list of species observed within this community is presented in Table 9. Chaparral occurs on approximately 1.35 acres, approximately 34 % of the area of Unit 2F within the SSFL property boundary.

Table 9. Species observed in the chamise chaparral within Unit 2F

Common Name	Scientific Name
Chamise	*Adenostoma fasciculatum*
Coyote brush	*Baccharis pilularis*
Black mustard	*Brassica nigra*
Wedgeleaf ceanothus	*Ceanothus cuneatus*
Yellow star thistle	*Centaurea solstitialis*
Birchleaf mountain mohogany	*Cercocarpus betuloides* var. *betuloides*
Bull thistle	*Cirsium vulgare*
California everlasting	*Gnaphalium californicum*
Chaparral yucca	*Hesperoyucca whipplei*
Toyon	*Heteromeles arbutifolia*
Heart-leaf penstemon	*Keckiella cordifolia*
Giant ryegrass	*Leymus condensatus*
Laurel sumac	*Malosma laurina*
Horehound	*Marrubium vulgare*
Hollyleaf redberry	*Rhamnus ilicifolia*
Sugarbush	*Rhus ovata*
White sage	*Salvia apiana*
Poison oak	*Toxicodendron diversilobum*

Riparian Forest

The riparian community within Unit 2F is characterized as Southern Coast Live Oak Riparian Forest (Holland 1986). The dominant species include coast live oak in the overstory and poison oak, wild cucumber (*Marah fabaceus*), and mugwort (*Artemisia douglasiana*) in the understory. Other species in the understory of this area include bull thistle, caterpillar phacelia (*Phacelia cicutaria* var. *cicutaria*), laurel sumac, and a variety of non-native annual grasses. A list of species observed within this community is presented in Table 10. This riparian community occurs on approximately 0.25-acre, approximately 6.3% of the area of Unit 2F within the SSFL property boundary.

Table 10. Species observed in the riparian forest within Unit 2F

Common Name	Scientific Name
Mugwort	*Artemisia douglasiana*
Wild oats	*Avena* sp.
Black mustard	*Brassica nigra*
Soft brome	*Bromus hordeaceus*
Red brome	*Bromus madritensis* ssp. *rubens*
Italian thistle	*Carduus pycnocephalus*
Yellow star thistle	*Centaurea solstitialis*
Bull thistle	*Cirsium vulgare*
Wild cucumber	*Marah macrocarpus*
Giant ryegrass	*Leymus condensatus*
Laurel sumac	*Malosma laurina*
Caterpillar phacelia	*Phacelia cicutaria* var. *cicutaria*
Coast live oak	*Quercus agrifolia*
Milk thistle	*Silybum marianum*
Common snowberry	*Symphoricarpos albus*
Creeping snowberry	*Symphoricarpos mollis*
Poison oak	*Toxicodendron diversilobum*

Grassland

Grasslands occur over a significant area in the northern portion of Unit 2F within the SSFL property boundary. The grassland community includes disturbed areas dominated by non-native grasses and annuals. Dominant species included yellow star thistle (*Centaurea melitensis*), soft brome, rip-gut brome, red brome, wild oats, smilo grass, black mustard, bull thistle, and milk thistle. The non-native grassland area appeared to have been significantly disturbed by the Topanga Fire. Native shrub species are sparsely dispersed throughout the grassland and include chamise, laurel sumac, wedgeleaf ceanothus, California sagebrush (*Artemisia californica*), chaparral mallow (*Malacothamnus fasciculatus*), and California buckwheat (*Eriogonum fasciculatum*). This community most closely matches the non-native grassland (Holland 1986, CDFG 2003) and California annual grassland series (Sawyer and Keeler-Wolf 1995). A list of species observed within this community is presented in Table 11. Non-native grassland occurs on approximately 2.4 acres, approximately 59.7 % of the area of Unit 2F within the SSFL property boundary.

Table 11. Species observed in the non-native grasslands within Unit 2F

Common Name	Scientific Name
Chamise	*Adenostoma fasciculatum*
California sagebrush	*Artemisia californica*
Wild oats	*Avena* sp.
Coyote brush	*Baccharis pilularis*
Black mustard	*Brassica nigra*
Rip-gut brome	*Bromus diandrus*
Soft brome	*Bromus hordeaceus*
Red brome	*Bromus madritensis* ssp. *rubens*
Italian thistle	*Carduus pycnocephalus*
Wedgeleaf ceanothus	*Ceanothus cuneatus*
Yellow star thistle	*Centaurea solstitialis*
Chaparral yucca	*Hesperoyucca whipplei*
Toyon	*Heteromeles arbutifolia*
Chaparral bush mallow	*Malacothamnus fasciculatus*
Laurel sumac	*Malosma laurina*
Smilo grass	*Piptatherum miliaceum*
Sugarbush	*Rhus ovata*
Milk thistle	*Silybum marianum*

Soils Mapping

Five soil types were identified and mapped in and around Unit 1D (Figure 3), and two soil types were mapped in 2F within the SSFL property boundary (Figure 4). Soil descriptions are provided below and are based on the soil survey for the area (Edwards et al. 1970).

Gaviota Rocky Sandy Loam

This upland soil (GrF) is characterized by a yellowish-brown, neutral sandy loam surface layer approximately 8 inches thick, underlain by sandstone. Bedrock outcrops are common within this soil type. The A horizon ranges from grayish brown through yellowish brown or dark grayish brown through dark yellowish brown. It is typically sandy loam in texture and is slightly acidic to neutral (pH = 6.5 to 7.0). In places where bedrock is deeper, there may be an AC or C horizon that is also sandy loam in texture and slightly acidic to neutral. This soil type occurs within Units 1D and 2F (portion within the SSFL property boundary) (Figures 3 and 4). Within Unit 1D, the Braunton's milk-vetch population occurs on 12.6 acres of this soil type (approximately 76.4 % of the total area occupied by the population) (Figure 3; Table 12).

Calleguas-Arnold Complex

This upland soil (CbF2) consists of approximately 50 % Calleguas shaly loam, 35 % Arnold sand, and the remainder of Castaic, Saugus, Diablo, Gaviota, and Soper soils. Characteristics of this soil are closely related to those of Calleguas shaly loam and Arnold sand. The soil is about 18 inches deep to sandstone and shale and is low in fertility. Calleguas shaly loam is pale-brown, moderately alkaline (pH 8.0), and strongly effervescent. Arnold sand is a light brownish-gray, slightly acidic sand (pH = 5.5 to 6.5), approximately 24 inches thick. This soil type occurs within Units 1D and 2F (portion inside the SSFL property boundary) (Figures 3 and 4). Within Unit 1D, the Braunton's milk-vetch population occurs on 2.2 acres of this soil type (approximately13.5 % of the total area occupied by the population) (Figure 3; Table 12).

Los Osos Clay Loam

This upland soil (LoE2) was formed over sandstone or shale and is located on gentle slopes. It is characterized by a dark-brown, slightly acid clay loam surface layer about 9 inches thick. The subsoil is dark-brown, slightly acid and neutral clay approximately 20 inches thick. The surface is underlain by decomposed shale at a depth of approximately 36 inches. The pH ranges from 6.2 to 7.0 with the most acidic layers on the ground surface. Within Unit 1D, the Braunton's milk-vetch population occurs on 1.2 acres of this soil type (approximately 7 % of the total area occupied by the population) (Figure 3; Table 12).

Zamora Loam

This soil includes strongly sloping soils (ZmD2) or gently to moderately sloping soils (ZmC) located in alluvial fans. The surface layer of this loam is dark grayish-brown and brown, slightly acid and neutral loam approximately 17 inches thick. Underneath the surface, there is mildly alkaline sandy loam that extends to a depth greater than 60 inches. It is more acidic at the surface (pH = 6.5) and ranges to mildly alkaline (pH = 7.5) in deeper horizons. Within Unit 1D, the Braunton's milk-vetch population occurs on 0.5 acres of this soil type (approximately 3.1 % of the total area occupied by the population) (Figure 3; Table 12).

Linne Silty Clay Loam

This upland soil (LeE2) is characterized by a gray, calcareous silty clay loam surface layer that is approximately 21 inches thick. Immediately below the surface layer is a calcareous silty clay loam that is light brownish-gray in color. At a depth of 48 inches, it is weathered, calcareous, soft shale. It is moderately alkaline (pH = 8.0) and violently to strongly effervescent. Braunton's milk-vetch was not observed on this soil type.

Table 12. Occurrence of Braunton's milk-vetch population on soil types within the SSFL property boundary in and near Unit 1D

Soil Type	Acreage[1]	Percentage[2]
Gaviota Rocky Sandy Loam (GrF)	12.64	76.40%
Calleguas-Arnold Complex (CbF2)	2.23	13.50%
Los Osos Clay Loam (LoE2)	1.17	7.00%
Zamora Loam (ZmD2)	0.51	3.10%
Total	**16.55**	**100%**

[1] Acreage calculating using ArcGIS (Figure 4); acreage is only for Braunton's milk-vetch on the SSFL
[2] Percent cover was estimated based on acreage calculations and is only for Braunton's milk-vetch on the SSFL

Braunton's Milk-vetch Occurrence Survey

Within the SSFL property boundary, the Braunton's milk-vetch population occurs over approximately 16.55 acres, including 16.5 acres within Unit 1D and 0.04 acres with SSFL property boundary adjacent to Unit 1D (Figure 5). Braunton's milk-vetch was observed on private lands within Unit 1D adjacent to the SSFL boundary; however, this portion of the population was not surveyed or assessed. Two isolated occurrences of Braunton's milk-vetch were observed within the SSFL property boundary outside of this population, including one individual in the southern portion of Unit 1D and another individual just west of Unit 2F (Figures 3 and 6). The Braunton's milk-vetch population is distributed among several vegetation communities, including chamise-chaparral yucca series, coast live oak woodland, non-native grassland, Mexican elderberry series, and purple needlegrass grassland (Table 13). The isolated Braunton's milk-vetch occurrences were observed within coast live oak woodland in

Unit 1D and in chaparral habitat near Unit 2F within the SSFL property boundary. Despite a thorough search of the vicinity, these individuals were determined to be isolated from nearby populations.

Table 13. Occurrence of Braunton's milk-vetch population within vegetation communities within the SSFL property boundary

Vegetation Community	Acreage	Percentage
Chamise-Chaparral Yucca Series	10.12	61.00%
Coast Live Oak Woodland	4.74	29.00%
Non-native Grassland	1.02	6.00%
Mexican Elderberry Series	0.32	2.00%
Purple Needlegrass Grassland	0.31	2.00%
Total	**16.55**	**100%**

Braunton's Milk-vetch Population Assessment

The population of Braunton's milk-vetch within and adjacent to Unit 1D within the SSFL property boundary was assessed for size and structure using a series of randomized transects. The transects were located primarily within the chamise-chaparral yucca series, although some areas of non-native grassland and coast live oak woodland bordering the chaparral habitats were also sampled (Figure 2). A total of 2,000 Braunton's milk-vetch plants were counted within the ten quadrats (Table 14). Not surprisingly, most of the plants were located along Transect 3, which was the longest transect and contained four quadrats. Quadrats along Transect 3 averaged approximately 278 Braunton's milk-vetch plants per quadrat. A considerable number of plants were also counted within the two quadrats located along Transect 1. The average number (n) of Braunton's milk-vetch plants per quadrat along Transect 1 was approximately 302 plants. Lower numbers of Braunton's milk-vetch plants were observed along Transects 2 and 4. The average number of plants per quadrat along Transect 2 was approximately 70, similar to the approximately 74 plants per quadrat counted along Transect 4.

Table 14. Detailed count and size class data for each of the ten quadrats sampled

Transect	Quadrat	Size Class				Total
		0-10 cm	11-35 cm	35-70 cm	70+	
1	1	65	78	16	4	163
1	2	187	205	47	1	440
Subtotal Transect 1		**252**	**283**	**63**	**5**	**603**
2	1	39	47	6	0	92
2	2	8	8	9	7	32
2	3	31	46	8	0	85
Subtotal Transect 2		**78**	**101**	**23**	**7**	**209**
3	1	114	40	2	0	156
3	2	233	81	21	3	338
3	3	115	123	28	10	276
3	4	162	156	26	0	344
Subtotal Transect 3		**624**	**400**	**77**	**13**	**1,114**
4	1	33	29	8	4	**74**
					Grand Total	**2,000**

Most (n = 987; 49.4 %) of the Braunton's milk-vetch plants fell within the smallest size class (0 to 10cm), and a considerable number (n = 813; 40.6 %) were in the next smallest size category (11 to 35 cm). Few plants (n = 171; 9 %) were within the 36 to 70 cm size category, and fewer (n = 29; 1.4 %) were within the largest size category (greater than 70 cm). Figure 7 summarizes the number of Braunton's milk-vetch plants within each of the four size categories. Figure 8 summarizes the relative percentage of plants according to size along each of the transects. A total of 15 individuals were observed in bloom; four of these were in the 36 to 70 cm category, and 11 were in the greater than70 cm size category.

The Braunton's milk-vetch population in and adjacent to Unit 1D occupies an area of approximately 16.55 acres within the SSFL property boundary. The area sampled by quadrats (approximately 1 acre) represents approximately 5.4 % of the total area occupied by the population. Assuming that the transects and quadrats resulted in a representative sample of the population, the total population size within the SSFL boundary is estimated at 33,500 individuals.

Vegetation Profile

All of the quadrats randomly chosen for detailed vegetation profiles were located within the chamise-chaparral yucca series. The species observed in each of the selected quadrats are presented in Table 15. A ranking was assigned to each species based on the number of quadrats in which it occurred; those that occurred in all four quadrats were assigned a score of four, those that occurred in three of the quadrats were assigned a score of 3, and so on. Seven plants (five native and two non-native invasive plants) received a score of 4. An additional seven species, including six native and one non-native, received a score of 3. Plants that scored 3 or 4 were considered important associates when characterizing Braunton's milk-vetch habitat. These included chamise, hoaryleaf ceanothus, slender-leaved sunflower (*Helianthus gracilentus),* chaparral yucca (*Hesperoyucca whipplei*), shiny biscuitroot (*Lomatium lucidum*), rigid bird's beak (*Cordylanthus rigidus*), laurel sumac, hollyleaf redberry, sugarbush, black sage (*Salvia mellifera*), purple nightshade (*Solanum xanti*), and cliff desertdandelion (*Malacothrix saxatilis*). Two highly aggressive, invasive species (black mustard and bull thistle) also scored high.

Table 15. Vegetation profile for sampled quadrats along each transect

Common Name	Scientific Name	T1, Q1	T2, Q2	T3, Q3	T4, Q1	Score
Chamise	*Adenostoma fasciculatum*	1	1	1	1	**4**
Hoaryleaf ceonothus	*Ceanothus crassifolius*	1	1	1	1	**4**
Slender-leaved sunflower	*Helianthus gracilentus*	1	1	1	1	**4**
Chaparral yucca	*Hesperoyucca whipplei*	1	1	1	1	**4**
Shiny biscuitroot	*Lomatium lucidum*	1	1	1	1	**4**
Black mustard*	*Brassica nigra*	1	1	1	1	**4**
Bull thistle*	*Cirsium vulgare*	1	1	1	1	**4**
Rigid bird's beak	*Cordylanthus rigidus*	1	1	1	0	**3**
Laurel sumac	*Malosma laurina*	1	1	0	1	**3**
Holly-leaf redberry	*Rhamnus ilicifolia*	0	1	1	1	**3**
Sugarbush	*Rhus ovata*	1	0	1	1	**3**
Black sage	*Salvia mellifera*	1	1	1	0	**3**
Purple nightshade	*Solanum xanti*	1	0	1	1	**3**
Cliff desertdandelion	*Malacothrix saxatilis*	1	0	1	1	**3**
Coast morning glory	*Calystegia macrostegia*	1	0	0	1	**2**

Table 15. Vegetation profile for sampled quadrats along each transect

Common Name	Scientific Name	T1, Q1	T2, Q2	T3, Q3	T4, Q1	Score
Yellow bleeding heart	*Dicentra ochroleuca*	1	1	0	0	**2**
Phlox-leaved bedstraw	*Galium andrewsii*	0	1	0	1	**2**
San Luis blazingstar	*Mentzelia micrantha*	0	1	0	1	**2**
Indian warrior	*Pedicularis densiflora*	1	1	0	0	**2**
Prickly poppy	*Argemone munita*	0	0	1	0	**1**
Slim aster	*Aster subulatus*	1	0	0	0	**1**
Oregon grape	*Berberis aquifolium*	0	0	1	0	**1**
Club-haired mariposa lily	*Calochortus clavatus ssp. clavatus*	1	0	0	0	**1**
White pincushion	*Chaenactis artemisiifolia*	0	0	1	0	**1**
Wild cucumber	*Echinocystis lobata*	0	0	0	1	**1**
Toyon	*Heteromeles arbutifolia*	0	0	1	0	**1**
Giant wild rye	*Leymus condensatus*	1	0	0	0	**1**
Douglas' sandwort	*Minuartia douglasii*	0	1	0	0	**1**
Poison oak	*Toxicodendron diversilobum*	0	1	0	0	**1**
Wild oats*	*Avena sp.*	0	1	0	0	**1**
Red brome*	*Bromus madritensis* ssp. *rubens*	0	1	0	0	**1**
Hairy vetch*	*Vicia villosa*	0	0	0	1	**1**

*non-native

Pollinator Occurrence

A total of ten species of pollinators were observed during work within Units 1D and 2F (Table 16). Although none of the pollinators were observed on Braunton's milk-vetch blooms, two bee species observed within Unit 1D are regarded as potentially important Braunton's milk-vetch pollinators: short leafcutter bee (*Megachile brevis*) and California bumblebee (*Bombus californicus*).

Table 16. Observed pollinator species

Common Name	Scientific Name (or taxon)
Diptera	
Hover fly	Syrphidae
Lepidoptera	
Anise swallowtail	*Papilo zelicaon*
Western tiger swallowtail	*Papilo rutulus*
Cabbage white	*Pieris rapae*
Orange sulfur	*Colias eurytheme*
Coronis fritillary	*Speyeria coronis*
Funeral duskywing	*Erynnis funeralis*
Hymenoptera	
Short leafcutter bee	*Megachile brevis*
California bumblebee	*Bombus californicus*
European honey bee	*Apis mellifera*
Aves	
Anna's hummingbird	*Calypte anna*

4.0 DISCUSSION

Vegetation Community Mapping

Unit 1D contains a mosaic of vegetation communities, including grasslands, chaparral, shrubland, and woodland. All of the communities within Unit 1D appear to have burned when the Topanga Fire swept through the area in October 2005. Only a few areas, mainly within interior stands of coast live oak woodland, were not burned. Despite the nearly complete burn of the area, vegetation communities are distinguishable and easily mapped. The grassland communities showed very little evidence of having been burned and were lush with the growth of new annuals at the time of field surveys. Most of the shrubs within the chaparral communities were crown sprouting at the time of surveys, and many seedling shrubs (particularly chamise and hoaryleaf ceanothus) and herbaceous perennials and annuals were observed in the understory.

Unit 2F contained three vegetation communities; only one community– non-native grassland – appeared to have burned substantially during the Topanga Fire.

The recent burn provided an excellent opportunity to perform surveys for Braunton's milk-vetch, a species that follows fire. As observed during the surveys and population studies, the Braunton's milk-vetch population within Unit 1D is fairly large. Its distribution, however, is somewhat restricted to stands of chamise-chaparral yucca (or chamise-hoaryleaf ceanothus). This community, because of the abundance of chamise, responded well to the fire. Chamise possesses a number of adaptations that enhances its flammability, resulting in intense, fast-spreading, and potentially large fires.

These adaptations include:

- Chemical composition of foliage, including flammable waxes, resins, oils, terpenes, and fats (Reid and Oechel 1984).
- Physical structure of the shrubs, which have large amounts of small-stemmed material, distributed continuously from ground level throughout the multi-stemmed canopy, lending spatial continuity to the fuel bed and facilitating heat transfer (Philpot 1977).
- Physiology of the shrubs, which have moisture within the leaves and stems that increases the concentration of extractive chemicals during hot, dry weather, making the plants more flammable in the fall (Rundel 1981).

As a chamise stand matures, the probability of fire occurrence increases (Philpot 1977). Chamise chaparral grows quickly following fire; the rapid growth produces fuel loadings capable of supporting a moderately intense fire within approximately 15 years (Anderson 1982).

Braunton's milk-vetch is well-adapted to chamise chaparral; its seeds can remain dormant for many years before germinating and can germinate quickly after they've been heated. Seedlings can grow quickly to maturity and produce seeds before the thick canopy of the chaparral community grows to block the sunlight. Because of this relationship, the chaparral habitats within Unit 1D that were classified as chamise-chaparral yucca or chamise-hoaryleaf ceanothus series should be considered important habitat for Braunton's milk-vetch.

Braunton's milk-vetch plants were also observed in other habitats, including coast live oak woodland, grasslands, and Mexican elderberry series, outside of, but directly adjacent to, this

chaparral type. In these habitats, Braunton's milk-vetch plants were located down slope from the chaparral habitat containing the core of the Braunton's milk-vetch population. Braunton's milk-vetch is known to germinate down slope from core population areas (USFWS 1999). These habitats, particularly the areas that burned and do not contain a dominant overstory, appear to provide suitable habitat for Braunton's milk-vetch as a result of the fire. Because of the average life span of the Braunton's milk-vetch (2 to 3 years), the population can be expected to survive for several years under current conditions. As the surrounding habitats recover from the fire, portions of the population in adjacent habitats may decline as a result of being crowded out by dense overstory vegetation (shrubs and trees).

Soils Mapping

Within Unit 1D, Braunton's milk-vetch occurs on four soil types: Gaviota rocky sandy loam, Calleguas-Arnold Complex, Zamora loam, and Los Osos clay loam. Most of the Braunton's milk-vetch population occurs on Gaviota rocky sandy loam, a soil that forms from sandstone and is slightly acidic to neutral. Calleguas-Arnold Complex is formed from shaly loam and sand, which ranges from moderately alkaline (shaly loam) to slightly acidic (sand). Zamora loam is an alluvial soil that also forms from sandstone and is slightly acidic to neutral. Finally, Los Osos clay loam is formed from sandstone or shale and is slightly acidic. Braunton's milk-vetch is reportedly restricted to calcareous or carbonate soils derived from limestone, though it has been observed on non-carbonate soils downstream of other occurrences (USFWS 1999). Data collected within Unit 1D indicate that Braunton's milk-vetch is not endemic to calcareous or carbonate soils. These observations agree with data on the historical distribution of Braunton's milk-vetch, which indicate that it occurs on gravelly clay soils overlaying granite sandstone (Skinner 1991). The observations also suggest that the plant is not necessarily endemic to calcareous or carbonate soils derived from limestone.

Braunton's Milk-vetch Population Survey

The Braunton's milk-vetch population occurs over 16.55 acres in the west-central portion of the Unit 1D and adjacent area within the SSFL property boundary. Sampling within the population resulted in a population estimate of approximately 33,500 plants. Based upon data from the CNDDB (Table 17), this would represent one of the largest, if not the largest, known population of this species within its range. Observations from the Santa Monica Mountains National Recreation Area located south of SSFL, which were also burned by the Topanga Fire, indicate that Braunton's milk-vetch populations are quite large there as well. Braunton's milk-vetch was identified on National Park Service lands throughout Palo Comado and Cheeseboro Canyons during the Burned Area Emergency Rehabilitation project. Scattered occurrences and several dense Braunton's milk-vetch stands in these areas indicate the possibility of thousands of individuals (Taya Cummins, personal communication).

Table 17. Known occurrences (presumed extent) of Braunton's milk-vetch

CNDDB Occurrence #	Quad	Maximum Recorded Population Size	Year of Maximum Population
4	Orange	235	2003
7	Calabasas	3	1999
8	Topanga	10	1975
10	Orange	5,092	2003
11	Thousand Oaks	390+	1993
14	Topanga	200	1987
15	Topanga	2,000	1996

Table 17. Known occurrences (presumed extent) of Braunton's milk-vetch

CNDDB Occurrence #	Quad	Maximum Recorded Population Size	Year of Maximum Population
16	Mt. Wilson	330	2001
17	Topanga	2,000	1996
19	Calabasas	30	1987
20	Thousand Oaks	465-815	2002
22	Thousand Oaks	29	1992
23	Calabasas	14	1999
24	Mt. Wilson	<20	2001
25	Thousand Oaks	7	1999
27	Point Dume	100	1999
28	Thousand Oaks	3	1999
29	Calabasas	1	1998
30	Thousand Oaks	68	2003
31	Calabasas	66	2004
32	Point Dume	300	2004
33	Calabasas	30	2000

The population structure data collected within Unit 1D indicates a range in plant sizes, with most individuals smaller than 35 cm. All of the plants likely germinated following the Topanga Fire. The largest plants (especially those in bloom), which had apparently germinated relatively early in the season, seem to be concentrated at lower elevations along slopes where topsoil is probably richer in nutrients. In contrast, smaller plants appear to be located on steeper slopes or high ridges where topsoil had likely eroded and exposed the seeds. Despite this general trend, individuals of all sizes were noted in a variety of topographic situations. The smallest plants appear to have germinated late in the season, possibly 2 to 3 weeks prior to the initiation of field studies within Unit 1D. It is not known how old the largest individuals are; these plants may have germinated within weeks after the Topanga Fire. These data appear to indicate that Braunton's milk-vetch seeds germinate asynchronously.

Two isolated occurrences of Braunton's milk-vetch were recorded during the surveys. The seeds of these plants may have been dispersed to these areas through wildlife agents, such as seed-eating birds. It is possible that Braunton's milk-vetch seeds remain viable after passage through the digestive systems of vertebrate seed predators. Alternatively, seed pods may be transported from population centers by seed predators when the seeds are accidentally dropped during consumption of the pod.

Pollinator Occurrence

A number of pollinator species were observed in the vicinity of the Braunton's milk-vetch population within Unit 1D. These included species previously identified as important Braunton's milk-vetch pollinators, such as Megachilid bees and bumblebees (*Bombus* sp.) (Fotheringham and Keeley 1998). The existence of these species within Unit 1D indicates the presence of conditions necessary for completion of the life cycle of Braunton's milk-vetch.

5.0 REFERENCES CITED

Anderson, D. G.
2004 Population status survey of Schmoll's milkvetch (Astragalus schmolliae C. L. Porter). Final Report prepared for National Park Service Mesa Verde National Park. Colorado Natural Heritage Program, Fort Collins, Colorado.

Anderson, H. W.
1982 Regenerating yellow birch with prescribed fire. In: Proceedings, Society of American Foresters national convention; 1982 September 19-22; Cincinnati, OH. Bethesda, MD: Society of American Foresters: 168-172.

California Department of Fish and Game
2003 List of California Terrestrial Natural Communities Recognized by The California Natural Diversity Database. Wildlife and Habitat Data Analysis Branch, Department of Fish and Game.

Edwards, R. D., D. F. Rabey, and R. W. Kover
1970 Soil survey, Ventura area, California. United States. Soil Conservation Service and California Agricultural Experiment Station. U.S. Soil Conservation Service, Washington, D.C.

Fotheringham, C. and J. Keeley
1998 Draft report, ecology and distribution of Braunton's milkvetch (*Astragalus brauntonii*) and Lyon's pentachaeta (*Pentachaeta lyonii*). Prepared for California Department of Fish and Game, USFWS section 6 contract No. FG5636-R5. 55 pp.

Hickman, J. C. (ed.)
1993 *The Jepson Manual*. University of California Press, Berkeley, California.

Holland, R. F.
1986 Preliminary Descriptions of the Terrestrial Natural Communities of California. California Department of Fish and Game, Sacramento, California

Philpot, Charles W.
1977 Vegetative features as determinants of fire frequency and intensity. In: Mooney, Harold A.; Conrad, C. Eugene, technical coordinators. Proceedings of the symposium on the environmental consequences of fire and fuel management in Mediterreanean ecosystems; 1977 August 1-5; Palo Alto, CA. Gen. Tech. Rep. WO-3. Washington, DC: U.S. Department of Agriculture, Forest Service: 12-16.

Reid, C. and W. Oechel
1984 Effect of shrubland management on vegetation. In: DeVries, Johannes J., ed. Shrublands in California: literature review and research needed for management. Contribution No. 191. Davis, CA: University of California, Water Resources Center: 25-41.

Rundel, Philip W.
1981 Structural and chemical components of flammability. In: Mooney, H. A.; Bonnicksen, T. M.; Christensen, N. L.; [and others], technical coordinators. Fire regimes and ecosystem properties: Proceedings of the conference; 1978 December 11-15; Honolulu, HI. Gen. Tech. Rep. WO-26. Washington, DC: U.S. Department of Agriculture, Forest Service: 183-207.

Sawyer, J. O. and T. Keeler-Wolf
1995 *A Manual of California Vegetation*. California Native Plant Society, Sacramento, California.

Skinner, M.
1991 Rare plants of California: Braunton's milkvetch. *Fremontia* 19(3):6-7

U.S. Fish and Wildlife Service
1999 Recovery Plan for Six Plants from the Mountains Surrounding the Los Angeles Basin. Portland, Oregon. 63 pp.

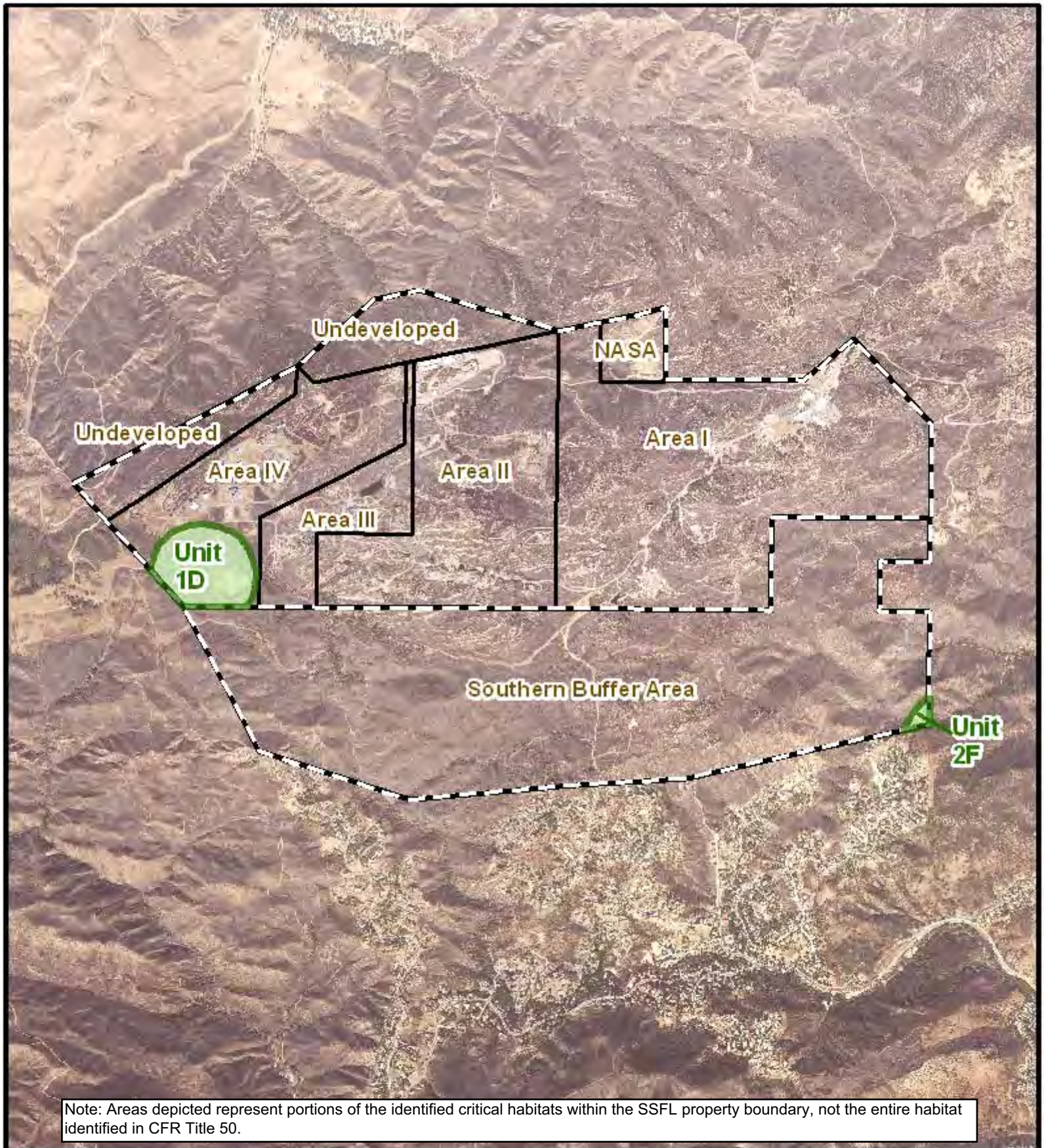
Photographs

Photograph 1. Braunton's milk-vetch.

Photograph 2. Braunton's milk-vetch in bloom.

Photograph 3. View of chaparral (chamise-chaparral yucca series or chamise-hoaryleaf ceanothus series) that burned in the Topanga Fire in October 2005.

Figures



Note: Areas depicted represent portions of the identified critical habitats within the SSFL property boundary, not the entire habitat identified in CFR Title 50.

Legend

- Braunton's Milk-vetch Survey Area
- SSFL Property Boundary

Background: Sage 2003 Aerial Photograph

N

0 1,250 2,500 5,000 Feet

Document: BMV_Survey.MXD

Date: Oct. 1, 2008

Figure 1. Project Location Map
Braunton's Milk-vetch Study

MWH

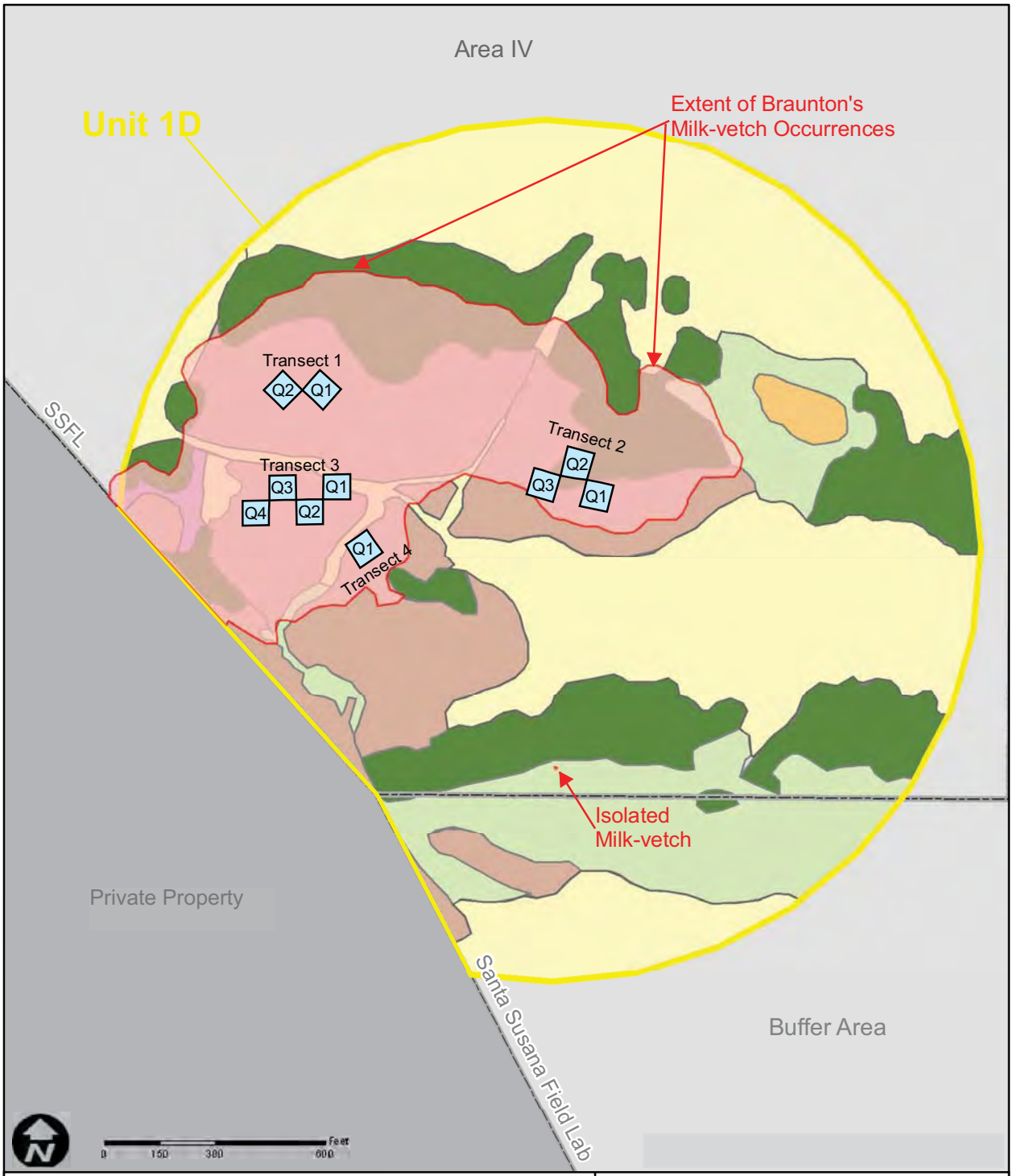


Figure 2. Vegetation Communities in Unit 1D

Braunton's Milk-vetch Study

MWH

Note: Areas depicted represent the portions of Unit 1D within the SSFL property boundary, not the entire habitat identified in CFR Title 50.

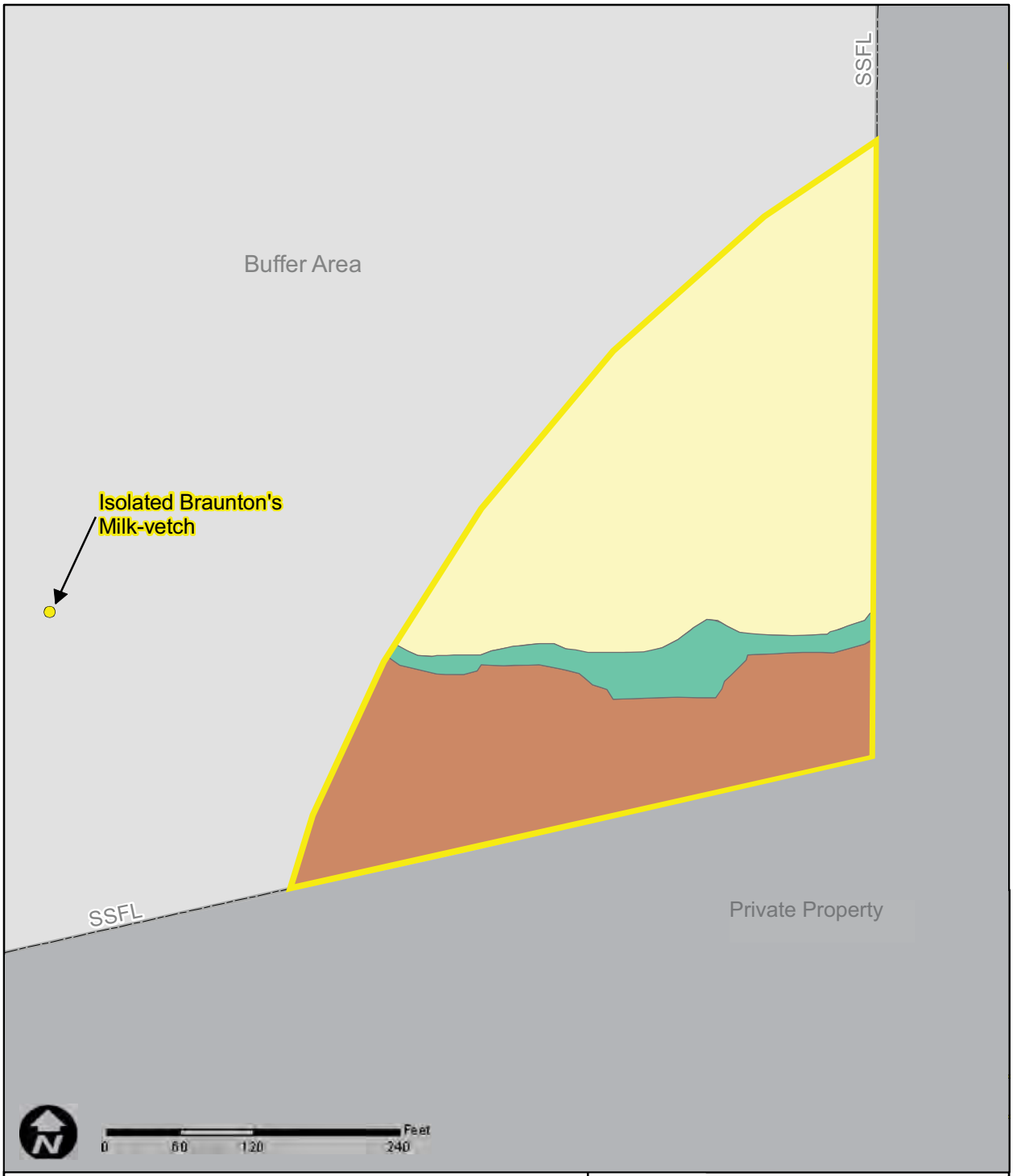
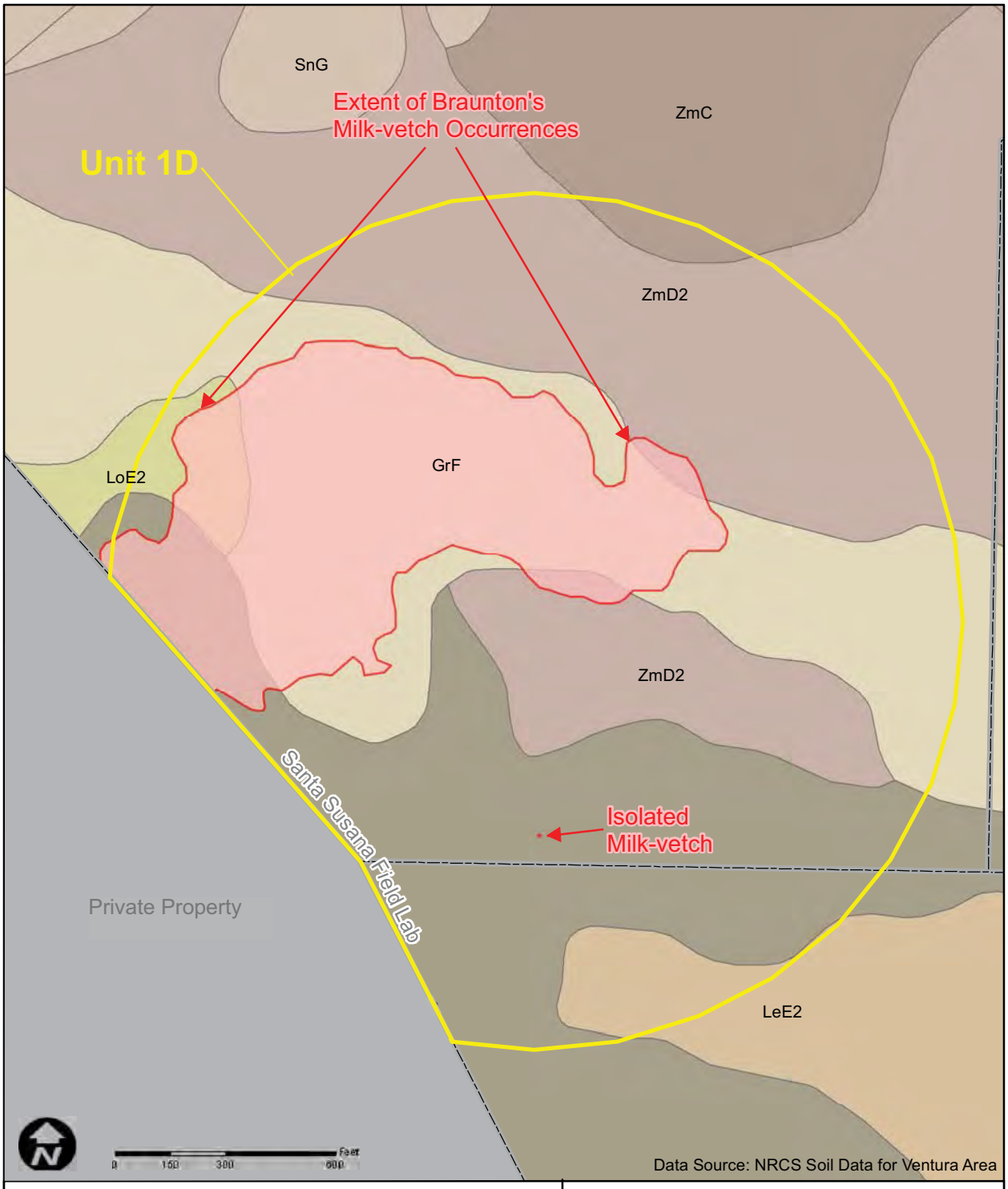


Figure 3. Vegetation Communities in Unit 2F on SSFL

Braunton's Milk-vetch Study

MWH

Note: Areas depicted represent the portions of Unit 2F within the SSFL property boundary, not the entire habitat identified in CFR Title 50.



Soil Map Unit

CbF2	ShE	Santa Susana Field Lab
GrF	SnG	Unit 1D
LeE2	ZmC	Extent of Braunton's Milk-Vetch
LoE2	ZmD2	

Figure 4. Soil Map Units in Unit 1D
Braunton's Milk-Vetch Study

MWH

Note: Areas depicted represent the portions of Unit 1D within the SSFL property boundary, not the entire habitat identified in CFR Title 50.

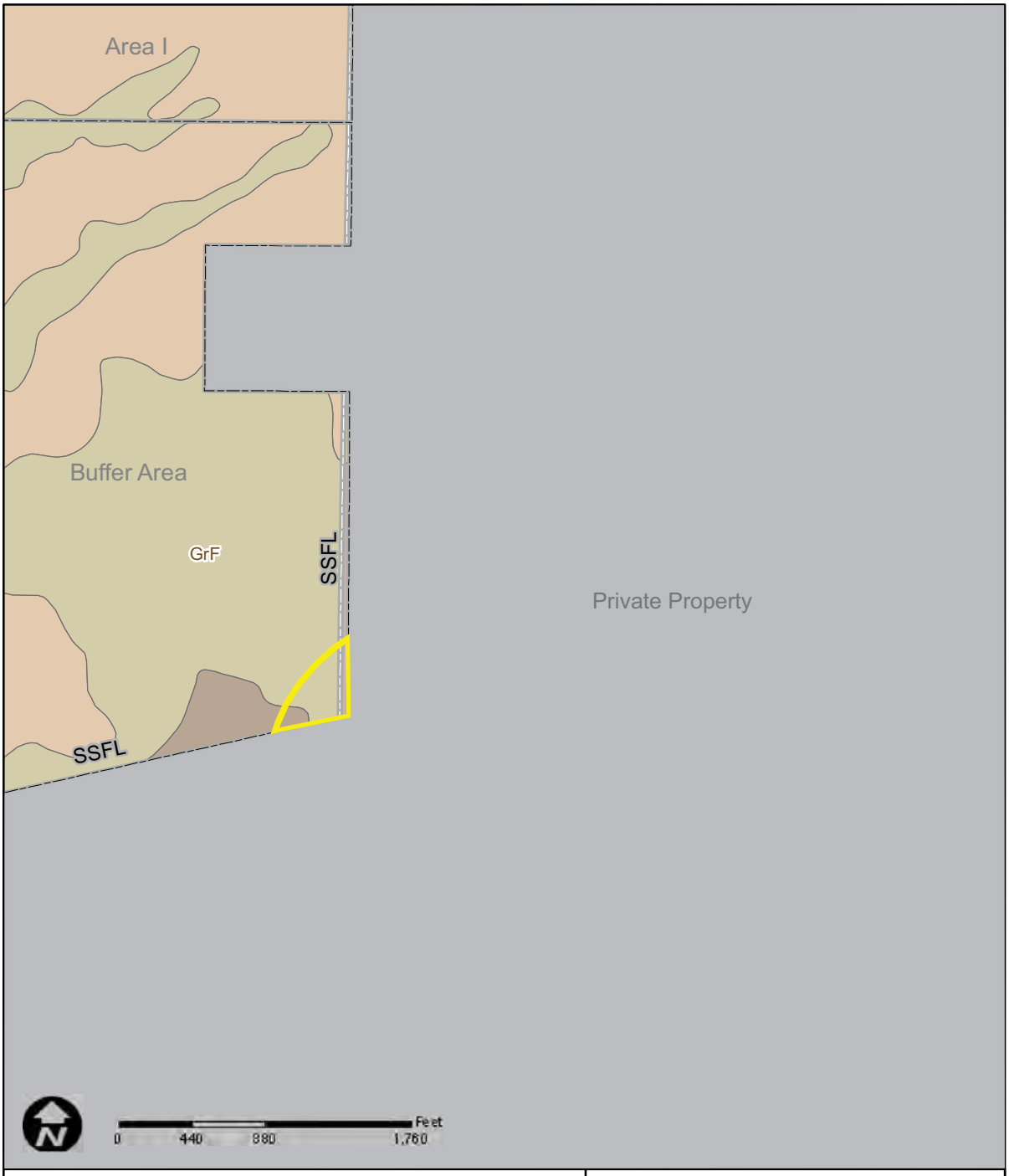


Figure 5. Soil Map Units in Unit 2F

Braunton's Milk-vetch Study

MWH

Note: Areas depicted represent the portion of Unit 2F within the SSFL property boundary, not the entire habitat identified in CFR Title 50.

Legend

- Santa Susana Field Laboratory
- Proposed Critical Habitat
- Extent of Braunton's Milk-Vetch

Figure 6. Milk-vetch Extent in Unit 1D
Braunton's Milk-vetch Study

MWH

Note: Areas depicted represent the portions of Unit 1D within the SSFL property boundary, not the entire habitat identified in CFR Title 50.

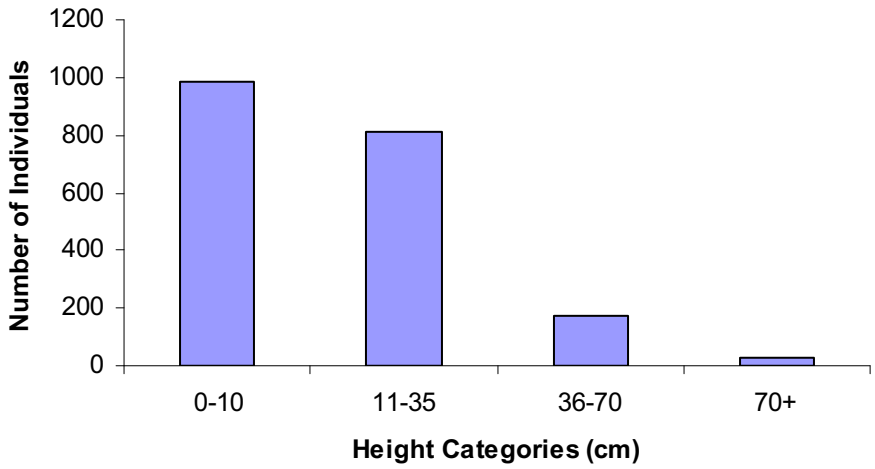


Figure 7. Distribution of Braunton's milk-vetch plants among the four size categories within sampled quadrats

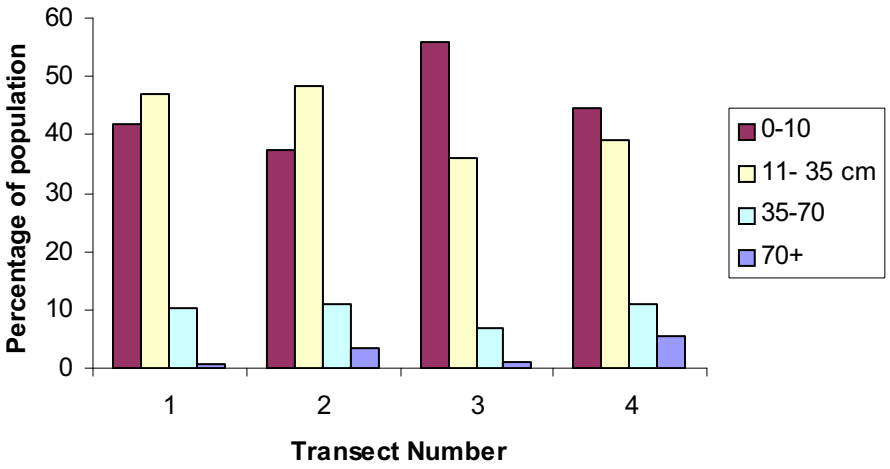


Figure 8. Relative distribution of Braunton's milk-vetch size categories along each transect

Note: Areas depicted represent portions of the identified critical habitats within the SSFL property boundary, not the entire habitat identified in CFR Title 50.