Dudek and Associates, Inc., "2006 Spineflower Monitoring Pilot Study" (2006; 2006A)

2006
SPINEFLOWER
MONITORING PILOT STUDY

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1.0 INTRODUCTION

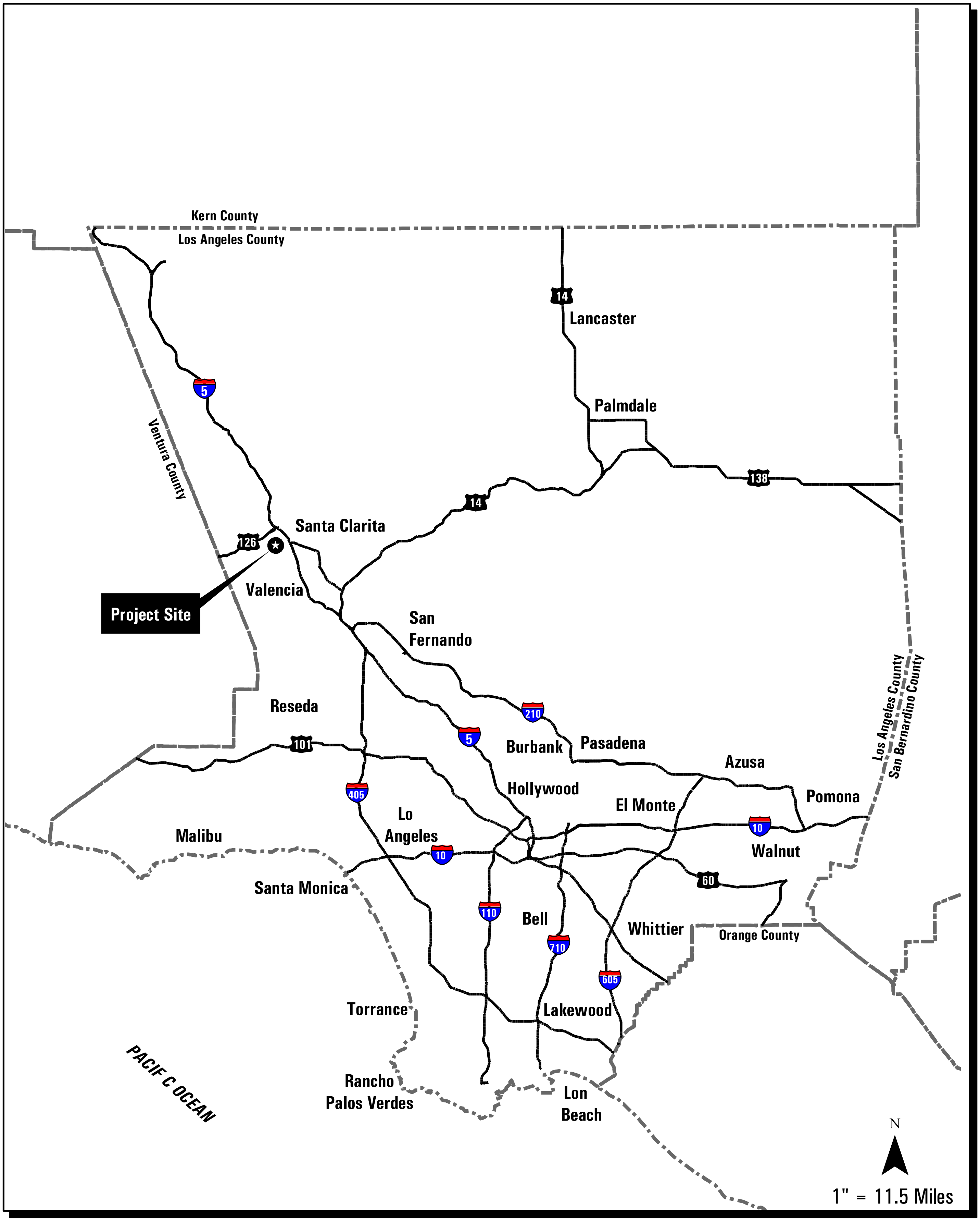
1.1 Pilot Study Location

The 2006 Spineflower Monitoring Pilot Study Area was conducted in the Entrada planning area; and the Airport Mesa, Grapevine Mesa, Potrero Canyon, and San Martinez Grande portions of the Newhall Ranch Specific Plan (NRSP). The Pilot Study Area is located in an unincorporated portion of the Santa Clara River Valley in northwestern Los Angeles County (*Figure 1*). The 11,963-acre NRSP lies roughly 0.5 west of Interstate 5 (I-5) and largely southwest of the junction of I-5 and State Route 126 (SR-126), with portions of NRSP located in San Martinez Grande and Chiquito canyons north of SR-126. The Entrada planning area lies just west of I-5, south of SR-126, and just east of the NRSP (*Figure 2*). Elevations in the Pilot Study Area range from 825 feet above mean sea level (AMSL) in the Santa Clara River bottom at the Ventura County/Los Angeles County line to approximately 3,200 feet AMSL on the ridgeline of the Santa Susana Mountains along the southern boundary.

The City of Santa Clarita is located to the east of the Pilot Study Area and the Ventura County/Los Angeles County line is to the west. On a regional level, the Los Padres and Angeles National Forests are located to the north of the Pilot Study Area, the Angeles National Forest lies to the east and the Santa Susana Mountains are to the south.

1.2 Objectives of the Pilot Study

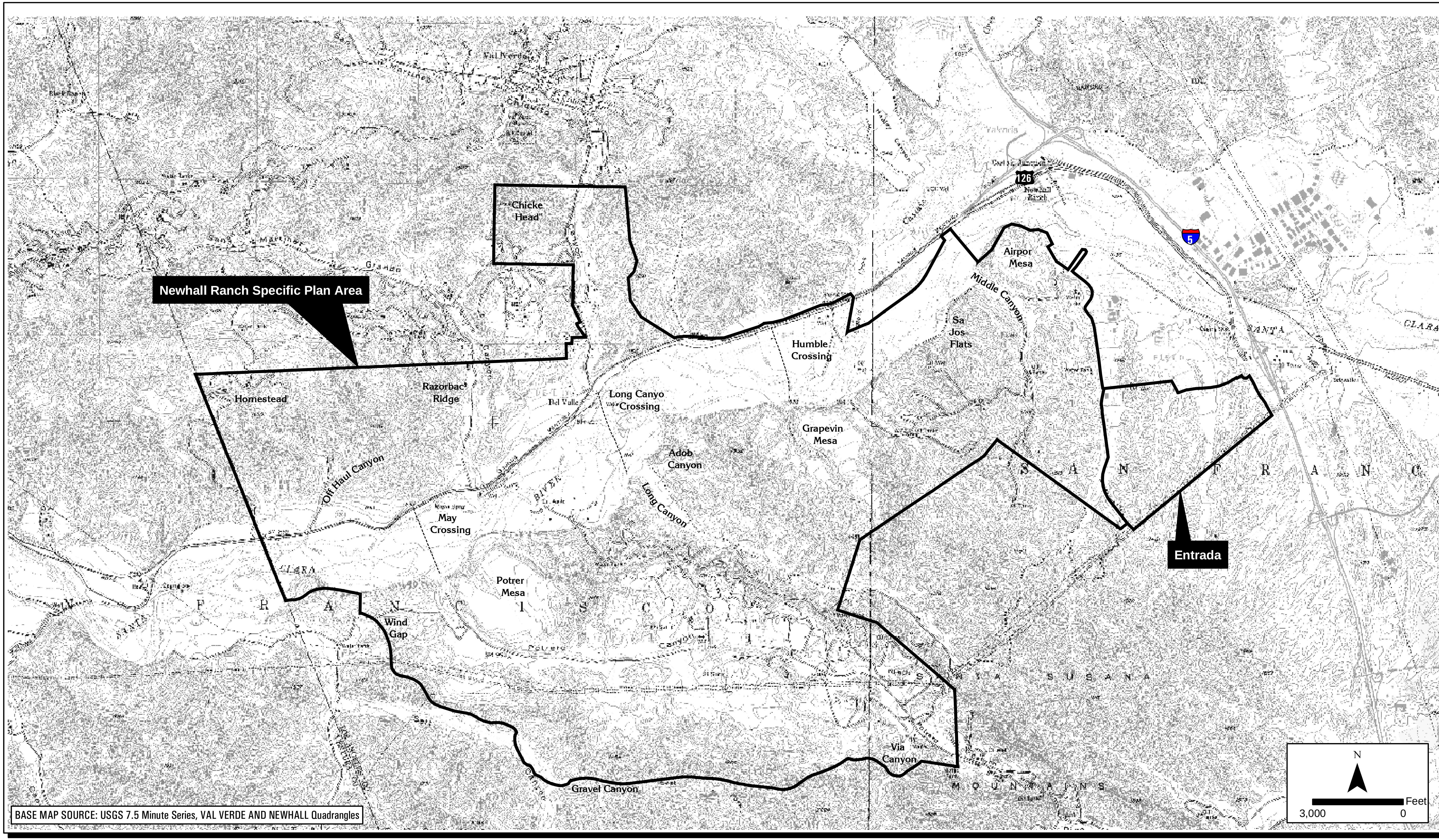
The objective of the Pilot Study was to evaluate the monitoring methods proposed in the Spineflower Conservation Plan (SCP) by implementing the monitoring protocol across a non-random selection of spineflower occurrences representative of the range of environmental conditions and spineflower densities present within the five core populations. The Pilot Study was intended to identify potential deficiencies in the spineflower monitoring methods as proposed in the SCP. Additionally, putting the proposed monitoring methods into practice in the field provided a real-world indication of the level of effort necessary to implement the proposed long-term biological monitoring within future spineflower preserve areas. Evaluating the monitoring methods proposed in the SCP involved biological, statistical and practical considerations. The statistical considerations are particularly important because they allow one to quantitatively evaluate the monitoring methods and identify ways of making the monitoring more efficient without losing statistical power.



2006 Spineflower Monitoring Pilot Study

Regional Map

FIGURE 1



2006 Spineflower Monitoring Pilot Study

Vicinity Map

FIGUR 2

2.0 BACKGROUND

2.1 Relationship to the SCP and Newhall EIR

The primary goal of the SCP is to develop a management and preservation framework that provides for the long-term persistence of spineflower within the project study area (*Figure 3*). The long-term management of core occurrences within future preserve areas is a major component of the preservation framework proposed in the SCP. In order to manage for these core occurrences, an effective long-term monitoring program is necessary to provide meaningful data that can be used to achieve the management objectives of the SCP. The current long-term monitoring protocol is described in the October 2005 Draft SCP and reflects the recommendations provided by CDFG staff at that time. The 2006 Spineflower Monitoring Pilot Study was completed in an attempt to evaluate whether the proposed monitoring protocol would meet the overall objectives of the SCP.

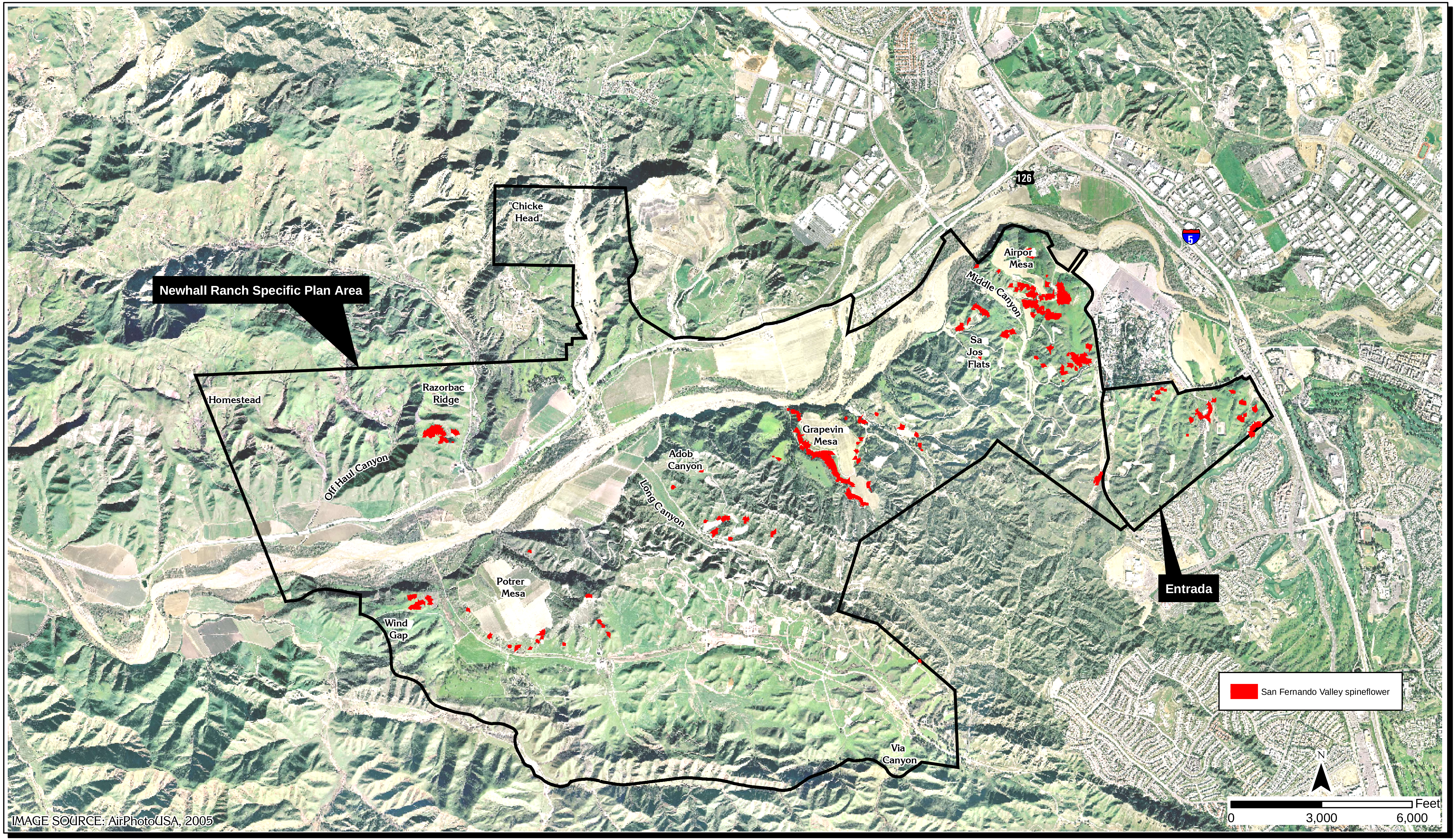
The Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) is expected to be distributed for public review in late 2007. It is anticipated that recommendations from the 2006 Pilot Study will be incorporated into the long-term monitoring protocol proposed in the Draft SCP to be distributed as part of the public review process.

2.2 California ESA/Section 2081

The spineflower is a state-listed endangered plant species, and a federal candidate species. In May 1999, there was only one known extant population of spineflower, located in Ventura County on Laskey Mesa in the southeast edge of the Simi Valley Hills.[1] Prior to May 1999, spineflower was thought to be extinct until it was rediscovered at the Ahmanson Ranch/Laskey Mesa location. It had last been collected in 1927 from the Castaic area of Los Angeles County (CDFG 2006).

At the federal level, the spineflower remains a federal candidate species; however, USFWS lowered the spineflower listing priority in 2004, to reflect threats that are high but non-imminent. Currently, spineflower is known from the Ahmanson Ranch/Laskey Mesa location in Ventura County and the Newhall Land property holdings in Los Angeles County. The Ahmanson Ranch/Laskey Mesa and Newhall Land locations are approximately 17 miles apart.

1 The Laskey Mesa is located within the former Ahmanson Ranch property in Ventura County.



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Overview of Newhall Ranch Spineflower Occurrences

FIGURE 3

Section 2081

California Department of Fish and Game (CDFG 2006) states that "sections 2081(b) and (c) of the California Endangered Species Act allow the Department to issue an incidental take permit for a State listed threatened and endangered species only if specific criteria are met." These criteria include take as incidental to an otherwise lawful activity; impacts that are minimized and fully mitigated and the take will not jeopardize the continued existence of the species (CDFG 2006).

3.0 METHODS

3.1 Summary of Annual Spineflower Mapping Methods

Spineflower populations have been mapped annually each spring from 2002 to 2006 using Global Positioning System (GPS) equipment with sub-meter accuracy. Each year, all spineflower plants within four meters of each other are included in the same polygon. Each polygon is given a number that will remain the same throughout the long-term monitoring period. GPS data are downloaded onto a geo-referenced topographic base map of the preserve using GIS and AutoCAD software. The results of spineflower mapping are reported annually and include spineflower maps that provide the square footage of each polygon and the total area of spineflower occupied habitat. The annual mapping data allow monitoring to identify and track changes in polygon sizes, shape and location. Spineflower maps include the polygons from the previous years (as an overlay) to allow comparisons of polygon sizes, shapes, areas and locations. In addition, spineflower quantity within each polygon was estimated by extrapolating counts of spineflower from high and low density patches estimated to be representative of the overall spineflower distribution within the polygon.

Annual mapping data from 2002, 2003, 2004 and 2005 were combined to create a map of composite polygons that represent the cumulative area occupied by spineflower. A single composite polygon is formed by the combined boundaries of all overlapping polygons mapped in the same area across different years.

3.2 Identification of Polygons Sampled in the Pilot Study

A total of 25 polygons were originally identified to be sampled under the Pilot Study using a stratified, non-random selection of habitat, aspect, slope, geology, soils, and elevation. As described in the SCP, the sampling rate (i.e., number of transects, transect spacing, and quadrat intervals) varies by polygon size. The number of polygons identified for sampling within each of the core population areas was intended to be representative of the distribution of polygon sizes within and adjacent to the core populations. *Table 1* below summarizes the number general size distribution of polygons sampled as part of the 2006 Pilot Study according to the breakdown of polygon sizes listed in the SCP.

TABLE 1
SUMMARY OF POLYGONS SELECTED FOR 2006 PILOT STUDY

Polygon Size (SF)	Transect Spacing	No. of Polygons
< 3,000	quadrats only*	8
3,000 < 5,000	5 meters	4
5,000 < 7,000	10 meters	2
7,000 < 10,000	15 meters	3
>10,000	20 meters	8
TOTAL		25

*Polygons less than 3,000 SF were sampled using quadrats only at a rate of 2 quadrats/500 SF.

3.3 Field Sampling

Spineflower monitoring was conducted within composite polygons representing the cumulative area occupied based on annual mapping data from 2002, 2003, 2004 and 2005. A composite polygon represents the cumulative area occupied by overlapping polygons from year to year. The polygons sampled within each core occurrence area are shown in *Figures 4* through *8*. Due to timing constraints, monitoring was completed in only 18 of the 25 polygons originally identified for sampling as described above in *Section 3.2*.

Spineflower monitoring was conducted by nine Dudek biologists over a four-week period from August 3 to August 24, 2006 (*Table 2*). As prescribed in the SCP, field sampling was performed when a vast majority of spineflower was senescent, so that flowering and fruiting spineflower were not negatively affected by data collection efforts. However, the majority of annual grasses (native and non-native) were in varying stages of dehiscence and were at times difficult to identify to species due to the lack of flowering structures. In addition, the species or height of grasses that were fallen over at the time of sampling was not recorded; species and height was only recorded for grasses that remained upright.

2006 Spineflower Monitoring Pilot Study

Entrada Sampled Polygons

FIGURE 4

2006 Spineflower Monitoring Pilot Study

Airport Mesa Sampled Polygons

FIGURE
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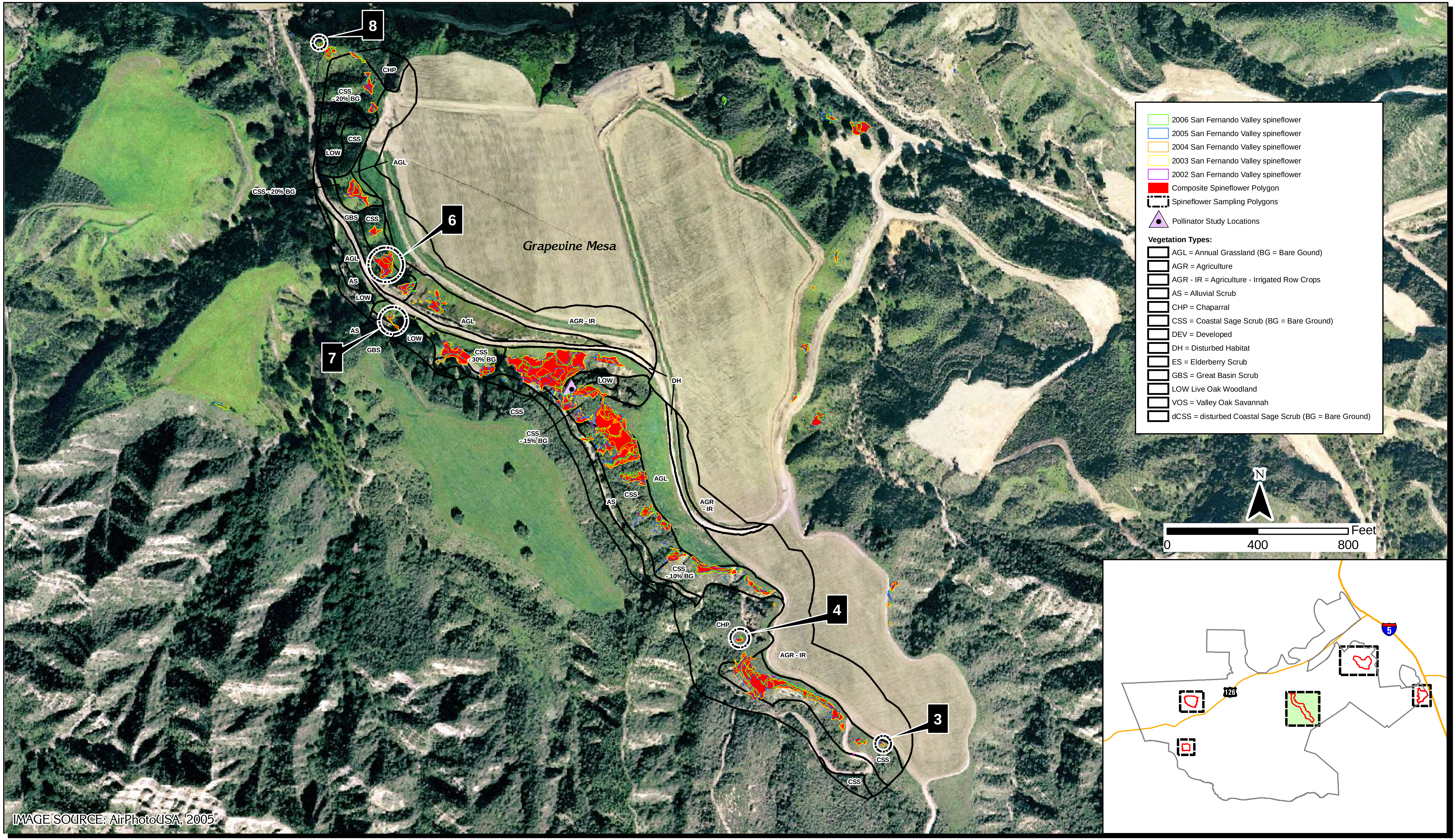

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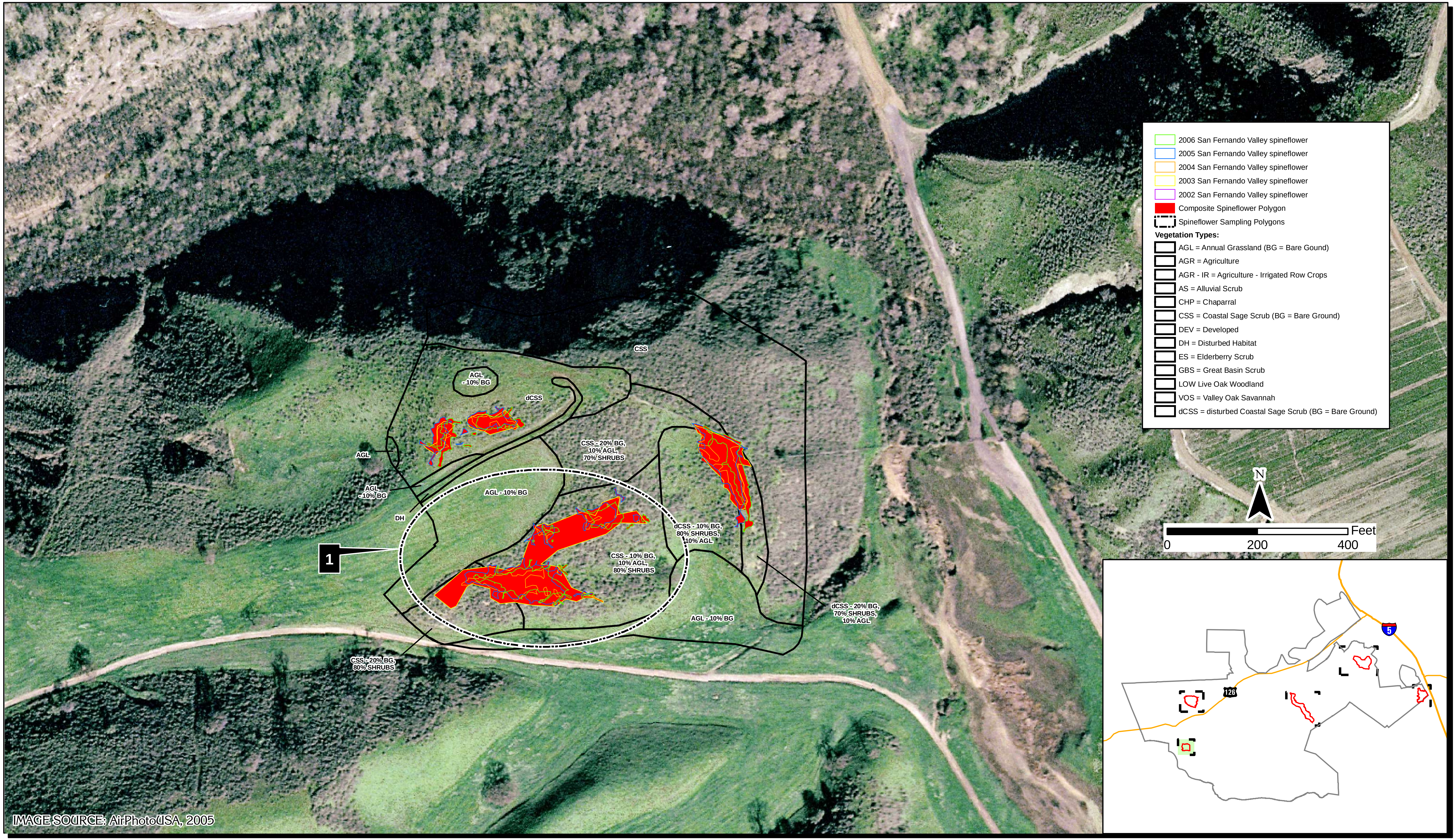
Grapevine Mesa Sampled Polygons

FIGURE 6



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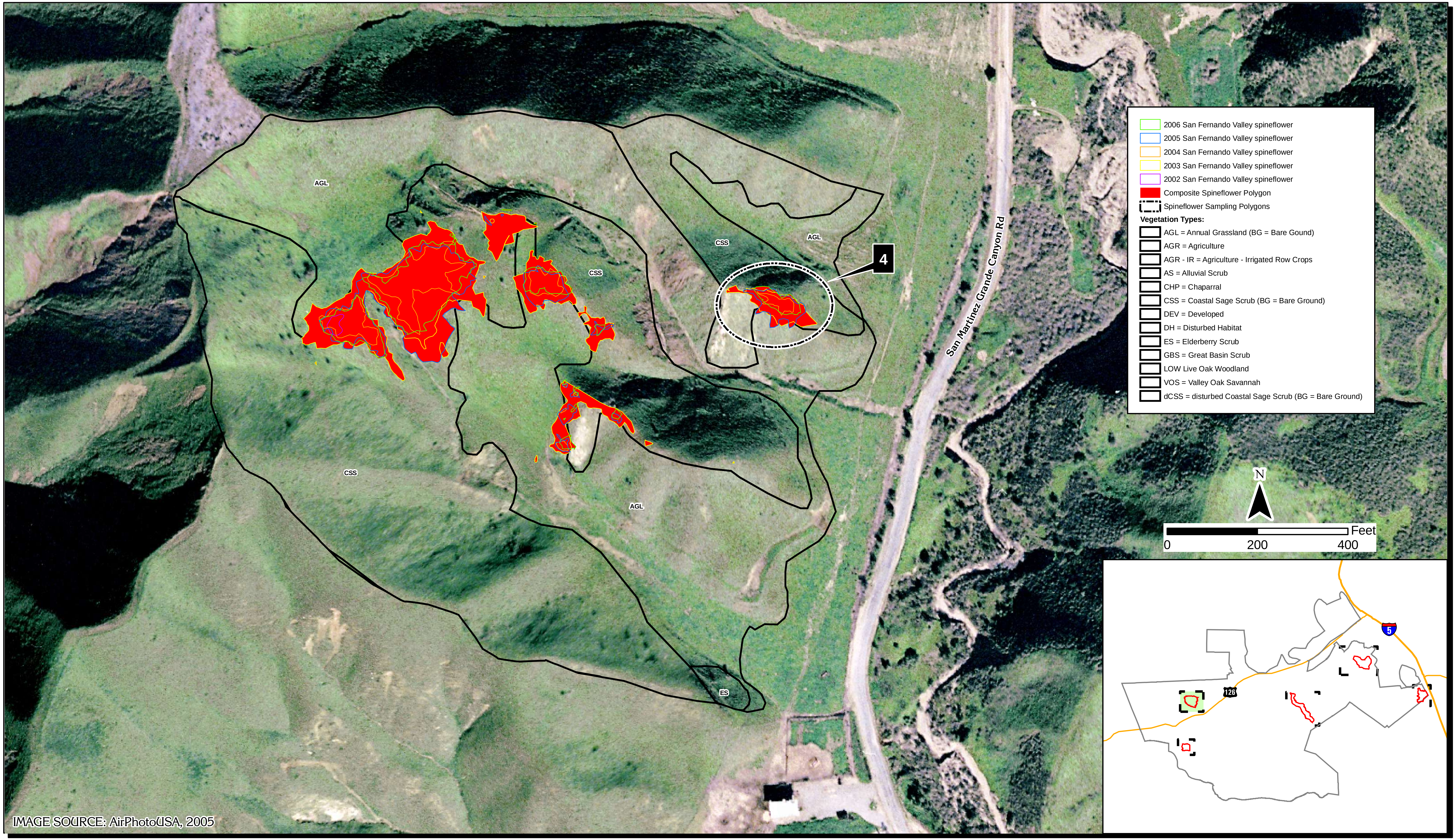
Potrero Canyon Sampled Polygons

FIGURE 7



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San Martinez Grande Sampled Polygons

FIGURE 8

Initial set up activities and a preliminary field assessment was conducted by Phil Behrends, Colin Khoury and Kamarul Muri on August 3 and 4, 2006. Initial set-up included using a GPS unit with sub-meter accuracy to delineate the polygons with 12-inch long galvanized steel spikes as permanent boundary monuments as specified in the SCP. Delineating polygon boundaries was completed with one person operating the GPS and a second person hammering the steel stakes into the ground. Polygon boundary monuments were installed with approximately 3 to 4 inches remaining above ground and painted blue to improve visibility in the field.

Field sampling included quantitative data collection using point-intercept transects and quadrat sampling conducted by teams of four biologists during three 3-day periods from August 7 to 24, 2006. Although personnel varied from week to week, each four-person team was led by one person present during the first week of sampling to ensure that sampling methods were employed consistently over the course of the Pilot Study.

Point-intercept and quadrat sampling was conducted based on a grid of transects laid over the spineflower polygons. Transects were placed perpendicular to, and at regular intervals along, an index line representing the longest axis of each polygon to maximize the number transects per polygon (*Figure 9*). Transect spacing varied from 5 to 20 meters based upon polygon size, as prescribed in the SCP (*Table 1*). Index line and transect end points of each polygon were located in the field using GPS units with sub-meter accuracy pre-loaded with spineflower polygons and transect grids generated and mapped using AutoCAD and ArcGIS software. Index line and transect end points were permanently marked with 12-inch rebar staked into the ground and painted green for the index line and orange for transects. The start- and end-points of the index line and transects were assigned based on the direction of west to east or north to south and labeled accordingly with an embossed aluminum tag. Transect grids are intended to be permanent in order to collect the baseline data needed to identify trends and to allow for year-to-year comparative analysis in future monitoring.

TABLE 2 SUMMARY OF PERSONNEL

STAFF	AUGUST 2006											
	3	4	7	8	9	14	15	16	17	22	23	24
Colin Khoury	X	X										
Phil Behrends	X											
Kamarul Muri	X	X	X	X	X	X	X	X				
Clint Emerson			X	X	X							
Callie Ford			X	X	X					X	X	X
Scott Boczkiewicz			X	X	X					X	X	X
Makela Mangrich							X	X	X			
Chris Oesch						X	X	X				
Sara Townsend							X	X	X			
Rebekah Krebs										X	X	X
Tish Schuyler										X	X	X

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Illustration of Field Sampling Methods

FIGURE 9

Including preliminary set-up activities, the field sampling effort involved 12 personnel over a total of 342 person-hours between August 3 and 24, 2006. *Table 3* below lists the total number of polygons, transects and quadrats sampled and reports general information regarding the level of effort involved in completing the field sampling activities. In general, polygon set-up and transect monitoring were the most time consuming tasks. Based on the total time spent in the field and the total number of transects completed, sampling was conducted at an average rate of 5 person-hours per transect, including set-up and the associated quadrat sampling for each transect. As all field sampling was completed by teams of four working in pairs, a pair of people working together were able to complete a single transect in approximately 2.5 hours, or between 3 to 4 transects in a single 10-hour day. Presumably, polygon set-up in the future will be much reduced as permanent polygon index line and transect markers will already be in place for the polygons sampled during the 2006 Pilot Study.

3.3.1 Point-Intercept Transects

Point-intercept transects were used to generally characterize existing biotic and abiotic conditions within and immediately adjacent to spineflower polygons (i.e., occupied habitat areas). Transect data were used to estimate cover of native and non-native plants, ground cover types, grasses and average grass height along each transect.

TABLE 3
SUMMARY OF 2006 SPINEFLOWER MONITORING SAMPLING EFFORT

Summary of Sampling Effort	
Polygons	25
Transects	64
Quadrats	294
Total Field Days (person-days)	36
Total Hours (person-hours)	342
Work Rate (person-hours per transect)	5.3

Once the index line and transects were staked as described above, a 50-meter tape was measured 5 meters beyond each transect start and end point and secured in the ground to begin point-intercept data collection. Transects extended 5 meters beyond the polygon boundaries in order to capture edge data and characterize unoccupied areas immediately adjacent to the spineflower polygons.

Data were collected using the point-intercept method at 0.20-meter intervals along the transect line. Species intercepted at each point were recorded, providing a tally of intercepts for each species in the herb and shrub layers. The surface condition (*e.g.*, bare ground, litter, thatch, cryptogammic soil crust, rock, burrows, etc.) and, if present, the depth of a non-native thatch layer was also recorded. In addition, the species and height of each grass intercepted was recorded, according to the appropriate height range (*i.e.*, 0-1.0 decimeters, 1.01-2.0 decimeters, 2.01-3.0 decimeters, 3.01-4.0 decimeters, 4.01-5.0 decimeters, up to the maximum height).

Spineflower vigor was assessed by indicating the diameter of each plant intercepted along the transect lines. The diameter is an indication of the number of inflorescences; height is an indicator of vigor or individual production. Descriptions of ground cover types recorded for the point-intercept sampling are listed below in *Table 4.* A sample transect data form is included in *Appendix A.*

3.3.2 Quadrat Sampling

Quadrat sampling was conducted to estimate spineflower density using 2.0 x 0.5 m quadrats (1.0 m^2 total) placed lengthwise along the transects. Quadrats were placed along each transect starting at the index line and moving out towards the edge of the polygon. Quadrats near the polygon boundary were recorded only if the entire quadrat was located within the polygon. Placement of the first quadrat along each transect was randomized between four possible positions relative to the index line at a distance of 0.25, 0.50, 0.75 or 1.00 m. Subsequent quadrats were placed regularly along the transect at 2.0-meter intervals (*Figure 9*). Quadrats were placed lengthwise over the meter tape to be bisected into left and right halves, and the number of spineflower plants observed within each 0.5 m^2 half was recorded. Counting individual spineflower plants was accomplished by crouching or kneeling next to the quadrat and locating the basal stem of each plant. In some instances, due to the timing of monitoring when plants were in senescence, the absence of basal leaves made it difficult to determine if basal stems located very close together belonged to the same individual or if more than one plant was present. A sample quadrat sampling data form is provided in *Appendix B.*

TABLE 4
DESCRIPTIONS OF GROUND COVER TYPES RECORDED

Cover Type	Symbol	Description
bare ground	BG	No vegetation immediately covering the ground surface and no other surface conditions (i.e., thatch, litter, burrows, cryptogammic crusts, rock) present.
litter	L	See definition of thatch.
thatch	T	Vegetative debris that remains on the ground and accumulates over successive seasons. In contrast, litter is defined as vegetative debris (primarily dead non-native grasses) that consists of dead or dried vegetation from the current year only.
burrow	B	Presence of burrows was recorded only where the point was projected directly into a burrow opening. Points projected over soil disturbed by fossorial activity were

TABLE 4
DESCRIPTIONS OF GROUND COVER TYPES RECORDED

Cover Type	Symbol	Description
		not recorded.
rock	R	Rock was recorded only where the point was projected directly onto rock exposed at or above the ground surface.
cryptogammic soils	C	Soil crusts formed by mosses and/or lichens growing on the soil surface. Crytogammic soil crusts typically form in relatively undisturbed areas when the right combination of shade and moisture are present.

3.3.3 Qualitative and Quantitative Monitoring for Small Polygons

Satellite spineflower populations that were less than 3,000 square feet were sampled using randomly placed 0.5 x 2.0m quadrats (1.0 m^2) at the rate of two quadrats per 500 square feet. The quadrats were analyzed to determine percent vegetative cover, species composition, percent bare ground, and percent non-native thatch. The depth of thatch and height of annual grasses were measured at six equidistant points within each quadrat and averaged. Data were recorded onto modified quadrat data field forms (see sample data forms in *Appendix C*).

TABLE 5
QUADRAT SAMPLING FOR SMALL "SATELLITE" POLYGONS < 3,000 SF

Polygon	SF	Quadrats
AM02	802	3
AM03	189	1
AM07	176	1
GM03	223	1
GM04	513	2
GM07	1,055	4
GM08	137	1
MME01	230	1
TOTAL		14

3.4 Analytical Methods

Cover estimates of native and non-native species, grasses, and ground cover types were calculated for each transect and a single mean value for the different components of cover was reported for each polygon. To assess the level of sampling necessary to adequately estimate native plant cover, three different estimates of native plant cover were calculated from the point-intercept data using: **(1)** all of the observed points (0.2-m intervals), **(2)** using every other point (0.4-m intervals), and **(3)** every third point (0.6-m intervals). Cover estimates calculated based on the different interval sizes were compared using a t-test to determine if there was a significant difference between estimates made using lower levels of sampling (i.e., at the 0.4- and 0.6-m intervals). Spineflower density was measured in 1.0 meter square quadrats. A single value of spineflower density for each polygon was computed as the mean value of the quadrats measured within that polygon.

A resampling analysis was used to evaluate sampling efficiency. Cover estimates and spineflower density were calculated using a subset of the data for comparison against values calculated using the entire data set for each polygon. Within each polygon, a subset of 3 transects was sampled randomly. The average of the 3 transects was compared to the estimate obtained using all transects in the polygon and reported as a percent difference (representing an estimate of error). This was repeated 100 times to produce a sampling distribution of the percent error using fewer transects. The entire analysis was repeated using only 2 transects. For the resampling analysis conducted for spineflower density, a subset of 3 to 7 quadrats were resampled from each polygon.

Spineflower densities from the 2006 sampling season was analyzed using environmental measurements obtained by the transect sampling. A Principle Components Analysis (PCA) was applied to the data collected to observe trends in the data in relation to spineflower density. In addition, spineflower densities were compared to the environmental parameters utilizing linear fit models (regression). The year-to-year data collected by visual estimation from 2002 to 2005 were compared to observed rainfall records in the area.

4.0 EXISTING CONDITIONS

4.1 Core Spineflower Locations

4.1.1 Entrada

The Entrada planning area includes the easternmost occurrence of spineflower on Newhall Land property holdings (*Figure 4*). The Old Road and I-5 are located to the east of the Entrada planning area, and the existing Westridge golf course is located to the south.

In 2003, there were approximately 735,580 spineflower individuals occupying a 0.76 acre area within the Entrada planning area. In 2004, approximately 32,210 spineflower were observed occupying a 0.31 acre area within the core occurrence area. In 2005, approximately 301,661 spineflower were observed occupying a 0.7 acre area within the core occurrence area. Within Newhall Land as a whole, the Entrada planning area accounted for 10 percent of the spineflower observed in 2003, 6 percent of spineflower observed in 2004, and 4 percent of spineflower observed in 2005. An overall decline of about 60 percent in spineflower individuals was observed between 2003 and 2005, although there was a considerable increase in spineflower individuals observed in disturbed areas in that time period.

Vegetation, Slope, Elevation and Aspect

The Entrada site consists of approximately 23.4 acres of California annual grassland, while California sagebrush scrub (including disturbed California sagebrush scrub) and disturbed land make up roughly equal portions of the remaining two acres. Disturbed California sagebrush scrub was mapped where the primary constituents of a California sagebrush scrub community are present, but where the overall cover of non-native vegetation exceeds 20 percent. The predominance of non-native species within California sagebrush scrub is likely a combination of disturbance from past grazing activities and ongoing physical disturbances in adjacent areas (*i.e.* maintenance of access roads, *etc.*).

The Entrada site soils are predominantly Saugus loam (30 to 50 percent slopes). Approximately 5 percent of the area consists of Hanford sandy loam (2 to 9 percent slopes), Metz loam (2 to 5 percent slopes) and Yolo loam (0 to 2 percent slopes). Geology within the area includes alluvium (mostly Holocene, some Pleistocene) Quaternary nonmarine and marine.

Slopes are gentle to moderate, with no slopes greater than 15 degrees. More than half of the area includes northeast- and east-facing slopes, with flat areas and north-facing slopes accounting for approximately one third of the area. Elevations range from 1,080 to 1,240 feet AMSL, with the majority of the area occurring between 1,160 and 1,200 feet AMSL.

Adjacent Land Uses

Existing land uses adjacent to the Entrada site include a golf course to the south, The Old Road and I-5 to the east, undeveloped land to the west, and the Six Flags Magic Mountain Amusement Park to the north. In addition, Southern California Edison and Southern California Gas Company transmission lines run along the southeastern boundary inside of the Entrada site, and include actively maintained dirt roads.

4.1.2 Airport Mesa

The Airport Mesa occurrence area is located toward the eastern end of the NRSP, to the west of the Six Flags Magic Mountain Amusement Park and south of the Santa Clara River (*Figure 5*). The area includes 45 acres dominated by California annual grassland and California sagebrush scrub communities along south- and west-facing slopes surrounding Airport Mesa. The area extends along the north side of Middle Canyon to the existing gated access road on the east side of the mesa.

In 2003, there were approximately 782,600 spineflower individuals (14 percent of the total within Newhall Land as a whole) occupying 4.6 acres. In 2004, approximately 25,700 spineflower (about 5 percent of the total within Newhall Land) were observed, occupying 1.7 acres. Considerably more spineflower individuals were observed in 2005, with 1,335,730 individuals occupying 2.9 acres; an increase of about 65 percent over the 2003 numbers and representing 18 percent of the total within Newhall Land as a whole.

Vegetation, Slope, Elevation and Aspect

California annual grassland and California sagebrush scrub are the dominant vegetation communities within the Airport Mesa area. There are approximately 11.30 acres of California sagebrush scrub and approximately 26.65 acres of California annual grassland. Although California sagebrush scrub and California annual grassland are generally the primary habitat for spineflower, it does occur in fairly high numbers within disturbed areas. Although to a lesser extent, spineflower also occurs in alluvial scrub and valley oak/grass. Other vegetation communities and land covers within the Airport Mesa area include agricultural land, but no spineflower occurrences were recorded on such land in 2003 or 2005.

Although more spineflower occurrences were recorded in 2005, those increases occurred predominantly in the California annual grassland vegetation community. In contrast, there were considerably fewer spineflower recorded in the alluvial scrub and valley oak/grass vegetation communities in 2005, than in 2003.

Soils include Castaic-Balcom silty clay loams (30 to 50 percent slopes), terrace escarpments, and Hanford sandy loam (2 to 9 percent slopes). Out of the three geologic units that occur within the Newhall Land project study area, two are present within the Airport Mesa occurrence area: **(1)** alluvium (mostly Holocene, some Pleistocene) Quaternary non-marine and marine; and **(2)** Plio-Pleistocene non-marine, Pliocene non-marine.

Slopes are gentle to moderate, with 91 percent of the area occurring on slopes less than 10 degrees and 100 percent of the area occurring on slopes less than 20 degrees. Approximately 78 percent of the slopes have a southwest-, northwest- or west-facing aspect. Elevations range from 1080 to 1160 feet AMSL.

Adjacent Land Uses

The areas surrounding Airport Mesa have historically been used for agriculture (irrigated row crops and dry-farmed row crops) and grazing. Currently, adjacent land uses include staging for agricultural operations on the graded mesa-top above the occurrences and active cultivation in the canyon bottom below. Open space along the Santa Clara River corridor is located to the north of the area, while the Six Flags Magic Mountain Theme Park is located to the southeast of the area.

4.1.3 Grapevine Mesa

The Grapevine Mesa occurrence area encompasses 44.1 acres dominated by agricultural land (irrigated row crops), California sagebrush scrub and chaparral on south- and west-facing slopes, along the western margin of Grapevine Mesa (*Figure 6*). The area varies in width from approximately 250 feet to 600 feet and is 1 mile in length, extending from the Santa Clara River in the north to the southern end of Grapevine Mesa. The eastern margin of the area includes agricultural lands along the mesa-top, but the majority of the occurrences are located on slopes surrounding the mesa that are dominated by California sagebrush scrub and chaparral. An unnamed drainage to the Santa Clara River occurs in the canyon bottom along the western boundary of the area.

In 2003, there were approximately 1,833,086 spineflower individuals occupying 3.4 acres within the Grapevine Mesa occurrence area. In 2004, approximately 422,100 spineflower occupied 1.4 acres. In 2005, approximately 3,881,294 spineflower occupied 2.3 acres. Within Newhall Land as a whole, the Grapevine Mesa occurrence area accounted for 34 percent of the spineflower observed in 2003, 80 percent of spineflower observed in 2004, and 54 percent of spineflower observed in 2005.

Vegetation, Slope, Elevation and Aspect

Agricultural land, California sagebrush scrub and chaparral are the primary habitats within the Grapevine Mesa area. The area also includes smaller components of California annual grassland, alluvial scrub, coast live oak woodland, disturbed land and Great Basin scrub. There are approximately 5.3 acres of California sagebrush scrub, with between 10 and 30 percent cover of bare ground. Although California sagebrush scrub is the primary habitat for spineflower within the Grapevine Mesa area, limited spineflower occurrences are located within disturbed land, alluvial scrub, California annual grassland, Great Basin scrub and coast live oak woodland. Other vegetation communities and land covers include agricultural land. Total numbers of spineflower were greater in 2005, than in 2003, especially in the California sagebrush scrub, coast live oak woodland and alluvial scrub community types. Fewer spineflower were observed in the great basin scrub and chaparral communities in 2005, than in 2003.

Grapevine Mesa area soils consist mostly of Zamora loam (2 to 9 percent slopes) and terrace escarpments, but also include severely eroded Castaic and Saugus soils (30 to 65 percent slopes).

The majority of the area consists of Plio-Pleistocene non-marine, Pliocene non-marine deposits. There are less than two acres of alluvium (mostly Holocene, some Pleistocene) Quaternary non-marine and marine deposits within the Grapevine Mesa occurrence area.

Slopes are gentle to moderate, with more than 90 percent of the area occurring on slopes less than 20 degrees. More than 80 percent of the slopes are west-, southwest- or northwest-facing. Elevations range from 1,000 to 1,320 feet AMSL, with a relatively even distribution of elevations occurring throughout.

Adjacent Land Uses

Existing land uses adjacent to Grapevine Mesa are limited to ongoing agricultural activities located on Grapevine Mesa within and above the main occurrences. Open space within the Santa Clara River corridor is located to the north, and additional undeveloped land occurs to the south and west.

4.1.4 Potrero Canyon

The Potrero Canyon occurrence area is located at the mouth of Potrero Canyon in the southwestern portion of the NRSP (*Figure 7*) and contains the westernmost population of spineflower within Newhall Land property holdings. The area consists of 14.76 acres, dominated by California sagebrush scrub and California annual grassland located on the west side of Potrero Canyon near Windy Gap.

In 2003, there were approximately 222,513 spineflower individuals occupying 1.16 acres. In 2004, approximately 8,200 spineflower occupied a 0.34-acre area. In 2005, approximately 243,632 spineflower occupied a 0.68-acre area. Within Newhall Land as a whole, the Potrero Canyon occurrence area accounted for 4 percent of spineflower observed in 2003, 2 percent of spineflower observed in 2004, and 3 percent of spineflower observed in 2005. A modest increase of 9.5 percent was observed in spineflower populations between 2003 and 2005.

Vegetation, Slope, Elevation and Aspect

California sagebrush scrub, disturbed California sagebrush scrub and California annual grassland are the primary vegetation communities within the Potrero Canyon occurrence area. Disturbed California sagebrush scrub occurs when the primary constituents of a California sagebrush scrub community are present, but where the overall cover of non-native vegetation exceeds 20 percent. The predominance of non-native species within California sagebrush scrub is likely a combination of disturbance from past grazing activities and proximity to ongoing agricultural activities in adjacent areas. Spineflower within the Potrero occurrence area are located within disturbed and undisturbed California sagebrush scrub and California annual grassland. Within the Potrero Canyon occurrence area, spineflower has not been observed within disturbed land areas.

Soils are predominantly Castaic-Balcom silty clay loams (20 to 50 percent slopes, eroded). Terrace escarpments and Yolo loam (2 to 9 percent slopes) also occur, but account for only 14 percent and 2 percent of the area, respectively. Geology is roughly two-thirds alluvium (mostly Holocene, some Pleistocene) Quaternary nonmarine and marine, and one-third Pliocene marine.

The majority of slopes are gentle to moderate, with approximately 79 percent of the slopes having an incline of less than 20 degrees. Slopes are predominantly southeast-, east- and south-facing. Elevations range from 820 to 1,080 feet AMSL, with the majority of the area occurring between 1,000 and 1,080 feet AMSL.

Adjacent Land Uses

Current land uses within Potrero Canyon include ongoing agricultural and ranching operations. Immediately adjacent to the occurrence area are actively farmed fields. Open space along the Santa Clara River corridor is located to the north, while additional undeveloped areas along the slopes and ridges of Potrero Canyon are in open space to the west south.

4.1.5 San Martinez Grande

The San Martinez Grande occurrence area encompasses 34.4 acres dominated by California sagebrush scrub and California annual grassland communities on slopes below the primary north-south trending ridgeline on the west side of San Martinez Grande Canyon (*Figure 8*). This occurrence area includes one of the two known occurrences of spineflower at Newhall Land that are located north of the Santa Clara River.

Of the six spineflower occurrences known from Newhall Land, two are located north of the Santa Clara River at San Martinez Grande Canyon and at VCC planning area. In 2003, approximately 1,124,375 spineflower were observed on 2.1 acres within the San Martinez Grande area. Approximately 95 percent of the area burned in Fall 2003. In 2004, approximately 1,400 spineflower were observed on 0.62 acre, accounting for less than 1 percent of all 2004 spineflower occurrences at Newhall Land. In 2005, approximately 123,527 spineflower were observed on 1.4 acres, accounting for 1.7 percent of all spineflower observed at Newhall Land that year. Unlike other occurrence area that saw an increase, the San Martinez Grande occurrence area saw a decrease of approximately one million spineflower individuals between 2003 and 2005.

Vegetation, Slope, Elevation and Aspect

Prior to burning in the fall of 2003, vegetation consisted mostly of California annual grassland and California sagebrush scrub. Although approximately 95 percent of the occurrence area burned, the area was observed to be quickly re-vegetating in the spring of 2004, with filaree (*Erodium* spp.), giant ryegrass (*Leymus condensatus*) and slender mariposa lily (*Calochortus clavatus* var. *gracilis*).

Soils are almost entirely Castaic-Balcom silty clay loams (30 to 50 percent slopes, eroded). Yolo loam (2 to 9 percent slopes), Hanford sandy loam (2 to 9 percent slopes) and Castaic-Balcom silty clay loams (50 to 60 percent slopes, eroded), also occur, but make up less than 5 percent of the area. The geology is limited to Pliocene marine deposits. A portion of the occupied habitat area is located on landslide debris.

Slopes are moderate to steep, with approximately 68 percent of the area occurring on slopes between 10 and 30 degrees. Approximately 94 percent of the spineflower occurs on slopes ranging from 15 to 25 degrees and 97 percent occur on slopes ranging from 10 to 30 degrees. As the San Martinez Grande occurrence area is located on the east-facing side of a north-south trending ridgeline, the majority of slopes have a southeastern or eastern aspect. Elevations range from 920 to 1,360 feet AMSL, with the majority of the area occurring between elevations of 960 and 1,120 feet AMSL.

Adjacent Land Uses

Historically, areas in the vicinity of the San Martinez Grande occurrences have been used for agriculture and grazing. Currently, a single-family residence and a barn used for hay storage are located to the south on the west side of San Martinez Grande Canyon Road. The Santa Clara River and State Route 126 are located to the south and San Martinez Grande Canyon Road is located to the east. Undeveloped areas occur to the north and west.

5.0 RESULTS

5.1 Native Cover, Ground Cover and Grass Height

Point-intercept data collected from a total of 64 transects in 10 polygons across the five core spineflower occurrences were used to compile estimates of native species cover, ground cover and grass height. A summary of native cover estimates by polygon is shown in *Table 6* and estimates of ground cover type are shown in *Table 7*. Native cover is reported as percent relative cover (i.e., relative cover of native and non-native species sums to 100 percent of the vegetation cover present). Estimates of ground cover are reported as proportions of total point-intercept samples. Because only one ground cover type can be recorded for each point-intercept, relative and absolute cover of ground cover types are identical. The high native cover in polygons GM06 and PC01 is related to high levels of native shrubs (~ 18% and 48% shrubs respectively), compared to other polygons where levels of native cover are more reflective of the ratio of native and non-native grasses and forbs.

TABLE 6
ESTIMATES OF NATIVE PLANT COVER

Native Cover = (Natives / Natives + Exotics) * (100 - % Unvegetated)

					% Native Cover	
Polygon	SF	ACRES	m^2	transects	mean	std dev
AM01	13,047	0.30	1,212	4	18.6	9.0
AM04	48,395	1.11	4,496	7	21.0	6.3
AM05	3,601	0.08	335	9	11.9	8.0
AM06	15,482	0.36	1,438	4	11.1	9.8
GM06	5,812	0.13	540	14	32.7	9.3
MME02	5,563	0.13	517	6	11.4	2.8
MME03	8,156	0.19	758	4	9.0	4.4
MME04	11,150	0.26	1,036	3	6.3	5.8
PC01	35,925	0.83	3,337	8	50.3	18.3
SMG04	7,849	0.18	729	5	15.0	2.7
	154,980	3.56	14,398	64		

TABLE 7
GROUND COVER TYPES, GRASSES AND MEAN GRASS HEIGHT

	Bare Ground		Litter		Thatch		Grass Height (cm)	
Polygon	mean	std dev	mean	std dev	mean	Std dev	mean	std dev
AM01	0.05	0.06	0.38	0.23	0.10	0.05	49.33	0.58
AM04	0.15	0.09	0.69	0.15	0.00	-	64.86	7.93
AM05	0.20	0.10	0.78	0.11	0.00	0.01	58.89	14.17
AM06	0.15	0.09	0.44	0.25	0.05	0.06	41.25	18.14
GM06	0.17	0.10	0.21	0.12	0.06	0.13	52.69	9.84
MME02	0.02	0.04	0.19	0.40	0.00	-	78.60	17.29
MME03	0.05	0.06	0.72	0.18	0.00	-	20.67	19.22
MME04	0.05	0.03	0.79	0.24	0.00	-	63.33	10.02
PC01	0.23	0.07	0.69	0.10	0.00	-	35.33	22.23
SMG04	0.38	0.07	0.61	0.08	0.00	-	32.33	7.02

5.2 Spineflower Density

Visual estimates of spineflower density made during annual mapping from 2002 to 2006 were compared to quadrat estimates in 18 different polygons. All spineflower observed during annual surveys were mapped, but some polygons did not have spineflower present in all years. In 2006, quadrat sampling was completed in 18 polygons. *Table 8* lists the estimates obtained for each polygon in each year data were obtained. No entry for visual estimate data indicates that spineflower was not observed in that polygon in that year. No entry for quadrat data means quadrat data were not collected, but spineflower was present if a visual estimate was made. Estimates made visually are reported as a point sample, mean and standard deviation are reported for the quadrat data.

TABLE 8
SPINEFLOWER DENSITY ESTIMATES (plants/m^2)
AND ANNUAL RAINFALL (inches)

Polygons	Visual Estimates (Rainfall: Oct-May)					Quadrat Data (2006)		
	2002 (4.59)	2003 (19.98)	2004 (9.23)	2005 (39.75)	2006 (16.82)	N	mean	std dev
AM01	-	25.47	3.70	97.52	78.19	12	2.41	5.83
AM02	-	30.57	2.15	104.4	308.9	3	24.33	27.39
AM03	-	23.91	9.07	19.42	-	1	13	-
AM04	0.26	22.85	4.63	142.48	133.66	64	14.08	36.53
AM05	0.86	15.81	9.12	151.14	145.35	31	9.19	27.00
AM06	-	71.48	1.99	166.27	184.79	17	8.47	15.55
AM07	-	1.93	2.94	6.14	-	1	1	-
GM01	62.55	101.89	100.87	657.87	0.05	ns	ns	ns
GM03	-	4.26	2604.17	3.61	-	1	2	-
GM04	-	11.30	5.83	6.39	3.21	2	7.5	10.6
GM05	-	6.07	12.11	1.96	0.31	ns	ns	Ns
GM06	-	139.78	17.37	43.51	1.06	51	0.94	3.65
GM07	-	32.77	120.07	92.13	29.65	ns	ns	ns
GM08	-	-	-	38.26	-	ns	ns	ns
MME01	-	9.87	-	17.98	13.34	2	6.5	4.95
MME02	-	53.06	7.26	26.66	0.01	13	3.23	5.92
MME03	32.37	341.55	131.32	30.14	61.10	18	0.17	0.71
MME04	8.09	237.63	63.89	189.64	58.06	18	23.56	42.32
PC01	-	45.82	1.19	91.90	25.84	23	0	0
PC02	-	43.15	8.65	94.75	93.83	ns	ns	ns
PC03	-	73.93	11.37	91.43	74.13	ns	ns	ns
SMG01	0.71	191.11	0.30	28.00	0.00	ns	ns	ns
SMG02	-	6.79	-	1.26	1.41	ns	ns	ns

TABLE 8
SPINEFLOWER DENSITY ESTIMATES (plants/m^2)
AND ANNUAL RAINFALL (inches)

Polygons	Visual Estimates (Rainfall: Oct-May)					Quadrat Data (2006)		
	2002 (4.59)	2003 (19.98)	2004 (9.23)	2005 (39.75)	2006 (16.82)	N	mean	std dev
SMG03	-	63.64	2.33	9.59	1.37	ns	ns	ns
SMG04	-	75.46	1.37	1.13	0.01	11	3.91	5.54

* No entry indicates that no spineflower were observed for that polygon in that year.
** 'ns' indicates polygons that were mapped as occupied in 2006 but were not sampled by the Pilot Study.

5.3 Environmental Correlates

Variation between the 5 years of visual estimate data (2002-2006) was significant (ANOVA, F = 2.476, p = 0.049). Densities in 2004 were significantly lower than average (t-test, t = -2.151, p = 0.0341) and, on average, were 49% lower within each polygon relative to 2003 and 2005. The lower density appears to be correlated with lower than average rainfall. The similarity between 2003 and 2005 estimates indicates that variation between average and above average amounts of rainfall had a much lower effect. In addition, Spatial variability, between polygons or main occurrence areas, is possibly a strong component of spineflower distribution but the visual estimate data were not appropriate for further analyses. Quadrat data could be used to analyze spatial variability but were only available for one year so a comparison of spatial and temporal variability components was not possible.

Based on quadrat data, no general correlation was found between the ground cover variables measured (*Table 7*) and spineflower density and there was no relationship between native plant cover (*Table 6*) and spineflower density. The exception to this is very low spineflower density in polygons with high shrub abundance (GM06 and PC01). Based on quadrat data, spineflower density in these two polygons was less than 1 plant/m^2. The only other polygon with density less than 1 plant/m^2 was MME02, which had the highest proportion of grass cover and the tallest mean grass height (*Table 7*). This indicates that shading may be a factor in spineflower distribution and that high native cover can be negatively correlated with spineflower density, but this hypothesis needs further data collection. A Principle Components Analysis (PCA) also showed no clear relationship between spineflower densities and any of the ground cover data. These analyses were limited by only having a single year of quadrat data and thus relatively low statistical power. Additional data, even from just one year, will significantly improve the power of these analyses.

5.4 Spineflower Diameter

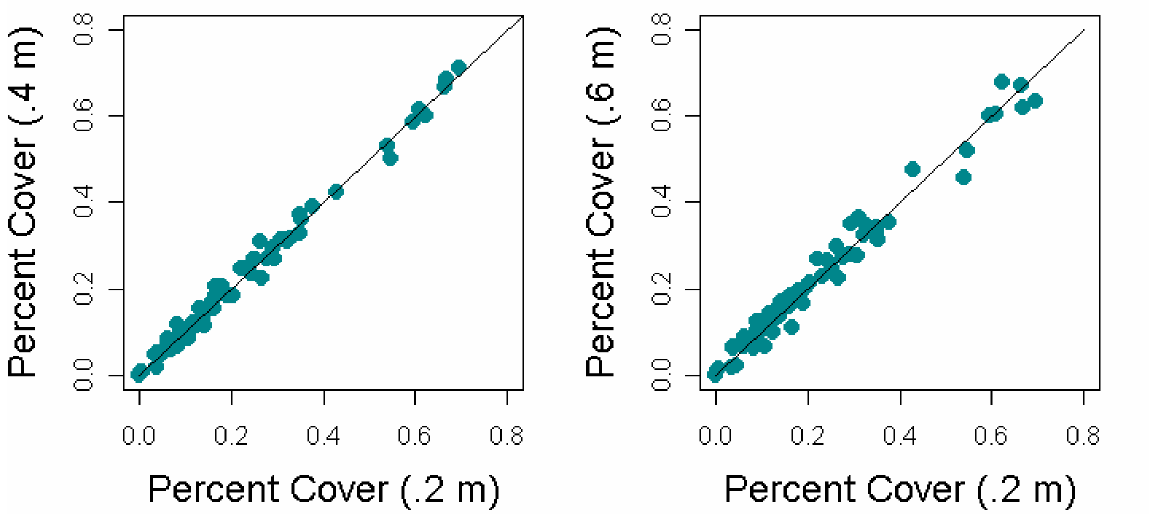
Spineflower diameter data was compiled for plants intercepted along transects, but sample size was relatively low due to the rarity of spineflower plants intercepted. An ANOVA conducted for spineflower diameter was significant indicating differences in spineflower diameter between polygons, but sample sizes were small in some polygons and the data were not sufficient to assess further. At a minimum, the data suggest that there are spatial differences in plant size. In addition, there was no relationship between plant size (diameter) and spineflower density.

5.5 Evaluation of Sampling Methods

5.5.1 Point-Intercept Interval Size

The transect data reported in *Tables 6* and *7* were analyzed based on point-intercept data sampled in the field at 0.2-m intervals. Subsamples based on 0.4-m and 0.6-m intervals were used to generate additional native cover estimates for comparison. Comparing cover estimates across the different interval sizes showed no difference in using 0.2-m, 0.4-m or 0.6-m intervals, and cover estimates across all interval sizes showed a strong one-to-one correlation (*Figure 10*; paired t-test, $p = 0.861$ and $p = 0.896$, respectively). The strong one-to-one correlation between estimates means that point-intercept data based on 0.6-m intervals can be used interchangeably with point-intercept data based on 0.2-m intervals. In other words, the equivalent cover data can be collected with one-third the effort.

Figure 10 Comparison of Point-Intercept Interval Size

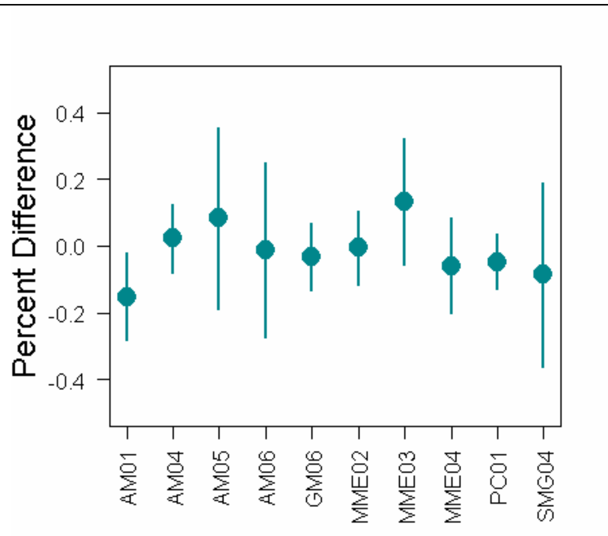


Results of native cover estimate comparisons. The line represents a one-to-one relationship. In addition to the reported t-test results, there is a significant correlation between native cover based on point-intercept data sampled at 0.4-m intervals ($r^2 = 0.990$) and 0.6-m intervals ($r^2 = 0.977$; $p < 0.0001$ in both cases).

5.5.2 Transect Frequency

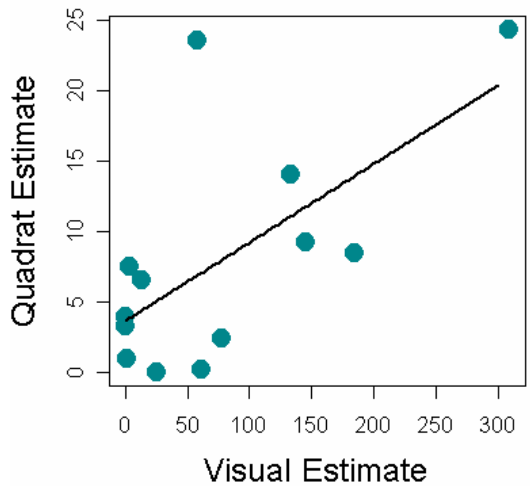
Resampling analysis indicated that for all of the polygons sampled, native cover estimates based on a subset of 2 transects sampled at 0.6-meter intervals were on average never more than 1% different from native cover estimates obtained using all transects sampled at 0.2-meter intervals (*Figure 11*).

Figure 11 Resampling Analysis of Transect Data



Resampling analysis of transect data. The average native cover of two transects, sampled randomly from each polygon, estimated using points 0.6 m apart were compared to the mean of all transects (estimated at 0.2 m intervals) and the percent difference was calculated This was repeated 10 times to generate a sampling distribution and the mean difference and 95% confidence interval are plotted for each polygon. Results were not different if more transects were sampled or the resampling was repeated more times.

Figure 12 Comparison of Spineflower Density Estimates



Comparison of visual and quadrat generated estimates of spineflower density. There is a significant correlation between the two estimates ($r^2 = 0.36$, $p = 0.018$. Excluding the one outlying point, the correlation is a much better fit ($r^2 = 0.67$).

5.5.3 Quadrat Sampling

Visual estimates consistently overestimated spineflower density by a factor of approximately 13 (*Table 8*). However, the relationship between visual estimates in 2006 and estimates based on quadrat sampling is linear (*Figure 12*), so general observations made using the visually estimated data from 2002 to 2006 are most likely valid.

Quadrat samples are a much better estimator of actual density in aggregated distributions. In highly aggregated populations where the mean approaches the standard deviation, which is what we see in spineflower, it is preferable to have more, smaller samples (i.e. smaller quadrats) than fewer, large samples (i.e. large quadrats). Data for spineflower were collected in 1 meter square quadrats, but the data were recorded by left or right half (0.5 m^2 quadrats) and summed for analysis. As there was very high correlation between plant counts using either half of each quadrat compared to the whole quadrat, a reduction in quadrat size will not affect the precision of future analyses.

6.0 RECOMMENDATIONS

6.1 Spineflower Monitoring Protocol

The following recommendations are made based on the results of the 2006 Pilot Study and with the understanding that the protocol will continue to be adaptive based on the results of future analyses. In general, monitoring was significantly more labor intensive than anticipated with set-up time and point-intercept monitoring accounting for the majority of the survey effort. As described in the October 2005 Draft SCP, sampling is supposed to occur within all spineflower polygons greater than 5.0 m^2 to establish baseline conditions. However, this does not appear to be a feasible monitoring objective due to the level of effort required to sample even a single polygon. As discussed in *Section 3.3*, a single transect required approximately 5 hours for two people working together to complete. Although the changes recommended will help to increase overall productivity while still providing statistically useful data, sampling almost every spineflower polygon remains unrealistic. Given that the primary management trigger currently described in the October 2005 Draft SCP is based upon changes in the overall area occupied by spineflower and not population numbers, the monitoring program should continue to focus on mapping all spineflower polygons within the core occurrence areas on an annual basis. Quantitative monitoring involving point-intercept transects and quadrat sampling will remain an important component of the monitoring protocol, but will only be implemented across a subset of representative polygons.

6.1.1 Point-intercept Intervals and Transects

Based on the results of the Pilot Study, the number of transects sampled per polygon can be reduced and the point-intercept spacing can be widened. As discussed in *Section 5.4.1*, measurements taken every 0.5 meters will provide a comparable estimate to the more comprehensive estimates made in 2006 using 0.2-meter intervals (see *Figure 10*). In small polygons, 2 transects should be made, 1 longitudinally and 1 perpendicular. In medium and large polygons, the number of perpendicular transects should be increased to 2 and 3 respectively (*Table 9*).

TABLE 9
RECOMMENDED TRANSECT SAMPLING RATE FOR POINT-INTERCEPT MONITORING

Polygon Size Class	Polygon Size (m^2)	Recommended No. of Transects
"Satellite" Polygons	< 10	0
Small	10 – 100	2
Medium	100 – 1,000	2-3
Large	>1,000	2-3

6.1.2 Minimum Quadrat Sampling

Spineflower populations are highly aggregated, with mean densities smaller than the standard deviation. Because of the high level of variance associated with spineflower density, a relatively large sample size (i.e., number of quadrats per polygon) is required to be reasonably accurate. Estimating spineflower density to within 50% of the true density value at a 95% confidence level would require sample sizes ranging from 14 to 93 quadrats per polygon. In the two polygons (GM06 and MME03) with spineflower density less than 1 plant/m^2, the required sample size is much higher. These estimates of sample size are in agreement with more general estimates which predict a sample size of 20 for unknown populations (Hayek and Buzas 1997).

Table 10 lists the recommended quadrat sampling rates for different polygon sizes, based on achieving density estimates within approximately 50% of the true density values. Although the recommended quadrat sampling rates would estimate spineflower density to within only 50% of the true value, the primary management trigger for spineflower polygons described in the October 2006 Draft SCP is based on the acreage of area occupied by spineflower rather than spineflower density. As such, the additional effort required to further increase the precision of density estimates (by further increasing the number of quadrats sampled per polygon) would have a limited effect on spineflower management. The recommended quadrat sampling rates involve a realistic level of survey effort but are still statistically valid and allow spineflower density to be estimated with reasonable precision.

TABLE 10
RECOMMENDED QUADRAT SAMPLING FOR SPINEFLOWER DENSITY ESTIMATES

Polygon Size (m^2)	Recommended No. of Quadrats
< 10	complete census recommended
10 – 100	20
100 – 1,000	40
>1,000	80

However, the recommended quadrat sampling rates should be viewed as adaptive with the understanding that future analyses may warrant additional modifications. For example, the highly aggregated nature of spineflower distribution may require polygons to be subdivided into two or more density categories to increase statistical power. Future sampling may also indicate that quadrat sampling can be reduced in some polygons without sacrificing the precision of density estimates. However, such determinations will require at least one additional year of sampling to better understand the temporal and spatial variability of the spineflower populations.

6.1.3 Measuring Spineflower Diameter and Height

Relying on measurements of spineflower intercepted along the point-intercept transects resulted in a very low sample size. Point-intercept sampling does not appear to be an effective manner for obtaining the desired data due to the rarity of spineflower interceptions. In order to obtain a larger sample size and to allow direct comparisons of spineflower density and plant size, it is recommended that sampling for plant size occurs at the quadrat level. The diameter and height of up to 10 plants selected at random will be measured within each 0.5 m^2 quadrat sampled. Although it is expected that spineflower will not be present in the majority of quadrats sampled, measuring up to 10 plants for each occupied quadrat will provide a size distribution that can be analyzed in relation to spineflower density at the quadrat scale.

6.1.4 Timing of Annual Monitoring Activities

Because of the late-season timing of the 2006 Pilot Study, the majority of annual grasses (native and non-native) observed were in varying stages of dehiscence and were at times difficult to identify to species due to the lack of flowering structures. The timing of the monitoring is also likely to affect estimates of grass cover, grass height and percent cover of litter. In addition, a substantial portion of spineflower was in some stage of disarticulation, and sampling often resulted in further disarticulation. Although these difficulties are apparent, the over-riding consideration remains in avoiding, to the greatest extent possible, any impacts to spineflower that may still be flowering or fruiting at the time of sampling. The only possible recommendation, therefore, is to initiate sampling as early as possible but only once the majority of spineflower have completed fruiting.

6.2 SCP Performance Standards for Spineflower Polygons

As described in the October 2005 Draft SCP, management actions for spineflower polygons would be triggered by a 20% decline in the overall area occupied by spineflower over a 3-year period, and by changes in baseline levels of non-native grass cover, non-native vegetation cover, thatch and grass height. Although it is expected that the proposed performance standards may be refined or modified over time as our understanding of the species improves, the results of the 2006 Pilot Study alone are not sufficient to support the development of additional performance standards at this time. Based on the 2006 Pilot Study data, none of the environmental variables measured (native plant cover, bare ground, thatch, litter, grass height) were significantly correlated with spineflower density. However, 3 polygons (GM06, PC01 and MME02) showed very low spineflower density of less than 1 plant/m^2. Polygons GM06 and PC01 showed high shrub cover, whereas MME02 showed the highest overall cover of grasses as well as the tallest mean grass height. The contrasting level of native cover (high in GM06 and PC01 due to shrub cover, low in MME02 due to prevalence of non-native grasses) suggests that shade or other vegetation structure-related factors may be more important for spineflower than just the proportion of native and non-native species alone. As shrub cover was typically due to the presence of native rather than non-native species, performance standards focused on cover of native and non-native species may overlook vegetation structure as an important factor affecting spineflower.

Although the results of the 2006 Pilot Study do not provide definitive relationships between spineflower and the environmental variables measured, it is recommended that performance criteria established in the SCP be adaptable to the results of future monitoring activities and/or specific investigations.

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Hayek and Buzas 1997. Surveying natural populations: Columbia University Press. LC Hayek, MA Buzas. New York, 1997.

Date		**Notes**
Polygon ID		
Transect No.		
Length (m)		
Monitors		

point #	herb (0-1m)		shrub (1.01-4.0m)		Cpf (cm)	No Veg	Grass (cm)
	native	non	native	non			
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							
0.2							
0.4							
0.6							
0.8							
_______ m							

Date		**Notes**
Polygon ID		
Polygon Size (SF)		
Transect Interval		
Monitors		

Transect #	up / down	Start Position	Quadrat Position	L	R

Date		**Notes**
Polygon ID		
Polygon Size (SF)		
Quadrat No.		
Cpf (# plants)		
Monitors		

Cover Estimate		**%**	**species composition**
vegetation cover	native		
	non		
ground cover	bare		
	litter		
	thatch		

Sample Point	**Thatch (cm)**	**Grass**	
		height (cm)	**species composition**
1			
2			
3			
4			
5			
6			

Date		**Notes**
Polygon ID		
Polygon Size (SF)		
Quadrat No.		
Cpf (# plants)		
Monitors		

Cover Estimate		**%**	**species composition**
vegetation cover	native		
	non		
ground cover	bare		
	litter		
	thatch		

Sample Point	**Thatch (cm)**	**Grass**	
		height (cm)	**species composition**
1			
2			
3			
4			
5			
6			