VTA-COYOTE RIDGE PROPERTY
YEAR 1 (2007) MONITORING REPORT

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EXECUTIVE SUMMARY

The Coyote Ridge property is a 548-acre site located on Coyote Ridge south of San Jose in Santa Clara County. This property was purchased by the Santa Clara Valley Transportation Authority (VTA) as compensation for known and predicted impacts to serpentine communities. The VTA prepared a Resource Management Plan (RMP) to describe the natural resource management program that will be implemented on the Coyote Ridge property by the Santa Clara County Open Space Authority (SCCOSA), which will provide long-term management of this site. Managed grazing is the primary management tool on the site. The RMP includes a description of the monitoring activities that will be performed to ensure that grazing management is maintaining suitable serpentine grassland communities without adversely affecting the wetland and riparian habitats used by species such as the California red-legged frog. In coordination with the VTA and SCCOSA, H. T. Harvey & Associates and the Creekside Center for Earth Observation performed the first annual monitoring on the Coyote Ridge property in 2007. This document describes the results of monitoring of the Coyote Ridge site during 2007, the first full year of management under the RMP.

Residual Dry Matter (RDM) provides a quantitative measure of the dry, above-ground plant material left standing or on the ground at the beginning of a new growing season. High RDM values are associated with poor serpentine habitat quality. Five of 15 RDM monitoring transects on and immediately adjacent to the Coyote Ridge property in 2007 were in the RMP's initial target range of 500-750 lbs/acre. Three were in the range of 751-1000 lbs/acre, 6 were between 1001 and 2000 lbs/acre, and one was above 2000 lbs/acre. These values were all lower than those on ungrazed reference sites, but were somewhat higher than the target range (500-750 lbs/acre) for ideal bay checkerspot butterfly habitat. Winter-spring grazing seems to remove the highest portion of the vegetation.

Grazing period/season sampling was conducted in order to monitor forage utilization within a given season. A grazing exclosure was constructed in the spring/fall-grazed paddock in the northwestern part of the site in September 2007, and standing biomass was clipped and weighed from one location within the exclosure and one location outside the exclosure in December 2007. The dry weight of the biomass clippings increased by 50% inside the exclosure between 13 September and 6 December, whereas outside the exclosure, dry weight declined by 75 g (15%). Although some of the difference in dry weight of herbage biomass from one sampling event to another may reflect spatial variability in biomass, the pattern observed in the Fall 2007 results is as would be expected – standing biomass increased within the exclosure as plants began to grow in late fall, but decreased outside the exclosure, likely due to grazing. Additional grazing exclosures will be constructed and monitored per the RMP to determine whether stocking rates need to be adjusted within a grazing season.

Baseline data on plant species composition and cover were collected along 6 transects on the Coyote Ridge property. Comparison of future monitoring results with 2007 results will provide a reliable system for detecting major changes in grassland composition in response to climate, topography, and management. Data from the Coyote Ridge property transects from 2005 and 2006, and from other serpentine sites, were also analyzed and discussed to provide a spatiotemporal context for the 2007 monitoring results on the Coyote Ridge property.

In 2007, livestock stocking rates continued as they have in the past, at approximately one cow-calf pair per 10 acres. As per the RMP, the majority of the property was grazed in winter and spring in 2007. In 2007, the paddock in the northwestern portion of the site was grazed in spring and fall, rather than in summer and fall as in previous years (and as specified in the RMP). This change from summer/fall to spring/fall grazing may only be temporary, and was not observed to result in any adverse changes to any monitoring parameters.

Bay checkerspot butterfly populations were estimated on the Coyote Ridge property based on larval surveys, and compared with results from 2006 (and earlier, where such data were available) to provide a temporal context for 2007 results, since populations of this species can show dramatic fluctuations. In 2006, there were ~25,000 larvae on the Coyote Ridge property as a whole. In 2007, numbers declined to ~10,000, with the majority on the lower western slopes of the property.

Five monitoring plots were established for each of 3 special-status plant species (Santa Clara Valley dudleya, most beautiful jewelflower, and Mt. Hamilton thistle), and the following densities were determined within the monitoring plots: 5.7 plants/m^2 for Santa Clara valley dudleya, 4.0 plants/m^2 for most beautiful jewelflower, and 13.8 plants/m^2 for Mt. Hamilton thistle. Because of the time of year in which monitoring began in 2007, the density estimates for the dudleya and jewelflower were likely lower than actual densities on these monitoring plots, and future monitoring should occur during the peak flowering periods for these species. Two other rare plant species were monitored by recording incidental observations made during other monitoring. The smooth lessingia is likely present throughout most of the lower (at least western) slopes of the Coyote Ridge property, although herbarium identification of voucher specimens collected in 2007 determined the presence of large numbers of hybrids between the rare smooth lessingia and the more common slender-stemmed lessingia (which dominates higher slopes on the site). No individuals of the San Francisco wallflower were observed during monitoring, much of which was conducted outside the species' peak flowering period.

Surveys for California red-legged frogs were conducted within a 98-acre portion of the property that had been acquired for red-legged frog habitat mitigation by a previous owner. No red-legged frogs, nor any bullfrogs or evidence of red-legged frog habitat degradation, was observed during 2007 surveys. Likewise, no major erosional problems or feral pig damage was noted during 2007 monitoring. Although pigs were regularly observed on the site, pig damage is limited and may be beneficial by uncovering bare mineral soil that enhances native annual forb recruitment.

Measures to control invasive plants in 2007 were focused on the barbed goatgrass. In 2007, the graminicide Envoy was applied to known goatgrass infestations on the Coyote Ridge property on 16 March, before the plants had bolted, and on 13 May, after plants had flowered. The product was delivered at full strength from handheld wands attached to a tank pulled by an ATV. An acre of goatgrass was mown using string cutters on 1 June. These measures complemented a 10-acre burn in a more heavily infested area on the adjacent UTC property on 18 June. The 16 March 2007 spraying was very successful, and the June mowing knocked back resprouted plants. Continued monitoring and treatment of this highly invasive species will be necessary.

Based on Year 1 monitoring efforts, we have the following recommendations for ongoing monitoring:

- **RDM**
  - All treatment groups produced total RDM values above the initial target range. It is generally agreed that current management is maintaining healthy populations of target species and a diverse serpentine plant community. Data collected over the next few years should be analyzed with existing RDM data to adjust the initial target range, rather than to begin initiating management changes.
  - RDM sampling should continue at least on the 10 RDM monitoring transects (all 3 VTA_NORTH_SF and VTA_NORTH_WS transects and 2 each of the VTA_SUMMIT_WS and VTA_MID_WS transects) located on the Coyote Ridge property itself. If feasible, and if access to other adjacent sites allows, sampling on the additional 6 transects would be useful in capturing the desired range of slopes, aspects, and elevations. The sites where RDM is measured would become permanent composition plots as well.
  - In the longer term, RDM monitoring would be facilitated by implementing photo-monitoring to replace clipping. Photo sites would be established using the range-pole and golf ball method, existing photos would be calibrated to measurements (see Appendix A), and SCCOSA staff would be trained to implement photo-monitoring and RDM estimation and replace clipping when appropriate. While these changes to the monitoring protocol are not required, we recommend that SCCOSA staff investigate these changes to facilitate long-term monitoring.

- **Grazing Period/Season Standing Forage**
  - The 9 additional grazing period standing forage monitoring areas to be constructed by the SCCOSA should be constructed within the same grazing management area as RDM monitoring plots in order to make results comparable with the RDM data.

- **Barbed Goatgrass**
  - Continue intensive monitoring and treatment. Progress was made in the 2007 dry year, and multi-year treatment will be required to deplete the seedbank. At a minimum, last year's treatments should be repeated. SCCOSA should continue working with neighboring landowners to reduce their source populations of goatgrass.
  - Dye should be added to the herbicide mix in order to ensure even coverage. Dye also improves applicators' personal safety, as they can more easily tell if they have been accidentally exposed. Because the area is not visited by the public, aesthetic concerns in treated areas should not be an issue.

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INTRODUCTION

COYOTE RIDGE PROPERTY OVERVIEW

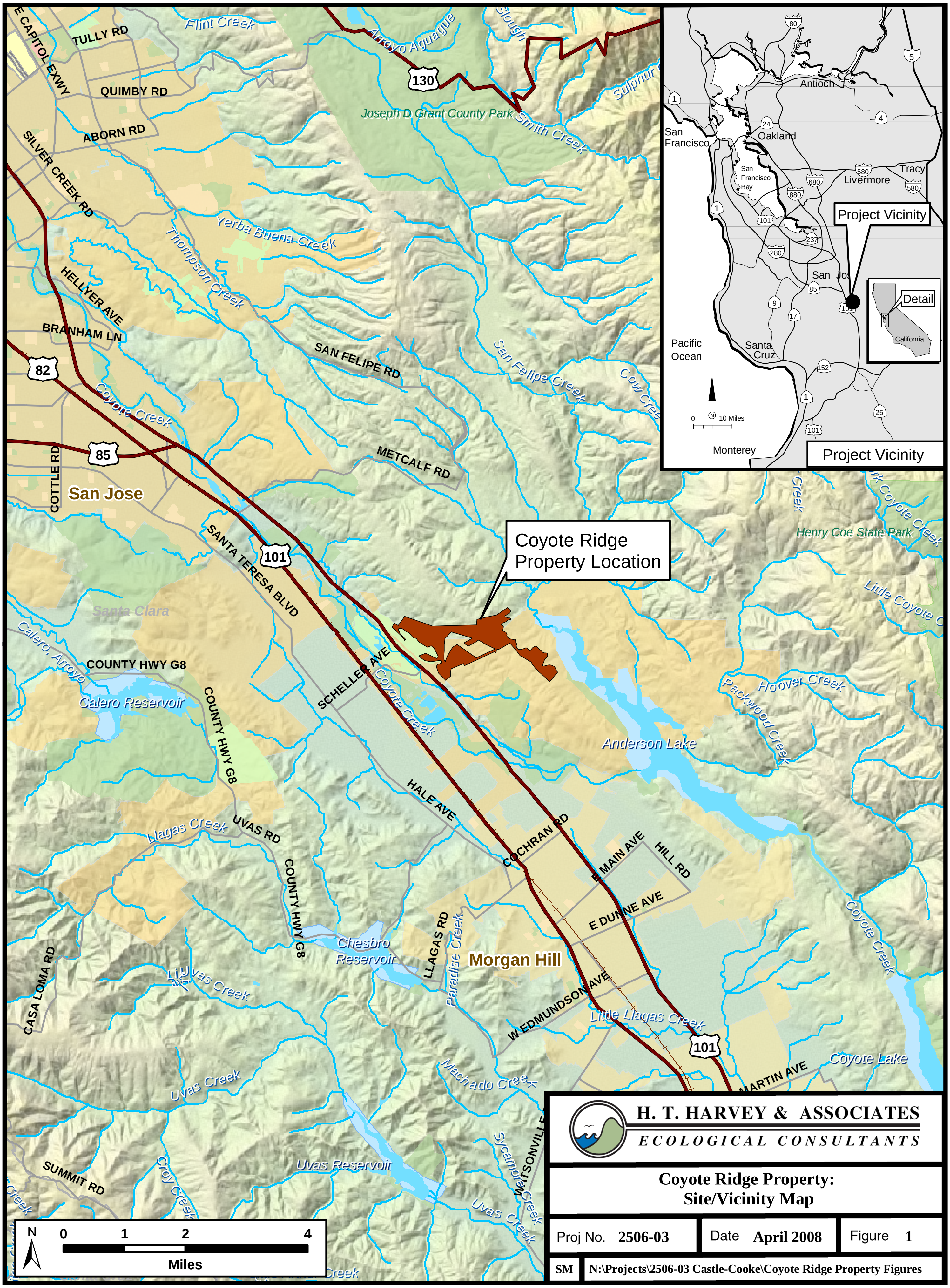
The Coyote Ridge property is a 548-acre site located on Coyote Ridge south of San Jose in Santa Clara County (Figure 1). This property was purchased by the Santa Clara Valley Transportation Authority (VTA) from Castle & Cooke as compensation for known and predicted impacts to serpentine communities. The site consists predominantly of areas dominated by serpentine-derived soils, but the eastern and western site boundaries extend slightly beyond the serpentine-derived soils to include small amounts of adjacent non-serpentine grassland included in the Critical Habitat designation for the bay checkerspot butterfly (*Euphydryas editha bayensis*) by the U.S. Fish and Wildlife Service (USFWS 2001a). The Coyote Ridge property also includes a ± 98-acre site, located east/northeast of the U.S. 101/Coyote Creek Golf Drive intersection, that had been preserved by Castle & Cooke as mitigation for impacts to the California red-legged frog (*Rana draytonii*) from expansion of the Coyote Creek Golf Course (BonTerra Consulting 1999).

Coyote Ridge comprises the westernmost foothills of the Diablo Range of California's Inner South Coast Range. The western boundary is located immediately upslope from the Coyote Valley floor, being bounded on the southwestern side by U.S. 101 and the Signature Course East of the Coyote Creek Golf Club. From here, the property extends upslope to the crest of Coyote Ridge, then eastward downslope toward San Felipe Creek and Anderson Reservoir. The property is bounded on the north side by property owned by United Technologies Corporation (UTC), on the east side by property owned by Castle & Cooke, and on the south/southeast side by property owned by Waste Management, Inc., including the Kirby Canyon Landfill and associated mitigation lands (Figure 2).

Two out-parcels within the boundaries of the Coyote Ridge property, ± 90-acre parcel owned by William Lyon Homes and a ± 15-acre parcel owned by the Silicon Valley Land Conservancy, serve as mitigation for impacts to serpentine habitat from projects by William Lyon Homes and Calpine, respectively. Other mitigation lands adjacent to the Coyote Ridge property include the 267-acre Kirby Canyon bay checkerspot butterfly preserve (which serves as mitigation for serpentine impacts from the landfill), a ± 8-acre Santa Clara Valley dudleya (*Dudleya setchellii*) mitigation area owned by Castle & Cooke, and another ± 100-acre mitigation area located along U.S. 101 northwest of the property (Figure 2).

The majority of the Coyote Ridge site is dominated by California annual grassland and serpentine grassland studded with small rock outcrops and patches of chaparral, coastal sage scrub, and oak woodland. These grasslands are interrupted by several drainages, some of which contain streams, seepage wetlands, and in the case of deeper drainages, riparian scrub/woodland. Figure 2 provides a map depicting the biotic habitats on this site.

Greater detail on the geological, hydrological, and biological conditions of the Coyote Ridge site is provided in the site's Resource Management Plan (RMP; VTA 2006). The VTA prepared the RMP to describe the natural resource management program that will be implemented on the Coyote Ridge property by the Santa Clara County Open Space Authority (SCCOSA), which will



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Coyote Ridge Property: Site/Vicinity Map

Proj No. 2506-03	Date April 2008	Figure 1
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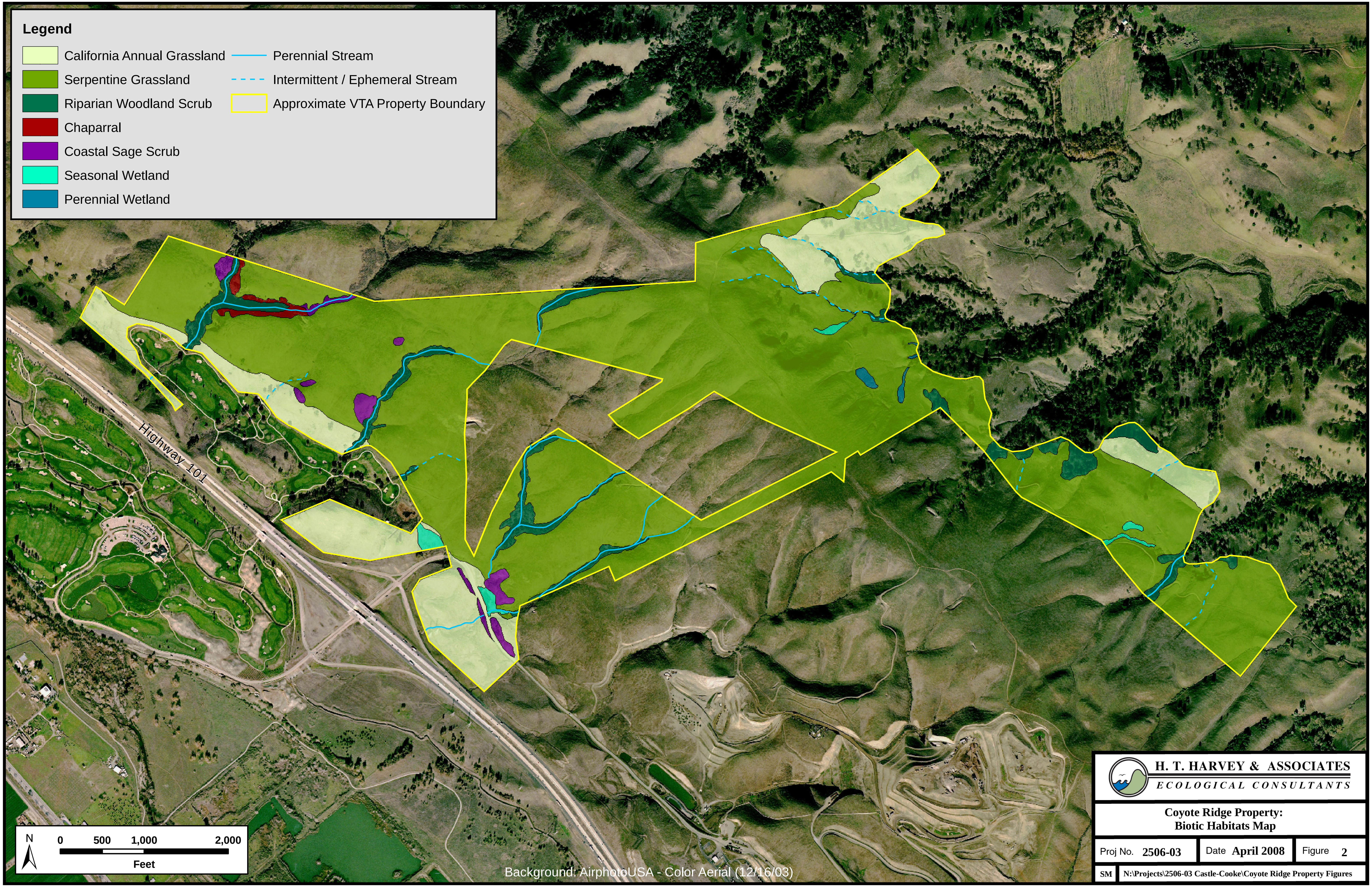

Legend
California Annual Grassland
Serpentine Grassland
Riparian Woodland Scrub
Chaparral
Coastal Sage Scrub
Seasonal Wetland
Perennial Wetland
Perennial Stream
Intermittent / Ephemeral Stream
Approximate VTA Property Boundary
Highway 101
N
0 500 1,000 2,000
Feet
Background: AirphotoUSA - Color Aerial (12/16/03)
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Coyote Ridge Property:
Biotic Habitats Map
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Date April 2008
Figure 2
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provide long-term management of this site. The primary management goal is to preserve, monitor, and, if necessary in the future, enhance habitat on the property for serpentine-endemic flora and fauna, and to preserve existing habitat for the California red-legged frog. Non-native grass management through cattle grazing, while protecting sensitive aquatic resources from damage by livestock, is the key objective. The USFWS approved the RMP in 2006.

MONITORING REQUIREMENTS

The RMP also includes a description of the monitoring activities that will be performed to ensure that grazing management is maintaining suitable serpentine grassland communities without adversely affecting the wetland and riparian habitats used by species such as the California red-legged frog. An annual monitoring report will be prepared each year, summarizing the results of all monitoring activities during the previous calendar year. Results for monitoring of Residual Dry Matter (RDM), grazing period/season forage availability, permanent vegetation transects (including bay checkerspot butterfly larval food plants and adult nectar sources), bay checkerspot larvae and adults, special-status plants, California red-legged frogs, wetland and riparian habitats, erosion problems, and invasive species will be included in the report as appropriate, based on the monitoring procedures and frequency described in the RMP. Information on grazing intensity will also be incorporated in this report. The annual report will also include any recommended changes to the management plan or monitoring regime, any remedial actions taken, and an analysis of relationships between monitoring results and grazing management.

Table 1 summarizes the monitoring efforts that will be implemented on the Coyote Ridge property, based on the RMP, and that are to be summarized in the annual monitoring report.

Table 1. Coyote Ridge Property Monitoring Summary.

Parameter	Monitoring Period	Monitoring Protocol
Residual Dry Matter (RDM)	Late fall (October and November)	Prior to the first significant rain in fall, RDM will be measured at each of 10 key monitoring locations, the locations of which will be stratified according to slope, aspect, and grazing regime (spring and fall vs. winter/spring grazing). RDM is most commonly measured through a combination of clipping plots and estimation, although an experienced land manager may be able to accurately estimate RDM visually. The initial target range for RDM is 500-750 lbs/acre. Target RDM values may be adjusted by SCCOSA staff in consultation with the current grazing lessee, as necessary, depending on correlations between RDM and parameters related to sensitive resources.

Parameter	Monitoring Period	Monitoring Protocol
Grazing Period/season Standing Forage	Throughout grazing period (winter/spring or spring and fall depending on grazing regime)	Immediately adjacent to each of the 10 key monitoring locations described above for RDM monitoring, standing herbage biomass plots will be established in grazed areas, and small fenced exclosures will be established to provide ungrazed reference areas. During the grazing period, all plants on the biomass plots and associated reference plots will be clipped and weighed monthly. Percent utilization will be estimated by comparing measurements taken from the grazed and ungrazed areas. When available biomass drops below an established threshold, to be determined during the first 2-5 years of vegetation monitoring, livestock will be removed as directed by staff of SCCOSA.
Plant Species Composition/cover	Spring (late March to early May)	One permanent transect will be established adjacent to each of the 10 key monitoring locations described above for RDM monitoring. Transects will be 50 m in length. Species percent cover will be measured using the quadrat method. A 50-m tape will be stretched along the transect, and a 0.5 x 0.5 m (0.25 m^2) quadrat will be placed at 10, 20, 30, 40, and 50 m along the right side of the tape, and at 5, 15, 25, 35, and 45 m along the left side of the tape. The percent cover (on a cover class scale of 1, 2, 5, 10, 20, 30…100%) of each plant species within the quadrat will be recorded. Percent cover of bare ground, rock, and litter will be included in the cover total. Monitoring will be conducted during peak spring flowering season (typically late March-early May). Timing of monitoring is expected to vary with transect location due to differences in phenology among areas with different topoclimates, and may vary among years.
Grazing Infrastructure	Ongoing	The ranching lessee will continuously monitor fencelines and other infrastructure (e.g., troughs) and maintain and repair such features as necessary. When on the property, SCCOSA staff and docents will note and report to the rancher any grazing infrastructure problems or maintenance needs observed.
Bay Checkerspot Butterfly	February/March (larvae), March/April (adults)	Post-diapause larvae will be counted annually on permanent plots. The number and location of plots will be stratified according to topoclimate and upper vs. lower slope, and will include plots monitored in past years by Dr. Weiss. Timing of larval surveys may be modified based on extremes in temperature or precipitation, as determined by a qualified biologist. More qualitative, reconnaissance-level surveys of other areas will be conducted annually during the peak of the flight season to determine the presence and relative abundance of adult bay checkerspots.

Parameter	Monitoring Period	Monitoring Protocol
Santa Clara Valley Dudleya	May	Focused surveys will be conducted on 5 permanent plots in Years 1, 5, and every 5th year thereafter (10, 15, etc.). The locations of the 5 plots will be stratified by grazing intensity (accessibility to livestock may be used as a proxy for different levels of grazing pressures). On each plot, the number of plants will be counted, age classes will be determined, and evidence of reproduction will be noted. Plots will be photographed, and any evidence of grazing or trampling impacts will be noted. Any necessary remedial measures (e.g., fencing around localized areas) will be identified.
Mt. Hamilton Thistle	February to May	Focused surveys will be conducted on 5 permanent plots in Years 1, 5, and every 5th year thereafter (10, 15, etc.). The locations of the 5 plots will be stratified by grazing intensity (accessibility to livestock may be used as a proxy for different levels of grazing pressures). The number of plants within each plot will be counted or estimated, and density estimates from these counts will be used to estimate population size on the property. Plots will be photographed, and any evidence of grazing or trampling impacts will be noted. Monitoring results will be correlated with livestock activity to determine the effects of grazing and trampling on freshwater resources and to identify any necessary remedial measures (e.g., fencing around localized areas).
Most Beautiful Jewelflower	May	Focused surveys will be conducted on 5 permanent plots in Years 1, 5, and every 5th year thereafter (10, 15, etc.). The 5 plots will be located randomly in serpentine grassland habitat, stratified by slope and aspect. The number of plants within each plot will be counted or estimated, and density estimates from these counts will be used to estimate population size on the property. Plots will be photographed.
Smooth Lessingia	Late summer	Incidental observations made during other monitoring efforts will be compiled. Evidence of declines in abundance or threats from grazing or invasive species will be noted. If numbers appear to be declining, more focused surveys could be conducted and/or remedial measures identified.
San Francisco Wallflower	Spring	Incidental observations made during other monitoring efforts will be compiled. Evidence of declines in abundance or threats from grazing or invasive species will be noted. If numbers appear to be declining, more focused surveys could be conducted and/or remedial measures identified.

Parameter	Monitoring Period	Monitoring Protocol
Riparian/wetland Habitats	Late summer/fall	Permanent stations in representative seepage wetlands, low-gradient vs. high-gradient streams, and dense vs. relatively open riparian habitats on both the eastern and western slopes will be monitored annually for dominant species composition, percent cover by plants in the ground layer (0-1 m), understory layer (1-2 m), and canopy layer (>2 m), and any obvious detrimental effects of livestock activity. Monitoring results will be correlated with livestock activity to determine the effects of grazing and trampling on freshwater resources and to identify any necessary remedial measures (e.g., fencing around localized areas). If no adverse effects of livestock activity (or lack thereof) are noted, monitoring frequency can be reduced (e.g., once every 2 or 3 years).
Erosion Problems	Spring	A reconnaissance survey to qualitatively assess potential erosion problems will be conducted annually in spring along all drainages. Any necessary remedial measures (e.g., fencing around localized areas) will be identified and recommended. If no adverse effects of livestock activity are noted, monitoring frequency can be reduced in known areas of low livestock use (e.g., once every 2 or 3 years).
California Red-legged Frog	Late spring/ summer	Focused surveys, including both daytime and nighttime surveys, will be conducted every 2 years, focusing on seeps, springs, and drainages. The locations and numbers of red-legged frogs will be recorded and any evidence of breeding will be noted. Any adverse effects of livestock on red-legged frogs or on particularly important habitat areas (e.g., breeding pools, if present) will be noted. Any bullfrogs detected will be captured and removed from the property.
Invasive Plants	March/early April	A reconnaissance survey for barb goatgrass, purple star-thistle, and other invasives will be conducted annually in spring. SCCOSA staff, docents, and ranchers will be on the lookout for invasives during all activities on the property, year-round. Infestations of noxious weeds will be eradicated immediately.
Feral Pigs	Year-round	SCCOSA staff, docents, and ranchers will be on the lookout for evidence of feral pig damage, especially in riparian areas, during all activities on the property, year-round. Substantial pig damage in sensitive areas will be addressed by removal of pigs and/or the construction of localized fencing around the affected areas.

This document describes the results of monitoring of the Coyote Ridge site during 2007, the first full year of management under the RMP.

YEAR 1 (2007) MONITORING METHODS, RESULTS, AND DISCUSSION

In coordination with the VTA and SCCOSA, H. T. Harvey & Associates and the Creekside Center for Earth Observation performed the first annual monitoring on the Coyote Ridge property in 2007. Below, the monitoring methodology and results are described separately for each monitoring parameter.

In conjunction with the RMP, this Year 1 monitoring report provides a foundation for future monitoring reports. For many monitoring parameters, such as monitoring of populations of individual special-status plants and California red-legged frogs, this report describes the first efforts to compile quantitative data on standardized survey plots for these species, providing a basis for comparison of future, long-term monitoring results. For these parameters, results of Year 1 monitoring are reported simply, and discussion is limited.

For other parameters, this report provides more detailed discussion, and provides more detail than would be expected in future monitoring reports, to provide an appropriate context for the results of 2007 monitoring. This is particularly true for monitoring parameters such as residual dry matter (RDM), bay checkerspot butterfly abundance, plant species composition/cover, and invasive plants, for which monitoring on the Coyote Ridge property has been ongoing for years. Also, to provide an appropriate temporal and geographic context for some of the results of the 2007 monitoring (especially given the drought conditions this year), data from sampling in previous years and locations outside the Coyote Ridge property are provided as appropriate and available (though it is not expected that such comparisons will be available or necessary every year).

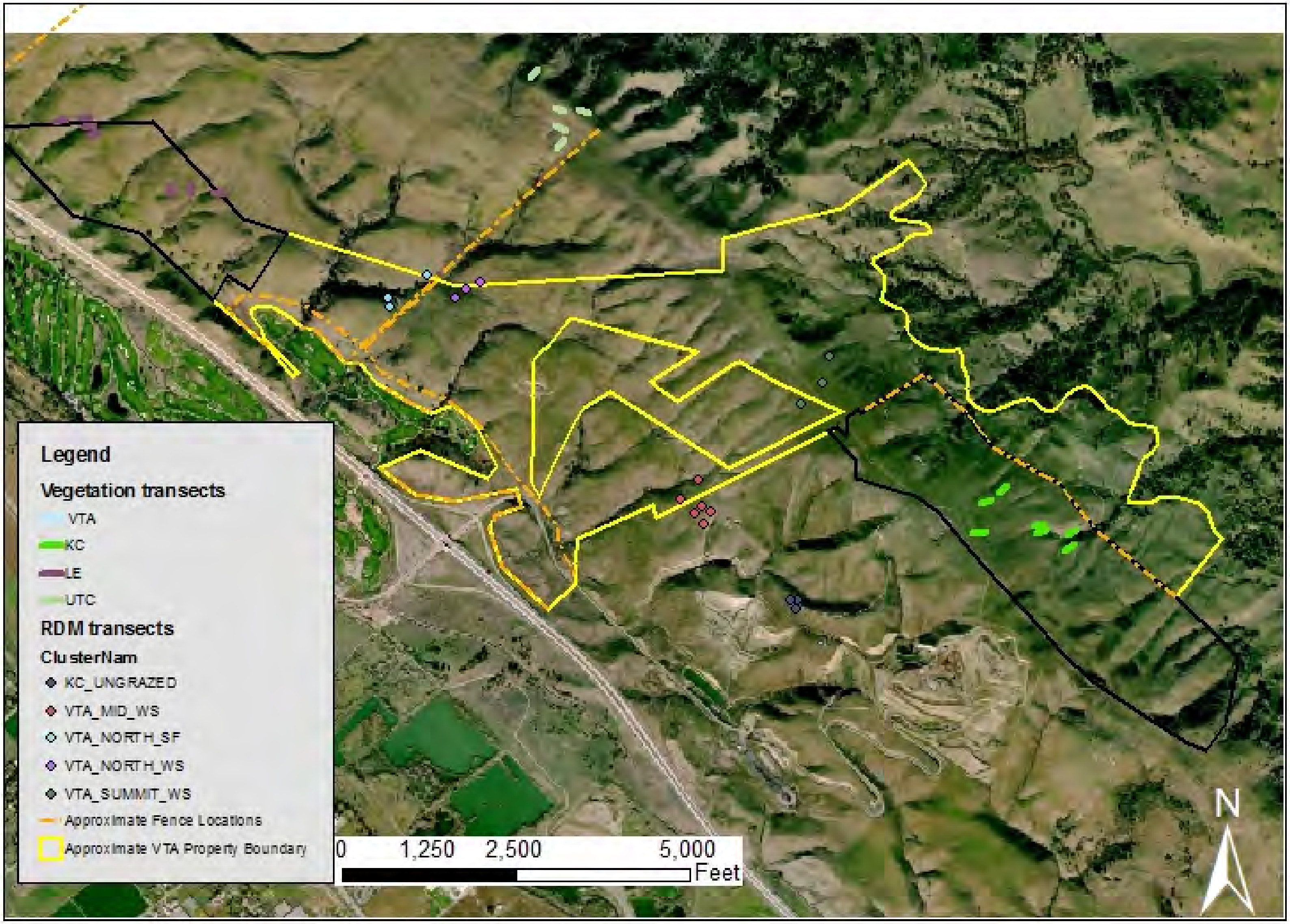
RESIDUAL DRY MATTER (RDM)

RDM provides a quantitative measure of the dry, above-ground plant material left standing or on the ground at the beginning of a new growing season. The amount of RDM remaining in a pasture at the time of the first germinating rain in fall influences soil protection and the microclimate for the coming year’s herbaceous plant community. Properly managed RDM protects soil from erosion and nutrient loss and increases organic matter content in clay soils (Bartolome et al. 2006, Wildland Solutions 2001, 2008). In serpentine communities, where sensitive native plants may be outcompeted by invasives if grazing intensity is not sufficiently high, the amount of RDM remaining also provides a measure of the success of grazing management over the prior year in reducing invasive grasses, thus informing the management regime for the following year. Thus, RDM analysis provides a measure of range condition and a forecast for future utilization, and facilitates rapid monitoring by providing data that can be extrapolated over an entire pasture.

Methods

The Coyote Ridge property covers different grazing pastures and regimes, topoclimates, and elevations. In 2007, RDM data were collected from 18 transects clustered at varying elevations and grazing regimes (Figure 3). As specified in the RMP, 10 of the transects were placed within

Figure 3. Locations of RDM and Vegetation Composition Transects. RDM Transects VTA_Mid_WS are the same as the VTA Vegetation Transects.



the Coyote Ridge property. In addition, several transects, including a set of 3 transects placed in an ungrazed area (for comparison purposes), were located outside Coyote Ridge property lines to allow for sampling of a diversity of grazing regimes, topoclimates, and elevations (Table 2, Figure 3). Within a cluster, transects were placed on uniform-looking slopes that represent the sites' variety of topoclimates. Fifty-meter permanent RDM transects were established, and their ends were marked with rebar.

The majority of the RDM transects were located in paddocks that were grazed by cattle in winter and spring, which is the predominant grazing regime on the Coyote Ridge property. Fewer transects, corresponding with a small area in the northwestern part of the Coyote Ridge property, were located in an area that was grazed in 2007 in spring and fall (and that, in 2005 and earlier, was typically grazed in summer and fall).

Table 2. Properties of 2007 Transect Clusters.

Transect Cluster Name	Elevation	Grazing Regime	# Transects
VTA_NORTH_SF	Mid	spring and fall	3
VTA_NORTH_WS	Mid	winter-spring	3
VTA_MID_WS	Mid	winter-spring	6
VTA_SUMMIT_WS	High	winter-spring	3
UNGRAZED (off VTA)	Mid	None	3

Five vegetation samples (within a 10 inch diameter circular ring) were collected from each transect in late September, before the start of seasonal rain. Samples were collected a meter away from the transect at regular intervals of 10 meters. Vegetation collected was divided into 2 categories, herbaceous cover without erect unpalatable herbs (grass) and erect unpalatable herbs only (tarweed). The tarweeds included *Lessingia* spp., hayfield tarweed (*Hemizonia congesta* ssp. *luzulifolia*), sticky western rosinweed (*Calycadenia multiglandulosa*), and showy tarweed (*Madia elegans* ssp. *densifolia*). Samples were allowed to air dry in warm, dry conditions, and then were weighed. Each transect result represents the average RDM (in terms of lbs/acre) for the 5 samples collected on each transect.

Photos were taken of each of the transects from a distance of 10 meters, including a Robel pole with subdivisions every 5 centimeters (Wildland Solutions 2008).

Results

Total RDM ranged from 549 to 2187 lbs/acre on the Coyote Ridge transects (Table 3). All figures show mean RDM ± standard error of the total.

Table 3. Mean RDM (lbs/acre) on Coyote Ridge Property Plots.

Transect	Grass	Tarweed	Total
VTA_NORTH_SPRINGFALL_COOL	1940	246	2187
VTA_NORTH_SPRINGFALL_WARM	1405	299	1704
VTA_NORTH_SPRINGFALL_MOD	1229	0	1229
VTA_NORTH_WINSPRING_COOL	377	278	655
VTA_NORTH_WINSPRING_WARM	507	99	606

Transect	Grass	Tarweed	Total
VTA_NORTH_WINSPRING_MOD	465	116	581
VTA_MID_WINSPRING_VERYCOOL	1247	363	1609
VTA_MID_WINSPRING_COOL	715	197	912
VTA_MID_WINSPRING_MOD	651	0	651
VTA_MID_WINSPRING_MOD2	549	0	549
VTA_MID_WINSPRING_WARM	574	648	1222
VTA_MID_WINSPRING_VERYWARM	673	366	1039
VTA_SUMMIT_WINSPRING_COOL	747	321	1004
VTA_SUMMIT_WINSPRING_MOD	581	197	778
VTA_SUMMIT_WINSPRING_WARM	546	250	796

Five of 15 transects are in the RMP's initial target range of 500-750 lbs/acre. Three are in the range of 751-1000, 6 are between 1001 and 2000, and one is above 2000 lbs/acre.

Within the transect clusters, the effects of topoclimate are visible, with higher RDM values found on steeper slopes (very cool or very warm). To limit the effect of topoclimate, RDM by grazing cluster (elevation and grazing regime) and by grazing regime only are displayed in Figures 4 and 5. The different pastures on Coyote Ridge are stocked at a similar rate of about one cow-calf pair per 10 acres.

Figure 4. Results for 4 RDM Transect Clusters on Coyote Ridge Property.

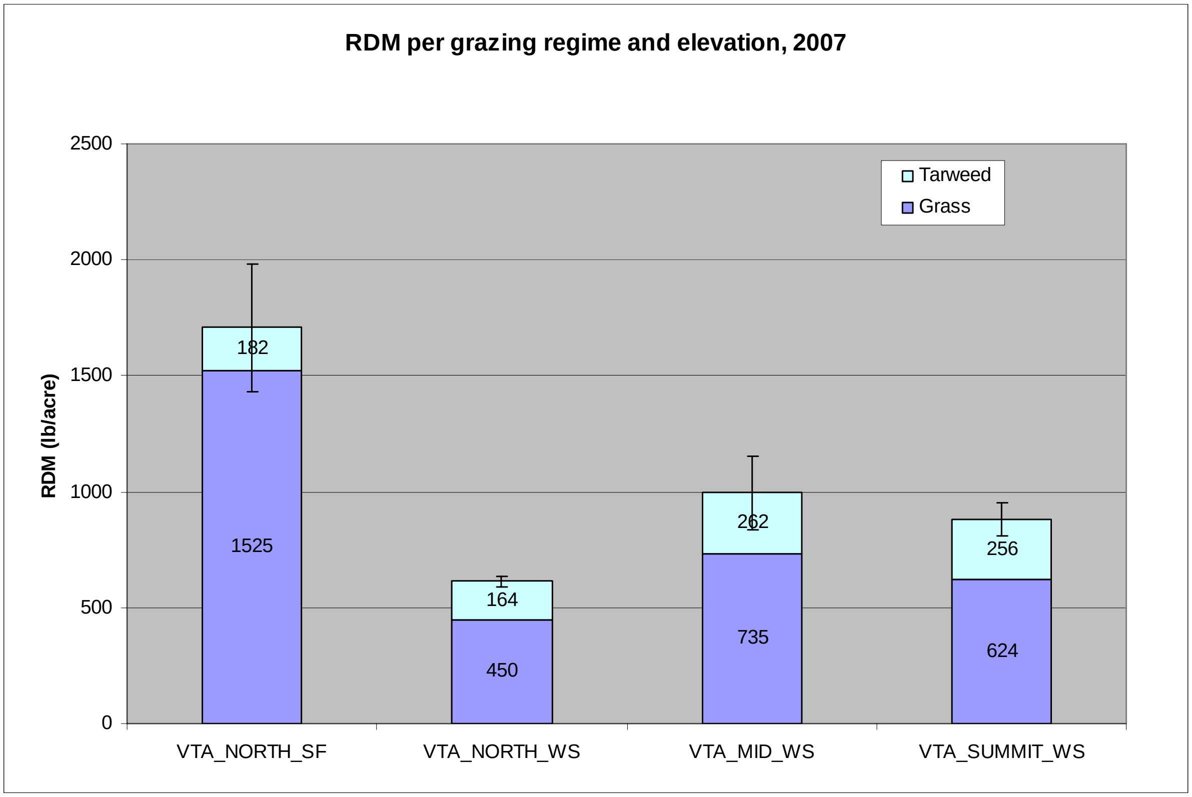
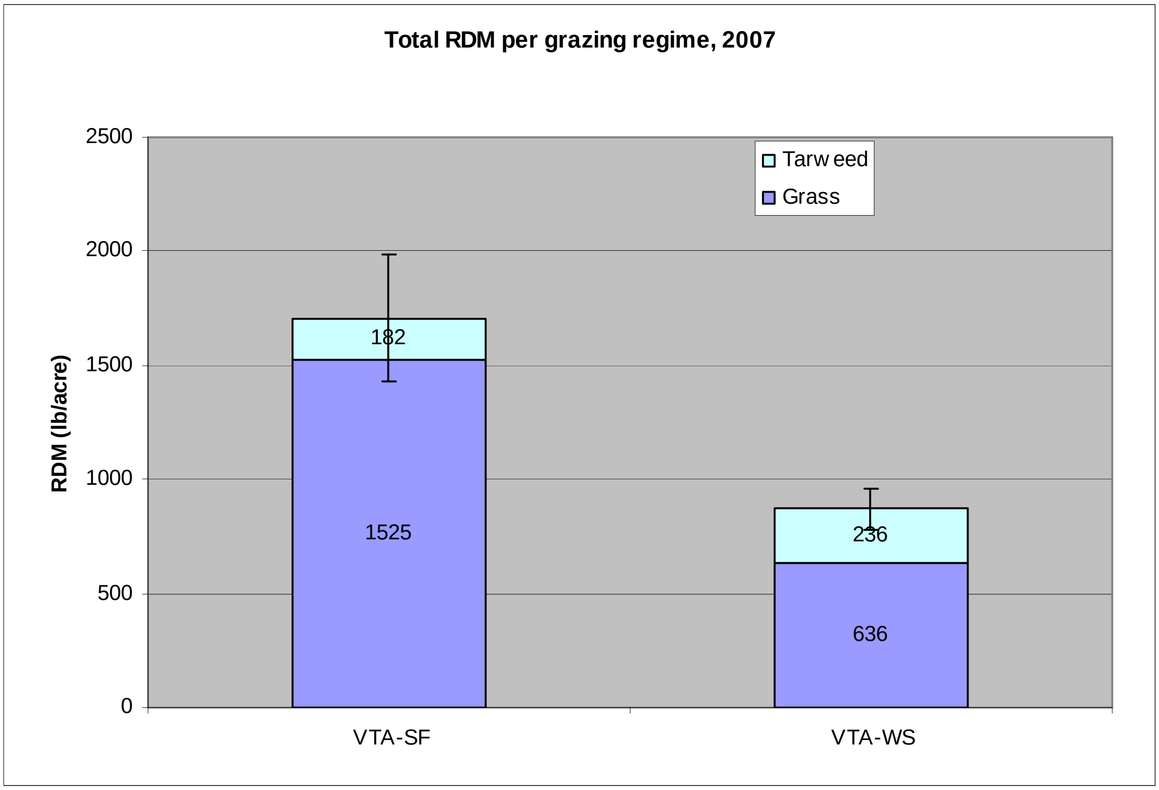


Figure 5. Results for RDM per Grazing Regime on Coyote Ridge Property.



Selected photopoints that display a range of RDM conditions are shown in Appendix A.

Discussion

Grazing Regime Affects RDM. The observed topoclimatic effect is to be expected. Very cool or very warm slopes are by definition very steep, and thus tend to receive less grazing pressure than flat, moderate slopes, which provide easier cattle access. Very cool slopes also show more RDM than very warm slopes, which dry out quickly and limit plant growth.

These existing conditions follow the guideline that higher RDM values are appropriate on steeper slopes to minimize potential erosion (Bartolome et al. 2006). In addition, it would be impractical to make management recommendations based on topoclimate, which is extremely variable on a small scale at Coyote Ridge.

It is more practical to compare RDM values among areas with different grazing regimes. The 3 different winter-spring grazed transect clusters were fairly similar to each other, and exhibited much lower RDM values than the spring and fall grazed cluster. It is interesting that the 2 most different transect clusters, VTA_North_SF and VTA_North_WS, were located directly across a fenceline from each other, demonstrating that otherwise very similar areas respond quite differently to a change in grazing regime. The spring and fall grazing regime appears to leave significantly more RDM than winter-spring.

RDM Correlates with Vegetation Composition. In the context of serpentine habitat management, RDM is important largely because of its effects on vegetation such as checkerspot butterfly host and nectar plants, other native forbs, and invasive annual grasses. This year, vegetation data for this monitoring report were taken on the VTA_Mid_WS cluster. Collection of vegetation data for other studies at other locations with grazing regimes and elevations similar to those of some of the other VTA RDM sampling locations allows generalizations to be made between RDM and vegetation transect clusters (Table 4). VTA_Summit_WS can be represented by Kirby Canyon vegetation plots, and VTA_North_SF can be represented by Los Esteros. VTA_North_WS has no close analog. In the future, collection of vegetation composition data on each RDM transect (if feasible) would allow for even closer comparisons to be made.

Table 4. Comparison of RDM and Vegetation Transects, 2007

RDM Transect Cluster	Vegetation Composition Transect Cluster	Relationship (Location, Grazing Regime, and Elevation)
VTA_NORTH_SF	LE (Los Esteros)	Similar
VTA_NORTH_WS	n/a	n/a
VTA_MID_WS	VTA	Same
VTA_SUMMIT_WS	KC (Kirby Canyon)	Similar

VTA_North_SF had an RDM value of 1707 lbs/acre, the highest of the 4 Coyote Ridge areas monitored. Its analog, Los Esteros, showed some habitat degradation this year, with a dramatic increase in thatch giving it the highest cover on Coyote Ridge. It has moderate dwarf plantain (*Plantago erecta*) cover, but somewhat low nectar cover. Annual and perennial grass cover are comparable to other Coyote Ridge sites. It has seen small increases in native species richness over the last 2 years. On Coyote Ridge, it has the second highest geophyte cover, but the lowest perennial and annual forb cover. While these transects often show the poorest habitat (with respect to serpentine communities) on Coyote Ridge, they still support checkerspot butterflies and show much greater habitat condition than properties on nearby Tulare Hill. Some of the lower habitat values found at Los Esteros are a function of low elevation, with subsequent higher temperatures, lower rainfall, and higher nitrogen deposition. Transects at the summit in this same spring and fall grazed paddock (on UTC property) show much higher habitat quality. More information is available below in the section on plant species composition and cover.

VTA_North_WS had an RDM value of 614 lbs/acre, the lowest of the 4 VTA areas monitored. It does not have an appropriate analog, with respect to vegetation survey transects, at this time.

VTA_Mid_WS had an RDM value of 997 lbs/acre. This area showed the highest dwarf plantain cover on Coyote Ridge, with moderate cover of nectar sources. It generally shows midrange values for many habitat indicators, including this years' cover of goldfields, thatch, perennial and annual forbs, and native species richness.

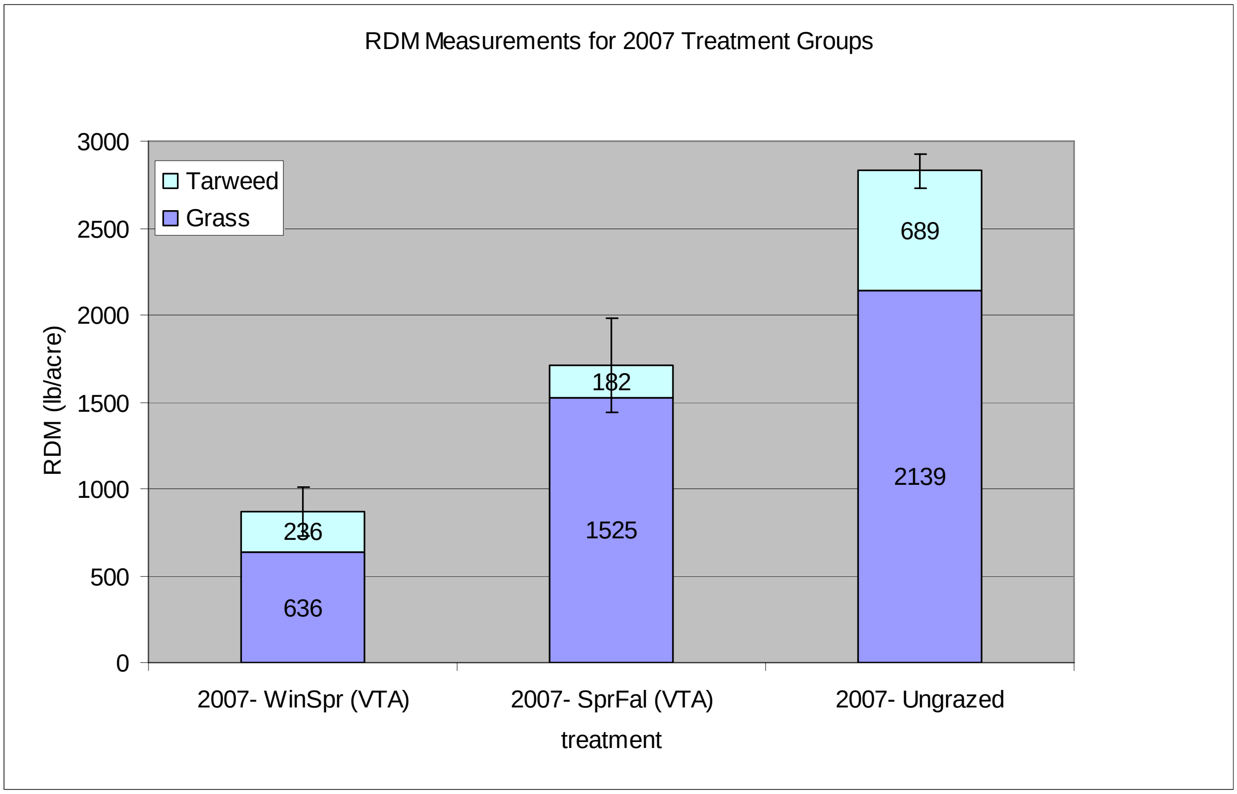
VTA_Summit_WS had an RDM value of 859 lbs/acre. Its analog, Kirby Canyon, continues to have the highest overall habitat quality, with the highest annual forb, perennial forb, and perennial grass cover; the lowest thatch and annual grass cover; and the highest native species richness and cover. Although relatively low in butterfly host plants, sufficient dwarf plantain and nectar sources remain to support bay checkerspots.

To underscore the importance of grazing, additional transects were established off Coyote Ridge property (with landowner permission), in an ungrazed area that had an RDM value of 2828 lbs/acre (Figure 6). While no vegetation composition studies were made on ungrazed sites on Coyote Ridge, this cluster is roughly analogous to an ungrazed (and similarly unburned) site at nearby Tulare Hill. These vegetation transects consistently show the poorest regional habitat quality with respect to serpentine communities, with the lowest dwarf plantain, highest thatch, high annual grass, lowest annual forbs, lowest native plant cover, and low species richness.

These data confirm that high RDM values are associated with low habitat quality.

More detailed results from vegetation composition transects are found below in the section on plant species composition and cover.

Figure 6. Three Grazing Treatments Lead to Significant Differences in RDM.



While the spring and fall grazed paddock has higher RDM values than the winter-spring grazed paddock, both the spring and fall and winter-spring grazed paddocks support bay checkerspot butterflies and sufficient cover of their related plants, while the ungrazed areas do not. This suggests that at least the upper limit of the initial target range of 500-750 lbs/acre could be raised and still support bay checkerspot butterflies and serpentine plant communities, although it should remain well below the amount found on ungrazed parcels.

Spatiotemporal RDM Discussion. To provide the proper temporal and geographic perspective for interpretation of the 2007 monitoring results, RDM results will also be discussed in a regional and temporal context, using additional data that were collected in September 2005 using the same methods. Data were collected from different transects than in 2007, so there is no direct comparison for any one group of transects, and temporal differences may also reflect spatial differences as a result.

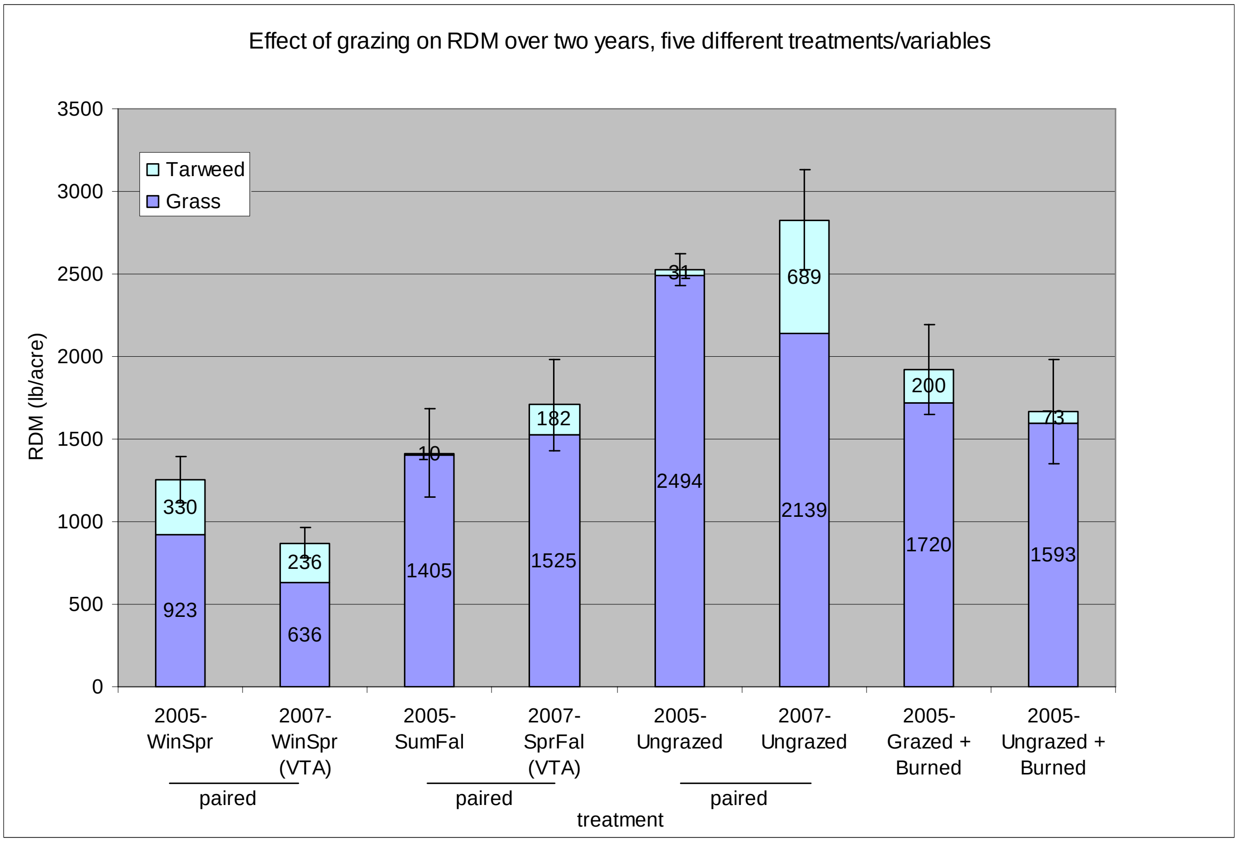
Since precipitation greatly influences vegetation, the annual precipitation recorded at the Morgan Hill weather station of California Irrigation Management Information System (http://wwwcimis.water.ca.gov) is presented:

October 04 to September 05 – 22.41 inches
October 06 to September 07 – 9.37 inches

Some of the 2005 data were collected at Tulare Hill, a 339-acre serpentine outcrop located approximately 3.5 miles northwest of the Coyote Ridge property. A wildfire occurred on Tulare Hill in 2004, allowing a broader comparison of management regimes. Regional information also assists in detecting whether yearly changes are due to annual weather variation. For example, a hypothetical decrease in RDM across all sites indicates weather as a main driver of change, rather than a specific management regime.

From the 2005 and 2007 data, 8 treatment groups (representing 5 different treatments/variables and 2 different years) were created based on grazing regime, fire history, and year. The paired treatments reflect similar management, although specific transects were not repeated. Those groups' mean RDM values ± 1 standard error are presented in Figure 7. During 2005 and before, the spring and fall grazed paddocks were grazed in summer and fall, which is anticipated to have similar effects on RDM.

Figure 7. Comparison of RDM Data by Lumping Individual Transects into 8 Treatment Groups. The Data are Organized into Pairs Comparing 2005 and 2007 RDM Measurement.



Precipitation data show that 2005 was a wet year, with high regional production of annual grasses and forbs. In contrast, 2007 was much drier, and most sites in the region saw a decrease in annual grasses and forbs. Even with the notable difference in precipitation, the only paired treatments that show a significant difference in RDM are the winter-spring group, where the 2007 sites had lower RDM as expected. Winter-spring grazing treatments show the lowest RDM of all study groups. Also related to precipitation, more of the 2007 transects contained tarweeds, and these tarweeds were on average a greater proportion of the total RDM in the drier year (2007). As expected, in both years, ungrazed transects showed the highest RDM, with no notable difference in total RDM between the 2 years.

Surveying after a 2004 burn on Tulare Hill showed that the two 2005 burned parcels still have lower RDM than those that were ungrazed. One year after the burn, the grazed and burned parcel is very similar to the ungrazed and burned parcel. This observation indicates that burning effects in this system are still biologically visible after 1.5 years. These effects do not last much longer, as shown by data in the vegetation composition section.

The winter-spring treatment in 2007 had much reduced RDM from the 2 other treatments surveyed. In a dry year, RDM measurements are typically lower since total forage levels are lower and the grazing pressure is relatively higher. All 3 treatments in 2007 were significantly different from the other, indicating that grazing treatments have a more pronounced effect in a dry year, as opposed to 2005 where the differences are more subtle between the winter-spring and the spring and fall treatments.

Summary. Grazing management has a significant impact on the amount of RDM observed in the field. Ungrazed treatments always contained significantly higher RDM than any of the grazed treatments. These sites also tended to have a much higher percentage of thatch covering the ground in spring. Winter-spring grazing seems to remove the highest portion of the vegetation. High RDM values are associated with poor serpentine habitat quality.

Interannual trends were also observed. RDM measurements in a wet year (2005) and a dry year (2007) were remarkably similar despite 2005 precipitation being more than twice that of 2007. In the dry year, the winter-spring grazing treatment showed a notable decrease in RDM from the wet year, while no marked difference was present in the spring and fall treatments. This indicates that grazing pressure increases in a dry year for paddocks grazed with a winter-spring regime, with little effect in the spring and fall paddocks. Closer observation of RDM in winter-spring grazing regimes may be warranted to confirm this.

All of the 8 treatment groups assessed in 2005 and 2007 produced total RDM values above the initial, RMP-recommended target range of 500-750 lbs/acre. It is generally agreed that current management is maintaining healthy populations of target species and a diverse serpentine plant community on the Coyote Ridge property (VTA 2006). Data collected over the next few years should be analyzed with existing RDM data to adjust the initial target range, if necessary, rather than to initiate management changes.

It should be noted that grazing may not be the only factor affecting RDM. Spring thatch, which is closely related to fall RDM, was negatively correlated with elevation in 2007. Low elevation properties are presumably closer to nitrogen deposition sources, which encourage annual grass growth. More detailed results from vegetation composition transects are found below in the section on plant species composition and cover.

The paddock that was grazed in 2007 in spring and fall had previously (in 2005 and earlier) been typically grazed in summer and fall, and the RMP called for summer/fall grazing in this area. In 2007, the rancher grazing this paddock lost permission to graze a large paddock on adjacent UTC property and had to modify his grazing arrangements to avoid having bulls in adjacent paddocks during the breeding season. This change from summer/fall to spring/fall grazing may only be temporary. Data on RDM and other monitoring parameters, as described in this report, do not indicate a drop in habitat quality in 2007 due to this change. Future monitoring efforts will continue to monitor whether the grazing regime in this area is maintaining the desired habitat conditions.

Recommendations. The purpose of the RDM transects is to track changes through time in representative areas. The VTA site is extremely heterogeneous, with two grazing regimes and strong climatic gradients across slopes. The extensive studies reported here provide sufficient background on the range of RDM variability in serpentine grassland, so that further extensive studies are not needed.

Fifteen RDM transects on and immediately adjacent to the Coyote Ridge property were sampled in 2007. Of these, 10 transects (all 3 VTA_NORTH_SF and VTA_NORTH_WS transects and 2 each of the VTA_SUMMIT_WS and VTA_MID_WS transects) are on the Coyote Ridge property itself according to Figure 3. We recommend that RDM sampling continue at least on these 10 on-site transects; if feasible, and if access to other adjacent sites allows, sampling on the additional 6 transects would be useful in capturing the desired range of slopes, aspects, and elevations. The sites where RDM is measured would become permanent composition plots as well.

In the longer term, RDM monitoring would be facilitated by implementing photo-monitoring to replace clipping. Photo sites would be established using the range-pole and golf ball method, existing photos would be calibrated to measurements (see Appendix A), and SCCOSA staff would be trained to implement photo-monitoring and RDM estimation and replace clipping when appropriate. While these changes to the monitoring protocol are not required, we recommend that SCCOSA staff investigate these changes to facilitate long-term monitoring.

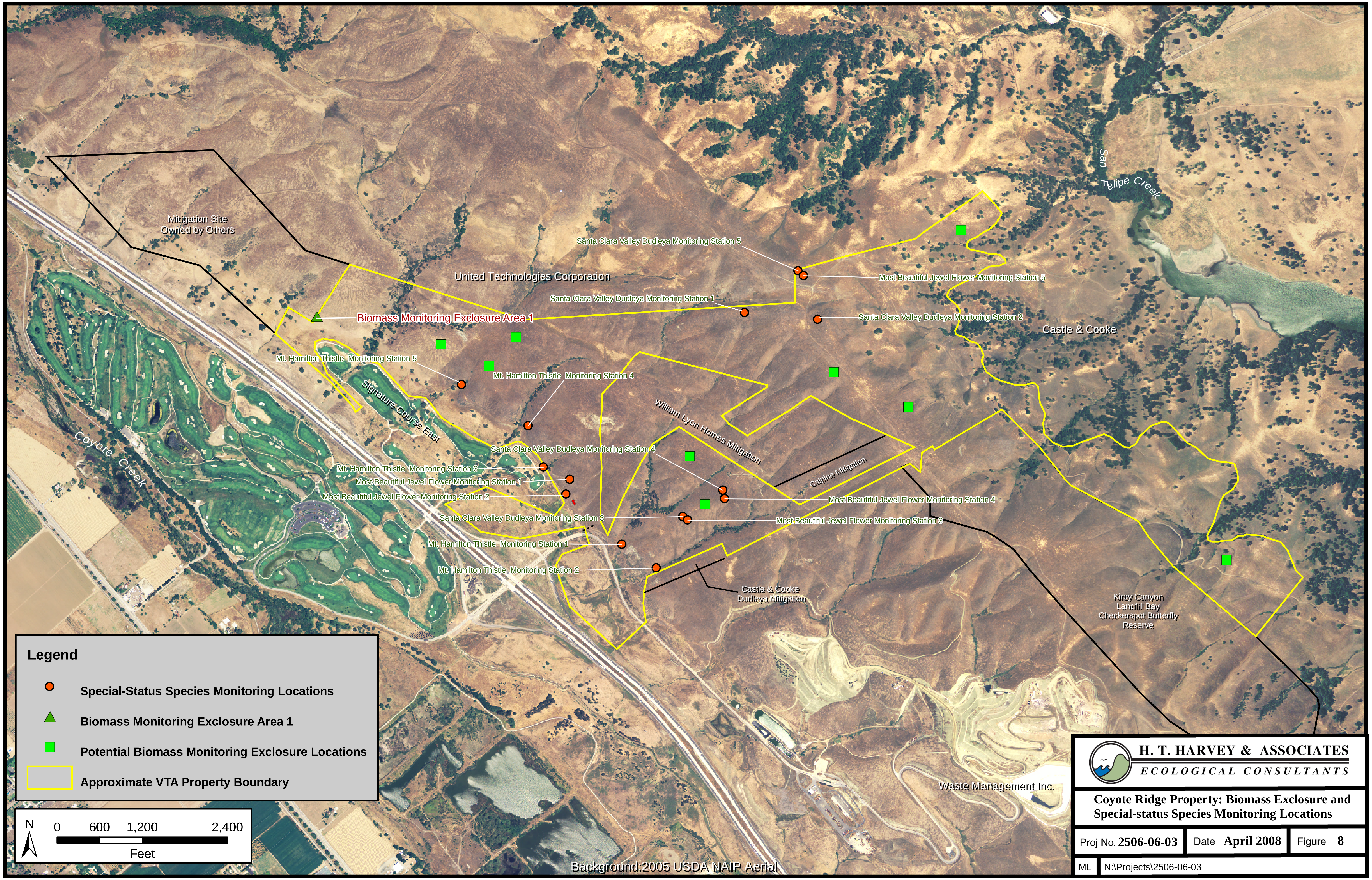
GRAZING PERIOD/SEASON STANDING FORAGE

Because RDM monitoring (described previously) measures vegetation generally after the grazing season, and not during the grazing period, additional sampling needs to be conducted in order to monitor forage utilization and, if necessary, to trigger modifications to stocking rates or grazing period on-site within a given season. Thus, measurement of standing forage within a given grazing period or season will determine the percentage of annual production of forage that has been removed by animals specifically throughout the grazing period or grazing season. If the target level of use for range plants in terms of forage removal is known, percent utilization at once reveals whether forage remains for use and whether adjustments in grazing need to be implemented. This method allows for greater flexibility within a given season than the RDM method allows.

Methods

The RMP specified that standing herbage biomass plots be established in grazed areas, and that small fenced exclosures be established to provide ungrazed reference areas, adjacent to each of the RDM monitoring locations. In 2007, monitoring began in late summer/fall, after the winter/spring grazing period had ended. As a result, there was no need to monitor standing forage in the winter/spring grazing paddock that comprises most of the Coyote Ridge property, and monitoring of standing forage therefore focused on the small area that was grazed in spring and fall of 2007, in the northwestern portion of the site.

H. T. Harvey & Associates constructed a standing herbage biomass monitoring exclosure in the northwestern part of the site, which in 2007 was grazed in spring and fall, on 13 September 2007 (Figures 8 and 9). The monitoring exclosure was constructed of 8 T-posts and 5-stranded barbed wire that enclosed approximately 100 square feet of grassland (Figure 9). A Global Positioning System (GPS) unit was used to map the location of the monitoring exclosure. This location within the summer/fall-grazed paddock was selected because it was determined to be representative of the vast majority of the grassland habitat within the paddock in terms of



Coyote Ridge Property: Biomass Exclosure and Special-status Species Monitoring Locations

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Figure 9. Grazing Exclosure/Standing Biomass Monitoring Area 1.

floristic composition, slope, aspect, and utilization by livestock. It had the additional benefit of being relatively easily accessible by using the golf course vehicle road that was utilized under permission of the superintendent of Coyote Creek Golf Course. Cattle were present in this paddock when the exclosure was constructed, and throughout the fall of 2007.

Subsequently, H. T. Harvey & Associates senior plant ecologist Patrick Boursier, Creekside Center for Earth Observation President Stuart Weiss, and SCCOSA General Manager Patrick Congdon conducted a site visit to discuss grazing management of the property and the methodology for monitoring range utilization. It was determined that grazing period standing forage monitoring would be performed using the biomass plot methodology described in the RMP, and that the single exclosure established in the paddock in the northwestern part of the site would be adequate for the purposes of monitoring standing forage in the fall of 2007.

Standing herbage biomass was determined using the methodology described in the RMP. Standing biomass was sampled twice, on 13 September 2007 (to estimate baseline conditions at the time the exclosure was constructed) and on 6 December 2007. During each visit, a 4-m^2 quadrat unit constructed of PVC material was placed randomly within the exclosure, and all of the plant biomass consisting of dead herbaceous grasses and forbs within the quadrat were clipped. For comparative purposes, the same sampling approach was used to clip herbage biomass within the grazed area immediately adjacent to (outside of) the exclosure during each of the two site visits. The clipped vegetation was then air-dried and weighed.

Results

Results of standing herbage biomass monitoring at the single monitoring area in the northwestern part of the site are shown in Table 5.

Table 5. Comparison of Grazed and Ungrazed Herbage Biomass at Standing Biomass Monitoring Area 1.

Collection Period	Location	Herbage Dry Weight (g)	Herbage Dry Weight (lbs/ac)
September 2007	Inside Exclosure Area 1	331	738
	Outside Exclosure Area 1	462	1030
December 2007	Inside Exclosure Area 1	496	1106
	Outside Exclosure Area 1	387	863

Discussion

In September, when the initial, baseline clippings were taken, a random sample from within the exclosure weighed substantially less (331 g) than the random sample taken immediately outside the exclosure (462 g). Because both areas had been subjected to the same grazing pressures up to the time when the sample was taken (i.e., on the same day the exclosure was erected), these differences are due to the natural variability in biomass among different areas within the paddock.

The dry weight of the biomass clippings increased by 165 g (50%) inside the exclosure between 13 September and 6 December, whereas outside the exclosure, dry weight declined by 75 g (15%). Plant distribution is not completely uniform either within the exclosure or in the grazed area outside, as evidenced by the differences in the baseline biomass measurements within and outside the exclosure on the date the exclosure was constructed. Thus, some of the difference in dry weight of herbage biomass from one sampling event to another may reflect spatial variability in biomass. However, the pattern observed in the fall 2007 results is as would be expected – standing biomass increased within the exclosure as plants began to grow in late fall, but decreased outside the exclosure, likely due to grazing.

Nine additional grazing period standing forage monitoring areas will be constructed by SCCOSA staff in spring or summer of 2008 to accompany each of the 10 on-site RDM monitoring transects. Potential locations for these exclosures are depicted on Figure 8. However, the SCCOSA has some latitude in determining the locations of these exclosures. They do not have to be sited directly adjacent to the RDM monitoring plots, however, they are routinely paired up in this way to facilitate field monitoring. In establishing the exclosure locations, the primary consideration is that they be constructed within the same grazing management area as RDM monitoring plots in order to make results comparable with the RDM data.

Standing herbage biomass will be measured by clipping vegetation from random locations inside and outside of each exclosure on a monthly basis during the grazing season. The amount of standing herbage biomass (in units of lbs/acre) will be compared to the RDM end-of-season goal of 500-750 lbs/acre to determine whether forage remains for use and whether adjustments in grazing, such as adding or removing livestock, need to be implemented.

PLANT SPECIES COMPOSITION/COVER

The purpose of monitoring the overall composition of the serpentine grassland is to provide a reliable system for detecting major changes in grassland composition in response to climate, topography, and management. A standard methodology, the same one described for this purpose in the RMP, is being used at multiple sites in the region. The system is designed to monitor large changes in composition from year to year (interannual) and across topographic and edaphic (soil) gradients, while at the same time being efficient for data collection and interpretation.

This information can be used to gauge changes or monitor range trend over time in response to changes in grazing pressure and as a means to correlate the RDM target levels to key plant species (e.g., dwarf plantain, owl's clover [*Castilleja* spp.], and adult nectar sources for the bay checkerspot butterfly).

Methods

Six transects were established on the Coyote Ridge property in spring 2006 and resampled in 2007. A site was selected on the western midslope to complement existing vegetation transect clusters located on other Coyote Ridge properties. The VTA transects are located in the winter-spring grazed paddock, and represent the only midslope transect cluster on Coyote Ridge. This cluster captures the variability of midslope topoclimates (very warm, warm, moderate, cool, and very cool). Collectively, this dataset captures different grazing regimes, elevations, and topoclimates throughout the Coyote Ridge properties, allowing managers to make inferences to various portions of the Coyote Ridge property. These additional sites are described further in Table 6.

The 6 transects on the Coyote Ridge property were established before the RMP was finalized. In the future, additional transects adjacent to the RDM monitoring locations will be read for vegetation composition, per the RMP. These will be the 3 VTA_Summit and 6 VTA_North transects installed for RDM monitoring in fall 2007. The 3 summit transects are similar in elevation and grazing regime to existing transects in Kirby Canyon, and the 3 spring and fall transects are similar to those at Los Esteros.

Transects are 50 meters long and permanently marked at each end with rebar. A 50-m tape is stretched along the transect, and a 0.5 x 0.5 m (0.25 m^2) quadrat is placed at 10, 20, 30, 40, and 50 m along the right side of the tape, and at 5, 15, 25, 35, and 45 m along the left side of the tape. The percent relative cover (on a cover class scale of 1, 2, 5, 10, 20, 30, 40 . . . 100%) of each plant species within the quadrat is recorded. Percent cover of bare ground, rock, and litter are included in the cover total. This method has been used regionally to measure serpentine grassland composition, and is described in the RMP.

Monitoring is conducted during peak spring flowering season (typically late March-early May). Timing of monitoring varies with transect location due to differences in phenology among areas with different topoclimates, and will vary among years.

Results

Results are compiled in Table 6 for specific plant species and functional groups that are used as indicators of bay checkerspot and serpentine grassland habitat quality.

Table 6. Vegetation Composition Results for 2006 and 2007.

Species	2006 Mean Cover ± SE	2007 Mean Cover ± SE
Checkerspot host and nectar plants		
Dwarf plantain (*Plantago erecta*)	9.80 ± 0.65	8.08 ± 1.16
Owl's clover (*Castilleja* spp.)	0.68 ± 0.13	0.13 ± 0.04
Goldfields (*Lasthenia californica*)	6.27 ± 0.73	2.50 ± 0.58
Tidy tips (*Layia gaillardioides*)	0.02 ± 0.01	0
Jeweled onion (*Allium serra*)	0.02 ± 0.01	0.08 ± 0.04
Seaside maritima (*Muilla maritima*)	0.67 ± 0.19	0.58 ± 0.19
Key nonnative grasses		
Italian ryegrass (*Lolium multiflorum*)	16.98 ± 1.60	23.02 ± 2.31
Soft chess (*Bromus hordeaceus*)	7.57 ± 0.68	4.57 ± 1.16
Functional guilds		
Native perennial grasses	1.02 ± 0.12	0.42 ± 0.12
Nonnative annual grasses	26.43 ± 1.58	28.75 ± 2.49
Geophytes	2.80 ± 0.31	2.28 ± 0.44
Perennial forbs	5.80 ± 0.58	4.25 ± 0.87
Annual forbs	29.72 ± 1.05	15.58 ± 1.44
Legumes	5.47 ± 0.24	2.07 ± 0.25
Native richness and cover		
Native species richness*	11.12 ± 0.19	9.95 ± 0.31
Native cover	44.97 ± 0.87	24.38 ± 1.55
Totals		
Total plant cover	71.63 ± 1.47	53.45 ± 2.73
Thatch	0.92 ± 0.23	4.67 ± 0.74
Bare	19.85 ± 1.28	29.80 ± 2.65
Rock	6.85 ± 0.49	10.92 ± 2.0

*Average number of native species per quadrat

Discussion

In order to draw meaningful conclusions, baseline vegetation results will be discussed in both a temporal and regional context. Additional sites throughout the region help compare different management regimes, and show site differences based on elevation (which affects temperature, rainfall, and nitrogen deposition). Regional information also assists in detecting whether yearly changes are due to annual weather variation. For example, the decrease in goldfields (*Lasthenia californica*) cover on Coyote Ridge property from 2006 to 2007 was mirrored at all other regional sites, indicating that low rainfall in 2007 was the main driver of low cover values across the board in 2007, rather than pointing to a specific management issue at the Coyote Ridge property.

Examining data in a spatiotemporal context also illustrates that a given management regime may produce different results in different years. Because of this interannual variability, a variety of management regimes are generally considered best for maintaining bay checkerspot habitat over time. There is no single optimal management regime (although unmanaged properties reliably suffer extreme habitat degradation). Subsequent annual reports may contain less information than is presented here, but a baseline report requires a regional and temporal context.

The Coyote Ridge property covers different grazing regimes, topoclimates, and elevations. The current Coyote Ridge proeprty vegetation plots are located at mid-elevation on the winter-spring grazed paddock (Table 7). The Kirby Canyon plots (KC) are representative of areas of Coyote Ridge property on top of the ridge in the winter-spring paddock, including the new VTA_Summit transects used for RDM data collection. Los Esteros plots (LE) are representative of areas of Coyote Ridge property low on the western side of the ridge, in the spring and fall paddock. UTC plots are high elevation and grazed in spring and fall, a combination that is not found on Coyote Ridge property. A map of these transects can be found above in the Residual Dry Matter section (Figure 3).

Data for Tulare Hill will be included in this report as a means to compare a nearby low elevation serpentine grassland in a high nitrogen deposition zone with additional management regimes not found on Coyote Ridge. Tulare Hill is a 339-acre serpentine outcrop located approximately 3.5 miles northwest of the Coyote Ridge property. It lies west of the Diablo Range (which includes Coyote Ridge), and east of the Santa Cruz Mountains. It is bounded by Monterey Highway, Fisher Creek, Santa Teresa Boulevard, and on the north and west by a residential community that includes Cheltenham and Pegasus Ways. Tulare Hill has multiple owners, and includes a 116-acre checkerspot butterfly habitat mitigation site owned by the Silicon Valley Land Conservancy.

Since 2005, sites on Tulare Hill have been broken down into 3 management treatments: grazed and burned (G-B), ungrazed and burned (UG-B), and ungrazed and unburned (UG-UB). The latter site is essentially unmanaged. It should be noted that the 2 burned sites were burned only once in May 2004. The year 2005 is included in this data set, even though there are no VTA data for that year, in order to illustrate postfire vegetation responses.

Serpentine soils are characteristically low in nitrogen and thus nutrient deficient for the growth of most plant species. Species associated with serpentine habitats are more suited to low nitrogen levels. Nutrient amendment in the form of nitrogen deposition can have a significant impact on vegetative species composition. Deposition can further encourage the growth and spread of nonnative grasses that compete for space with native species such as bay checkerspot host and nectar plants. This nitrogen deposition is caused by air pollution formed by fuel-burning sources such as combustion vehicles and natural gas power plants (Weiss 1999).

Mowing, grazing, and burning have been shown to reduce the cover of nonnative grasses associated with nitrogen deposition. Data collected from Tulare Hill plots are an important tool for local serpentine grassland managers, as they illustrate the habitat degradation that occurs in the absence of active management such as grazing and/or burning. Data for the ungrazed, unburned site illustrate clearly the effects of unmanaged serpentine grassland in high nitrogen deposition areas. The data also show the timescale at which burning is effective.

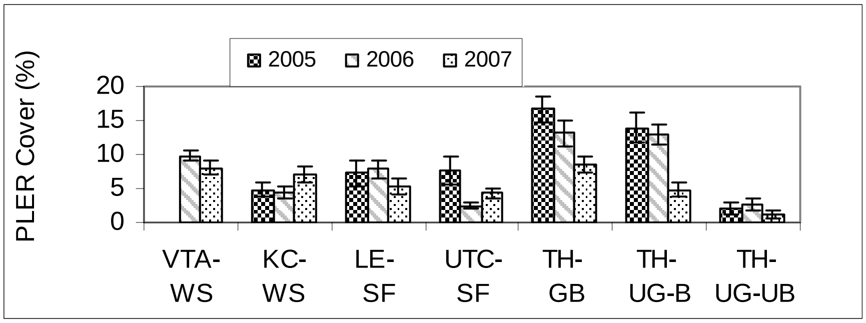
Studies at Edgewood Natural Preserve in San Mateo County illustrate that mowing is also an effective management tool to reduce cover of invasive grasses on serpentine soil (Weiss 2002). Mowing is not discussed further here as it is not practical in the large, steep, rocky areas found throughout Coyote Ridge.

Table 7. Intersite Comparison Information and Abbreviations.

Name	Full Name	Site	Management	Elevation	Nitrogen Deposition (kg-N/ha/yr)
VTA-WS	Valley Transportation Authority	Coyote Ridge	Grazed, winter-spring	Mid	~14
KC-WS	Kirby Canyon	Coyote Ridge	Grazed, winter-spring	High	~11
LE-SF	Los Esteros	Coyote Ridge	Grazed, spring and fall	Low	~15
UTC-SF	United Technologies Corp.	Coyote Ridge	Grazed, spring and fall	High	~11
TH-GB	Tulare Hill	Tulare Hill	2004 burn; Grazed, spring-fall	Low	~17
TH-UG-B	Tulare Hill	Tulare Hill	2004 burn; Ungrazed	Low	~17
TH-UG-UB	Tulare Hill	Tulare Hill	Unburned; Ungrazed	Low	~17

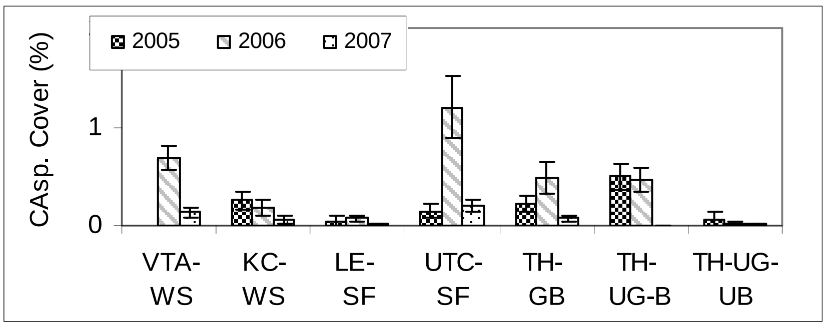
Bay Checkerspot Host Plants. The Coyote Ridge property transects had the second highest dwarf plantain (*Plantago erecta*) cover at 8.08%. Regionally, plantain cover declined or held steady at most sites from 2006 to 2007, but increased slightly at the high elevation Kirby Canyon and UTC sites. Dwarf plantain cover was low during the period 2005-2007 due to lack of management at Tulare Hill (TH-UG-UB), but was higher overall during this period (i.e., responded positively to) burning (TH-UG-B) or burning and grazing (TH-GB) (Figure 10). Dwarf plantain cover was the lowest, among these study sites, at Tulare Hill's ungrazed and unburned transect. Cover declined at the burned sites as the vegetation redeveloped post-fire, and declined particularly steeply in the ungrazed burn site. The Tulare Hill grazed and burned site had highest cover values in 2007 (8.6%), down from 2003's high of 32.9% at the same site (Weiss and CH2M Hill 2007).

Figure 10. Average Cover of Dwarf Plantain (*Plantago erecta*), ± SE



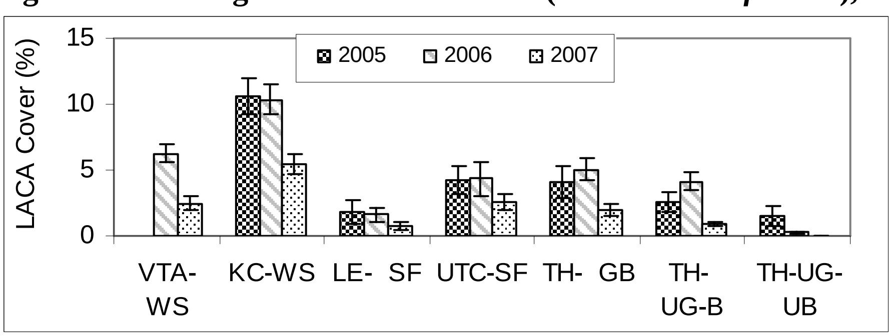
Owl's clover (*Castilleja* spp.) cover showed sharp declines during the period 2005-2007 at nearly all sites, including VTA (Figure 11). The highest cover was at UTC, still below 0.2%.

Figure 11. Average Cover of Owl's Clover (*Castilleja* spp.), ± SE



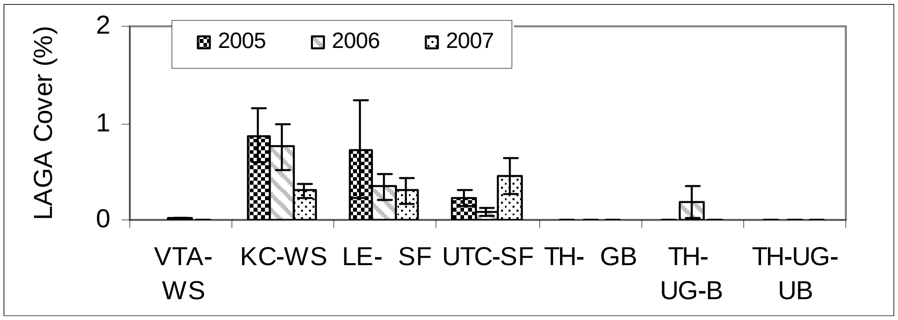
Bay Checkerspot Nectar Plants. Goldfields (*Lasthenia californica*) cover dropped during the period 2005-2007 at all sites, including VTA (Figure 12). This suggests the dry year (2007) as the main factor in average cover decreases, although the differences in cover at the 3 Tulare Hill sites suggest management regimes to be important as well. The lowest cover was again found on the unmanaged Tulare Hill site, with the highest Tulare Hill cover found on the grazed and burned site. It is interesting that, from 2005 to 2006, goldfields cover increased only in the burn sites, and declined more rapidly in the ungrazed burn site from 2006 to 2007 than in the grazed burn area.

Figure 12. Average Cover of Goldfields (*Lasthenia californica*), ± SE



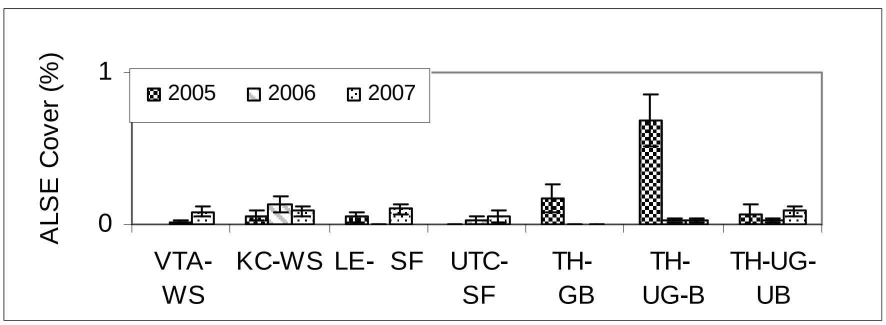
Tidy tips (*Layia gaillardioides*) cover is always relatively low in the South Bay, and it declined at most sites during the period 2005-2007 (Figure 13). None was found in the VTA plots in 2007. Its cover appears too sporadic to quantitatively detect regional patterns.

Figure 13. Average Cover of Tidy Tips (*Layia gaillardioides*), ± SE



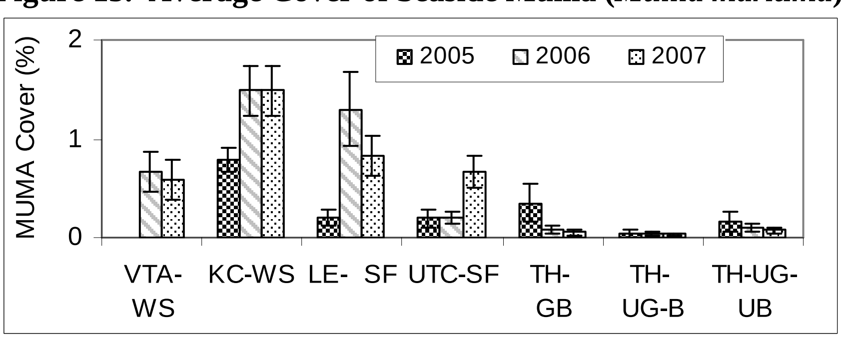
Jeweled onion (*Allium serra*) continued to show very low cover across the board, with mixed increases and decreases in 2007 (Figure 14). The Coyote Ridge property showed a slight increase from 2006 to 2007. We noted that 2 burned plots on Tulare Hill showed high values in jeweled onion cover immediately after the fire, but densities have since receded.

Figure 14. Average Cover of Jeweled Onion (*Allium serra*), ± SE



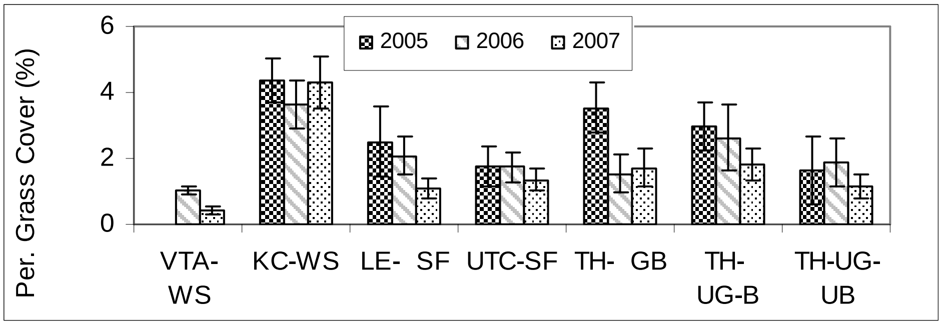
Seaside muilla (*Muilla maritima*) largely held steady with low cover, with the highest cover being 1.5% at Kirby Canyon (Figure 15). The VTA (Coyote Ridge) transects had an insignificant decrease between 2006 and 2007. There did not appear to be a clear trend based on grazing regime.

Figure 15. Average Cover of Seaside Muilla (*Muilla maritima*), ± SE



Grasses. Bunchgrass cover remained static this year, with some minor decreases (Figure 16). The highest cover was 4.3% at Kirby Canyon. The lowest cover was 0.42% at VTA (Coyote Ridge), a decrease from 2006 estimates of 1.02%. There were no notable management effects. All recorded perennial grasses were native.

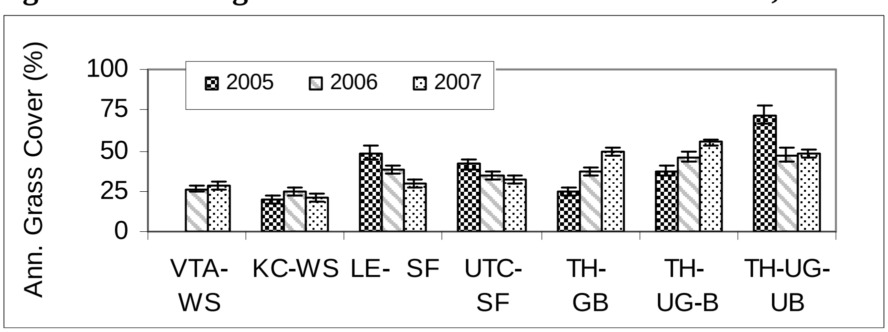
Figure 16. Average Cover of Perennial Grasses, ± SE



Burning clearly altered the cover of nonnative annual grasses. Unlike unburned sites, which saw either little change or decreases in annual grass cover from 2005 to 2007, the Tulare Hill burn sites both saw significant increases in cover (Figure 17). The lowest annual grass cover was at Kirby Canyon; Tulare Hill continues to have the highest annual grass cover.

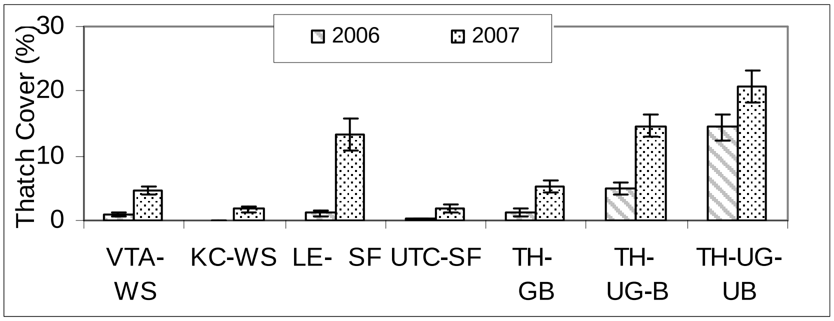
In 2007 for the first time, the Tulare Hill ungrazed, unburned parcel did not have the highest annual grass cover. This can be explained by its high thatch cover (Figure 18), as this unmanaged parcel has reached a point where thatch buildup limits even annual grass recruitment. Annual grasses have continued to increase on the other Tulare Hill sites, to the point where they are now all comparable.

Figure 17. Average Cover of Non-native Annual Grasses, ± SE



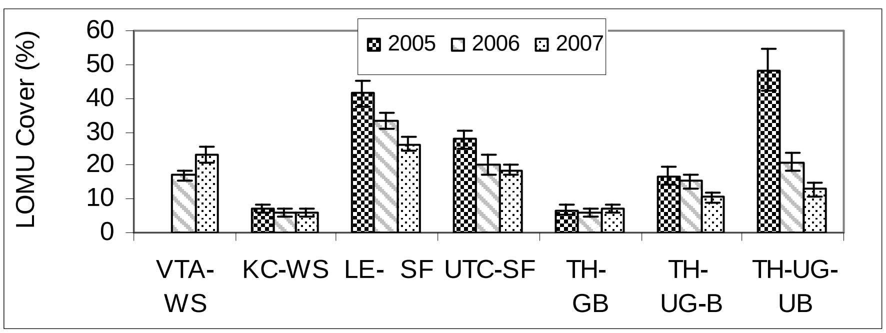
Thatch appeared to follow an elevational gradient, with the exception of relatively low thatch buildup on the Tulare Hill burned and grazed parcel (Figure 18). The Tulare Hill ungrazed unburned area showed severe thatch buildup, at 20% cover in 2007. The elevational gradient could correlate with a nitrogen deposition gradient, since most nitrogen source pollution is at lower elevations in the San Jose and the Santa Clara Valley — or a temperature/rainfall gradient, as temperature decreases and precipitation generally increases with elevation. All sites had increased thatch in 2007 over 2006, which is probably due to 2006 being a relatively wet year. High plant production in the 2006 growing season became high thatch cover in 2007.

Figure 18. Average Cover of Thatch, ± SE



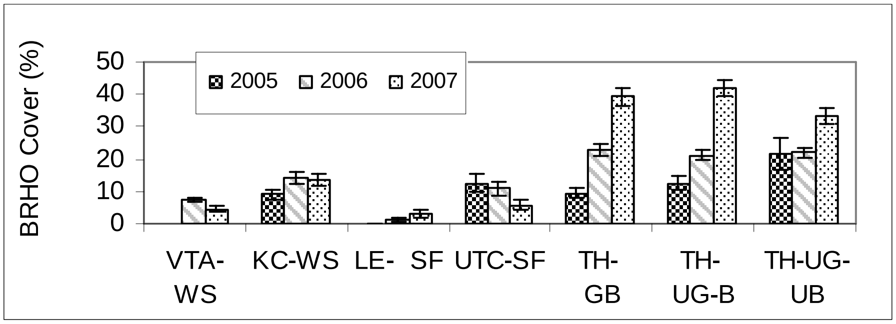
Italian ryegrass (*Lolium multiflorum*) showed regional decreases, but increased at VTA from 17.0 to 23.0% from 2006 to 2007 (Figure 19). Of the annual grass species, Italian ryegrass cover was lowest at Kirby Canyon and Tulare Hill burned and grazed. There did not appear to be a pattern based on elevation or management regime. The 3 sites where Italian ryegrass declined most also showed the greatest thatch development (TH-UG-B, TH-UG-UB, LE-SF), which supports that severe thatch development limits even annual grass recruitment.

Figure 19. Average Cover of Italian Ryegrass (*Lolium multiflorum*), ± SE



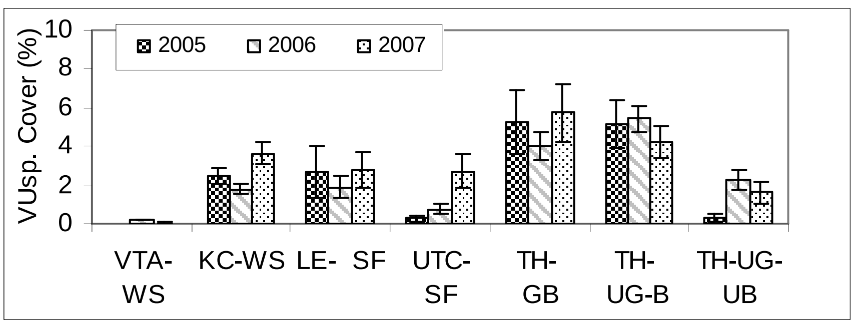
The Italian ryegrass increase at VTA was countered with a decrease in soft chess (*Bromus hordeaceus*), from 7.6 to 4.6% (Figure 20). Soft chess showed large increases at all the Tulare Hill sites, even in the presence of grazing. The soft chess cover at the grazed, burned site has continued to increase well beyond its preburn cover of 16.1% in 2004 to its current 39.3% (Weiss and CH2M Hill 2007).

Figure 20. Average Cover of Soft Chess (*Bromus hordeaceus*), ± SE



The lowest annual fescue (*Vulpia* spp.) cover is found at VTA, at 0.05%. Annual fescue cover was highest at the burned sites on Tulare Hill (Figure 21). It otherwise showed no clear pattern among elevation or management regimes. Its largest increase was at UTC. Both native and nonnative species are included in this group.

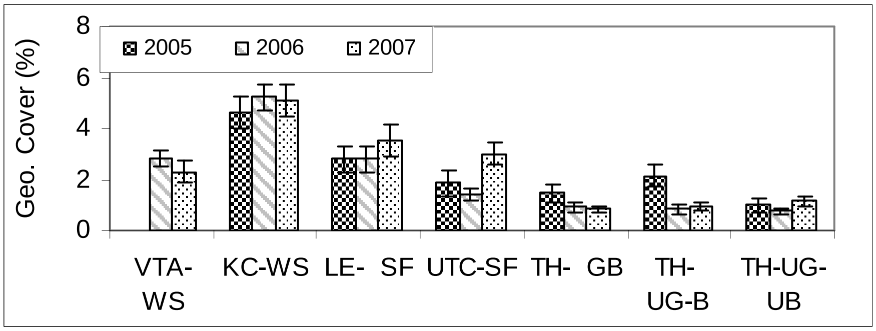
Figure 21. Average Cover of Annual Fescue (*Vulpia* spp.), ± SE



Other Functional Groups. A geophyte is a plant that has bulbs, corms, tubers, or similar underground structures. The California poppy (*Eschscholzia californica*) and blue-eyed grass (*Sisyrinchium bellum*) are 2 common examples. While technically a type of perennial forb, here geophytes are calculated separately from that category. Forbs are herbaceous (non-woody) plants that are not grasses, sedges, or rushes. Legumes are members of the pea family, which are biologically important because they have nitrogen-fixing bacteria in their root nodules. The legumes found on these sites are all annual forbs, but again are not double counted in that category.

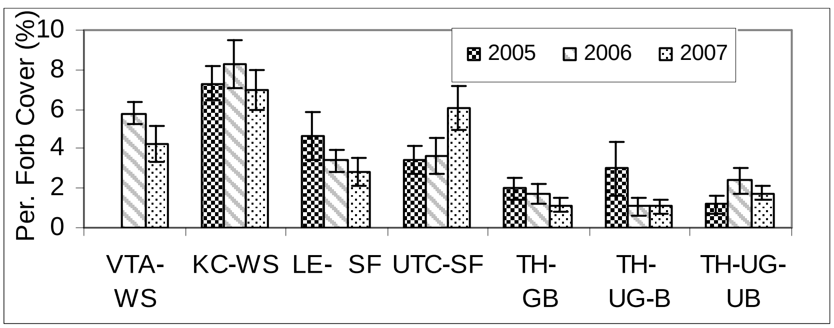
VTA showed the lowest geophyte cover of Coyote Ridge sites. Differences among other Coyote Ridge sites did not seem to follow patterns of elevation or grazing regime (Figure 22). Cover was largely unchanged, with the exception of a notable increase at UTC, making it more similar overall to the other Coyote Ridge sites. Geophyte cover at burned Tulare Hill sites declined during the period 2005 to 2007 while other sites remained similar or had increases in cover, suggesting that post-fire vegetation succession may have been suppressing geophytes. All surveyed geophytes are native.

Figure 22. Average Cover of Geophytes, ± SE



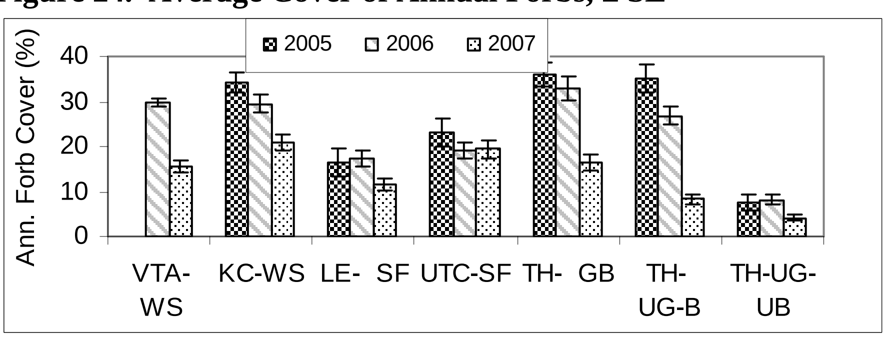
Perennial forb cover was higher on Coyote Ridge than Tulare Hill (Figure 23). With 2007's increase at UTC and a decrease at VTA (Coyote Ridge property), perennial forbs now follow an elevational gradient. Tulare Hill sites remain lowest in cover, where the high postfire value at the burned, ungrazed plots has disappeared. All surveyed perennial forbs are native.

Figure 23. Average Cover of Perennial Forbs, ± SE



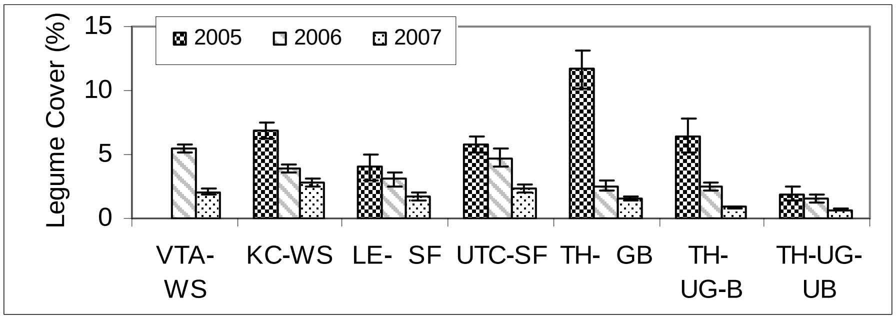
There were regional declines in annual forb cover, most likely due to the dry year (Figure 24). The lowest annual forb cover was at Tulare Hill's unburned, ungrazed site. Tulare Hill's grazed and burned site has more annual forb cover than Los Esteros and VTA (Coyote Ridge property), otherwise the data suggest a gradient with increasing elevation of increasing annual forbs. Again, this could be a gradient of decreasing nitrogen deposition or decreasing temperature/increasing precipitation. The spring and fall grazed areas show the lowest decrease, suggesting grazing pressure early in the season may negatively impact annual forbs in dry years. The annual forbs are dominated by natives.

Figure 24. Average Cover of Annual Forbs, ± SE



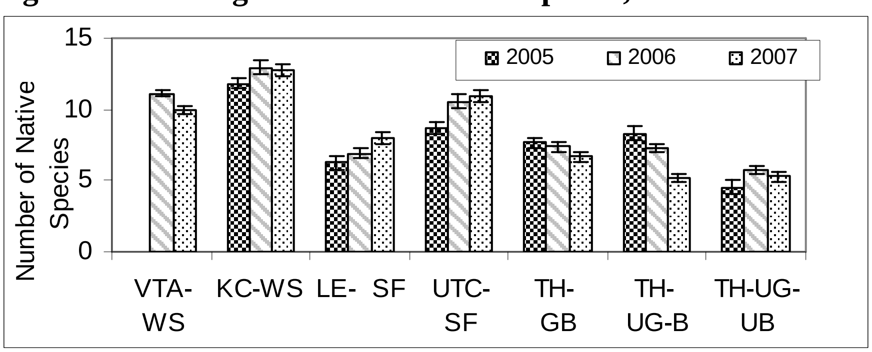
Like other annual forbs, legumes decreased across sites (Figure 25). Even the highest cover in 2007, at Kirby Canyon, was low at 3%. Coyote Ridge property values dipped from 5.5 to 2.1% from 2005 to 2007. A weak elevational gradient among sites, with cover increasing from lower to higher elevations, may be present. High values in legume cover on Tulare Hill disappeared in the second postfire year. All surveyed legumes are native.

Figure 25. Average Cover of Legumes, ± SE



Species Richness and Plant Cover. Coyote Ridge had the highest native species richness, which in 2007 generally fit an elevational gradient, increasing with increasing elevation (Figure 26). The Coyote Ridge property had the lowest native species richness of the 3 Coyote Ridge sites, with a mean 10.0 native species per quadrat, but was higher than Los Esteros and all 3 of the Tulare Hill sites. Tulare Hill was least diverse, and showed a significant decline at the burned, ungrazed site. This site is now similar in native species richness to the unburned, ungrazed site, showing the positive effect of burning was short-lived. Both burned sites declined in richness as vegetation redeveloped post-fire, whereas unburned sites generally showed increasing richness per quadrat or remained similar from 2005 to 2007.

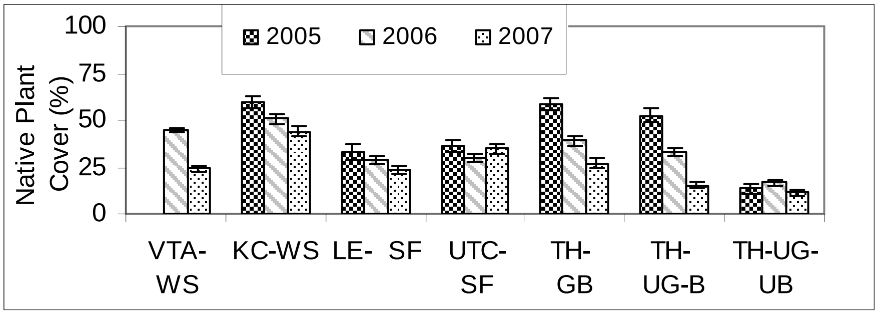
Figure 26. Average Number of Native Species, ± SE



While native species richness was mostly steady, notable declines were seen in native cover (Figure 27). The Coyote Ridge property showed a decline from 45.0 to 24.4% between 2006 and 2007. Tulare Hill burned, ungrazed and unburned ungrazed stand out as having the lowest native cover. Tulare Hill grazed and burned, and ungrazed and burned sites showed large declines, along with the Coyote Ridge property. The high elevation plots at Kirby Canyon and UTC had highest native cover. High native cover was largely associated with lower nonnative cover, rather than with less thatch or bare ground. For example, native cover was highest at Kirby

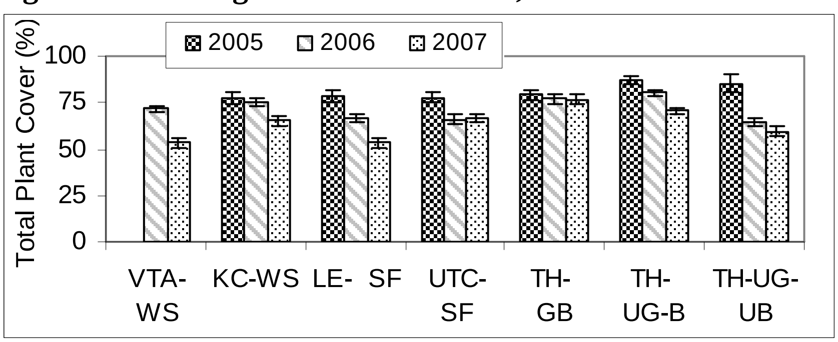
Canyon and lowest at unburned, ungrazed Tulare Hill, and annual grasses were lowest at Kirby Canyon and high at unburned, ungrazed Tulare Hill (compare Figures 16 and 25). Also, declines in native plants from early high values at both grazed and ungrazed Tulare Hill 2004 burn sites were mirrored by strong increases in annual grass cover as vegetation succession proceeded in the years after burning.

Figure 27. Average Cover of Native Species, ± SE



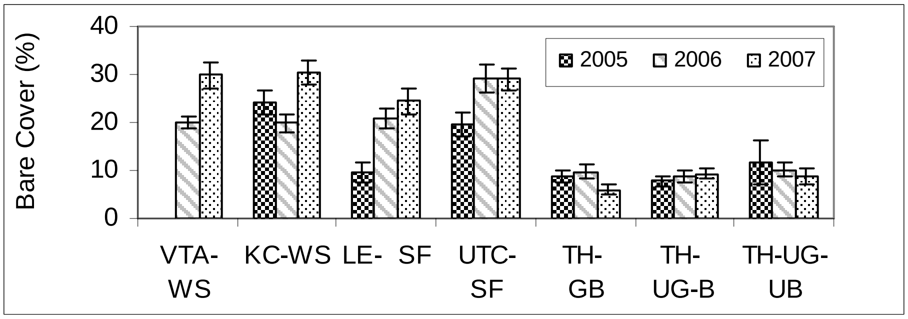
Most sites were steady or showed slight declines in total cover of all live plants (Figure 28). No site jumps out as having much more or less cover than another. This is one of the few measured parameters that did not show obvious differences between management regimes, even under different annual weather patterns. This apparent "equilibrium" may be ascribed to the competitive tradeoff between native species and non-natives — predominantly annual grasses.

Figure 28. Average Total Plant Cover, ± SE



Abiotic. There were large increases in bare ground at the winter-spring grazed sites, including the Coyote Ridge property, increase from 19.9 to 29.8% between 2006 and 2007 (Figure 29). The notable increases in bare ground are matched by decreases in annual forbs (Figure 24). Early grazing pressure in dry years would appear to increase bare ground at the expense of annual forbs. The only large decrease in bare cover was at Tulare Hill's grazed and burned parcel, probably due to its large increase in thatch and annual grass. Tulare Hill sites have the least bare ground overall. The Tulare Hill sites have not shown significant differences in bare ground among the different management regimes, despite the considerable differences in thatch, for example.

Figure 29. Average Bare Cover, ± SE



Summary

Located midway up the ridge, the Coyote Ridge property vegetation plots have the same winter-spring grazing regime as Kirby Canyon. This area of the Coyote Ridge property has the best dwarf plantain cover on Coyote Ridge, and has moderate cover of nectar sources. This year saw large decreases in owl's clover and goldfields cover compared to 2006. It also showed decreases in annual forb, perennial forb, and legume cover, as well as native plant cover. This site has the lowest perennial grass cover of the serpentine study sites surveyed. In spite of these decreases, overall habitat quality for serpentine-associated species at these mid-elevation Coyote Ridge property plots is superior to the Tulare Hill sites, and generally ranges in the midvalues for the Coyote Ridge sites. These plots are considered representative of the mid-elevation areas on the Coyote Ridge property.

The Kirby Canyon vegetation survey plots continue to have the highest overall habitat quality, with the highest annual forb, perennial forb, and perennial grass cover; the lowest annual grass cover; and the highest native species richness and cover. Although relatively low in butterfly host plants, sufficient dwarf plantain and nectar sources remain to support bay checkerspots. It should be reiterated that large portions of the Coyote Ridge property are similar in elevation, grazing regime, and nitrogen deposition rate to the Kirby Canyon vegetation plots. As a result, it is expected that large portions of the Coyote Ridge property (i.e., at higher elevations) have vegetation characteristics similar in quality to those of the Kirby Canyon survey plots.

Los Esteros showed some habitat degradation this year, with a dramatic increase in thatch giving it the highest cover on Coyote Ridge. It has moderate dwarf plantain cover, but somewhat low nectar cover. Annual and perennial grass cover are comparable to other Coyote Ridge sites. It has seen small increases in native species richness over the last 2 years. On Coyote Ridge, it has the second highest geophyte cover, but the lowest perennial and annual forb cover. Being lowest on the ridge, this site is nearest to the nitrogen sources and will dry out more quickly than the higher sites. Again, the Los Esteros plots are similar to the low elevation sections of Coyote Ridge property that are grazed in spring and fall.

UTC showed excellent habitat characteristics again this year with its spring/fall grazing regime. While it has very low dwarf plantain cover, it compensates with the highest regional owl's clover cover. Nectar sources were moderate. Thatch was very low. UTC had the second highest annual forb, perennial forb, and legume cover, as well as the second highest native species richness and cover. The high ridge elevation may have helped the annual plants resist desiccation. No portion of the Coyote Ridge property has a similar high elevation, spring and fall grazing regime.

The ungrazed sites, both at Tulare Hill, continue to deteriorate. The ungrazed, unburned site continues to have the poorest habitat quality, with the lowest native plant cover, low species richness, lowest dwarf plantain, lowest goldfields, lowest annual forbs, lowest legumes, and high annual grass and highest thatch. Three years after burning, the ungrazed, burned site is no longer significantly better in habitat quality than the ungrazed, unburned site, whereas grazing has maintained lower thatch and higher dwarf plantain, goldfields, and annual forbs in the grazed burned site. Given these results, grazing is clearly an important vegetation management tool at these sites.

In 2007 for the first time, the Tulare Hill ungrazed, unburned parcel did not have the highest annual grass cover. This can be explained by its high thatch cover, as this unmanaged parcel has reached a point where thatch buildup limits even annual grass recruitment. Annual grasses have continued to increase on the other Tulare Hill sites, to the point where they are now all comparable.

Burn effects were some of the strongest observed over time (neglecting rainfall patterns, which are not in the control of local land managers). Burning resulted in increased cover of bay checkerspot butterfly host plants dwarf plantain and goldfields, and reduced cover of nonnative annual grasses and thatch that impair native species. The positive effects of burning were short-lived, however, and effects on the vegetation components discussed above and on annual forbs, legumes, native species richness, and combined native plant cover were greatly reduced or indiscernible by 3 years after the fire.

The annual moisture signal was strong in the regional data. The 2007 dry conditions led to decreases across all sites for annual forbs, including bay checkerspot host and nectar plants. High thatch across all sites in 2007 can be related to high moisture in 2006.

GRAZING AND GRAZING INFRASTRUCTURE

Tracking cattle stocking rates on the Coyote Ridge property is important in allowing correlation of grazing intensity with habitat parameters when necessary. In addition, maintenance of grazing infrastructure is important both for the sake of the cattle and the ranching operation and to ensure adequate grazing management for habitat purposes.

Methods

The ranching lessee tracks the livestock stocking rate (i.e., number of cattle/acre) on the Coyote Ridge property. The rancher continuously monitors fencelines and other infrastructure (e.g., troughs) and maintains and repairs such features as necessary. When on the property, staff of the SCCOSA, H. T. Harvey & Associates, and the Creekside Center for Earth Observation also note and report to the rancher any grazing infrastructure problems or maintenance needs observed.

Results

In 2007, livestock stocking rates continued as they have in the past, at approximately one cow-calf pair per 10 acres. The paddock that was grazed in 2007 in spring and fall had previously (in 2005 and earlier) been typically grazed in summer and fall, and the RMP called for summer/fall grazing in this area. In 2007, the rancher grazing this paddock lost permission to graze a large paddock on adjacent UTC property and had to modify his grazing arrangements to avoid having bulls in adjacent paddocks during the breeding season. This change from summer/fall to spring/fall grazing may only be temporary.

Discussion

The change from summer/fall to spring/fall grazing in the northwestern paddock may only be temporary. Data on RDM and other monitoring parameters, as described in this report, do not indicate a drop in habitat quality in 2007 due to this change. Future monitoring efforts will continue to monitor whether the grazing regime in this area is maintaining the desired habitat conditions.

Fences and other infrastructure on the property are repaired as needed, and no change to the way in which such infrastructure is maintained is needed at this time.

BAY CHECKERSPOT BUTTERFLY

The bay checkerspot butterfly is a federally threatened subspecies closely associated with serpentine grasslands, which support its larval food plants and adult nectar sources. The grazing program at the VTA Coyote Ridge property is intended to manage the serpentine grasslands on the property specifically for the benefit of this species and for rare, serpentine-associated plants. The RMP requires monitoring of bay checkerspot populations on the site to ensure that long-term stewardship of the property continues to benefit special-status serpentine-associated species, and to identify the nature of (and need for) any modifications to the management program that become necessary to protect these species.

This section provides current (2006 and 2007) bay checkerspot butterfly population estimates as well as background on population dynamics on the Coyote Ridge property and adjacent areas of Coyote Ridge. This allows observed population fluctuations to be placed in context of a historical range of variability.

Larval population estimates on the Coyote Ridge property are continuous since 1992. The record for the adjacent 267-acre Kirby Canyon Butterfly Trust extends continuously sine 1985, and other sites were added and intermittently sampled from 1992 to 2007.

Bay checkerspot populations fluctuate widely over 2 or more orders of magnitude, and exhibit complex spatial shifts across local slopes. Normal population fluctuations in intact habitat are driven by weather interacting with complex topography to create phenological variability in the timing of butterfly emergence and hostplant senescence (Weiss et al. 1987; Weiss et al. 1988; Weiss et al. 1993). Cooler north-facing slopes provide refuge from extreme growing seasons, because larval hostplants senesce later based on local temperature. Differences in topography and population history can lead to asynchronous fluctuations across Coyote Ridge, which leads to greater resilience in the face of weather extremes.

Populations can crash for reasons other than weather. Habitat deterioration from nitrogen deposition and lack of grazing has led to population crashes and near-extinctions in the Silver Creek Hills (Weiss 1999) and Tulare Hill (Weiss and CH2M Hill 2007). At high densities, postdiapause larvae can locally consume nearly all of the dwarf plantain, its primary hostplant. This leaves few sites for oviposition by adult butterflies, and low densities of larvae the following year.

Many factors in the population dynamics of the butterfly — the overwhelming effect of weather and the history of populations — are clearly not under control of managers. Only by putting population fluctuations in a regional context, as is done in this monitoring report, can the response to management be intelligently discussed.

Methods

The basic method of population estimation is timed counts of larvae in a stratified sampling design (Murphy and Weiss 1988). The habitat is stratified into thermal strata based on March 21 insolation values calculated in GIS. The 5 strata are: Very Warm (>18 MJ/m^2), Warm, Moderate, Cool, and Very Cool.

In the original work (Murphy and Weiss 1988), larvae were counted in arrays of 1 m^2 quadrats (1985-1991). From 1992 through the present, larvae have been counted in 10 person-minute intervals over irregularly shaped sample areas corresponding to patches of uniform insolation, and the counts are converted into density by the equation:

$$\ln(\text{density}) = -4.33 + 0.88*\ln(\text{count}),\ n = 13,\ r^2 = 0.85 \text{ (Weiss 1996)}$$

Larval sample sites are distributed across the landscape, and grouped into "population zones" in which average densities and absolute numbers are estimated. These correspond to natural breaks in the landscape, modified locally by property lines for regulatory purposes. The Coyote Ridge property (including the Ranch at Silver Creek inholding) consists of 4 full population zones (Figure 30). Two are along the ridge top (VTA-High1 and VTA-High2), one consists of the mid-slopes (VTA-Mid), and the third consists of the lower slopes below the old road (VTA-Low). The area north of the fence in the spring and fall grazing regime is not calculated separately from the areas to the north; only a density estimate will be made for this area of VTA. The area of each thermal class found in the different population zones is presented in Table 8.

Figure 30. Larval Population Zones on Coyote Ridge Property.

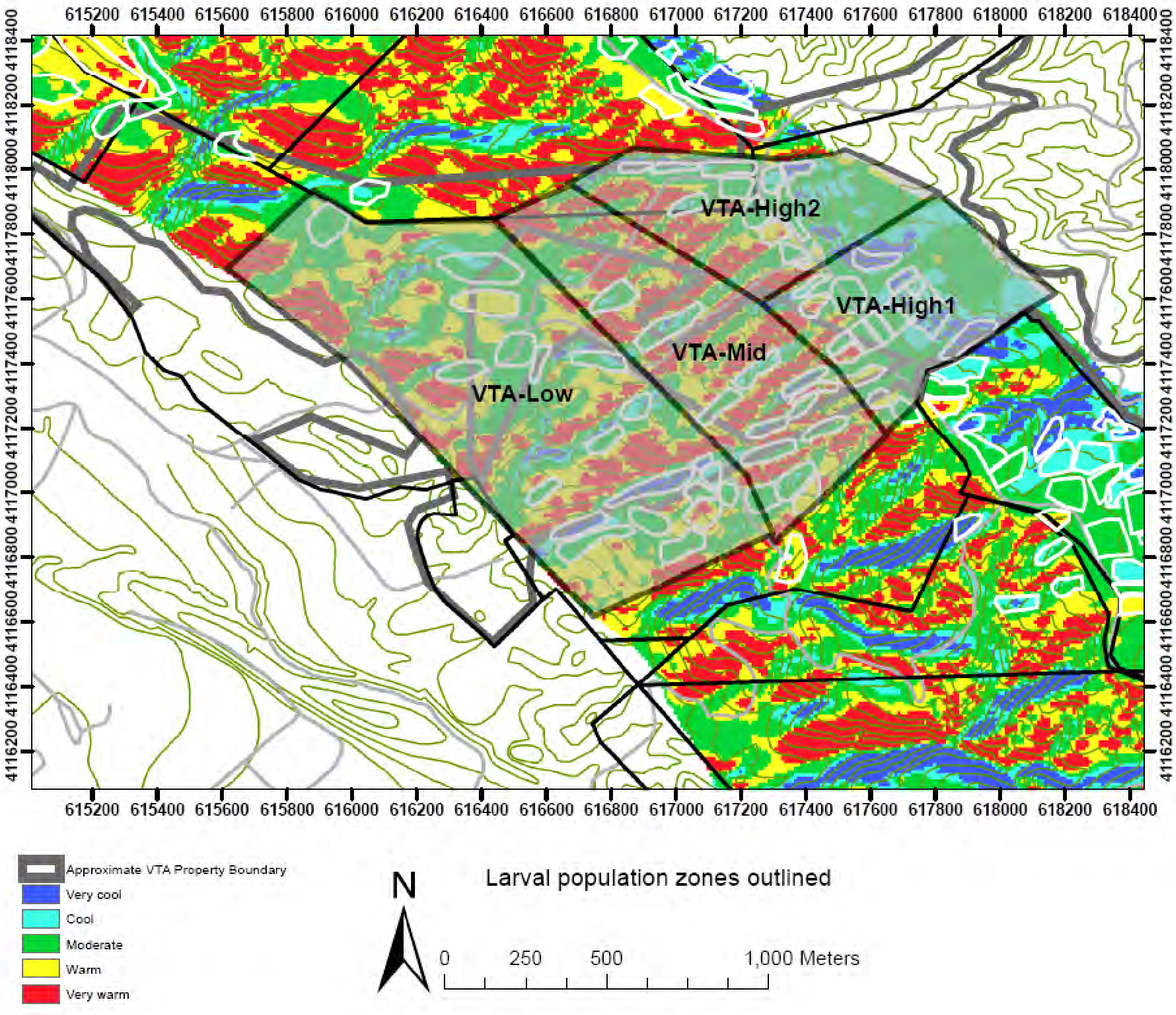


Figure 31. Larval Sample Areas Surveyed In and Adjacent to Coyote Ridge Property.

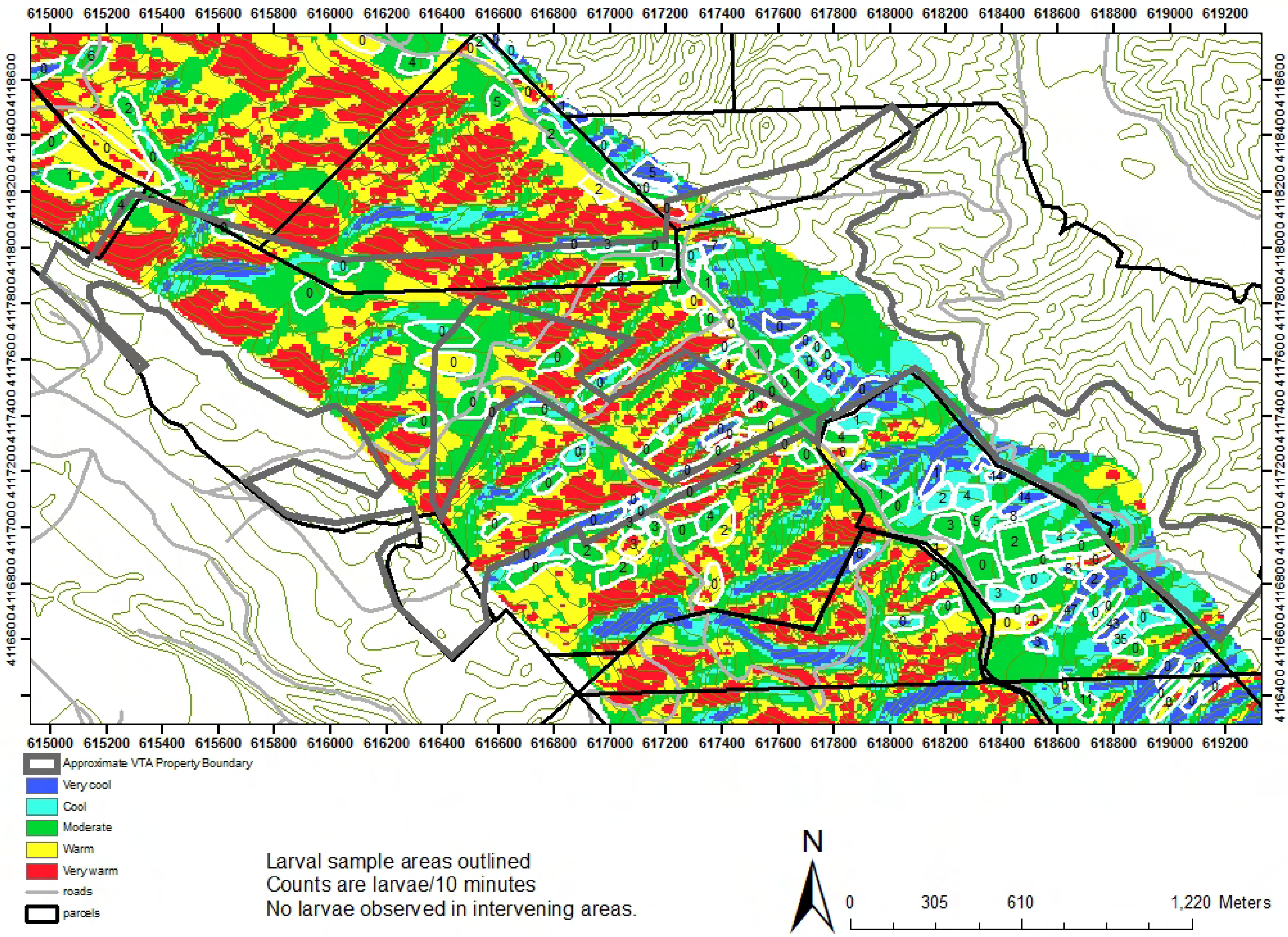


Table 8. Area (ha) of Thermal Stratification per Larval Population Zone (March 21 Insolation MJ/m^2 in Parentheses)

Site	Total ha	Area (ha) in Each Thermal Stratum				
		Very Warm (>18.5)*	Warm (17-18.5)	Moderate (15-17)	Cool (13-15)	Very Cool (<13)
VTA-High1	22.86	2.54	3.38	10.16	3.93	2.85
VTA-High2	25.61	7.35	4.42	9.86	2.53	1.45
VTA-Mid	37.78	13.68	10.64	10.78	2.15	0.53
VTA-Low	75.48	14.41	23.75	29.91	5.34	2.07

* Insolation values expressed in MJ/m^2.

A total of 40 sites were sampled among the 4 population zones, with numerous areas of Very Warm and Warm slopes traversed with no larvae found. Figure 31 shows all the sampled sites on a map of the thermal strata.

Surveys for adult checkerspots are not used to estimate population densities on the Coyote Ridge property for several reasons. Surveys for adults using quantitative walking transect data are difficult to translate into absolute densities, and need to be repeated at least once a week over the entire flight season. Adult distributions are also very sensitive to topoclimate, so transect systems need to take that into account. Mark-release-recapture is the only way to establish an absolute number of adult butterflies, but this method is time-intensive and can be statistically uncertain.

Per the RMP, if no larvae are found in an area, then reconnaissance-level surveys for adults are conducted to establish presence-absence. Because larvae were found in each of the four larval population zones within the Coyote Ridge property in 2007, no adult surveys were conducted.

Results

The number of larvae found per 10-minute search in 2006, to provide context for the 2007 data, is shown in Figure 32. The results for 2007 are shown in Figure 33.

Figure 32. Larval Densities in 2006.

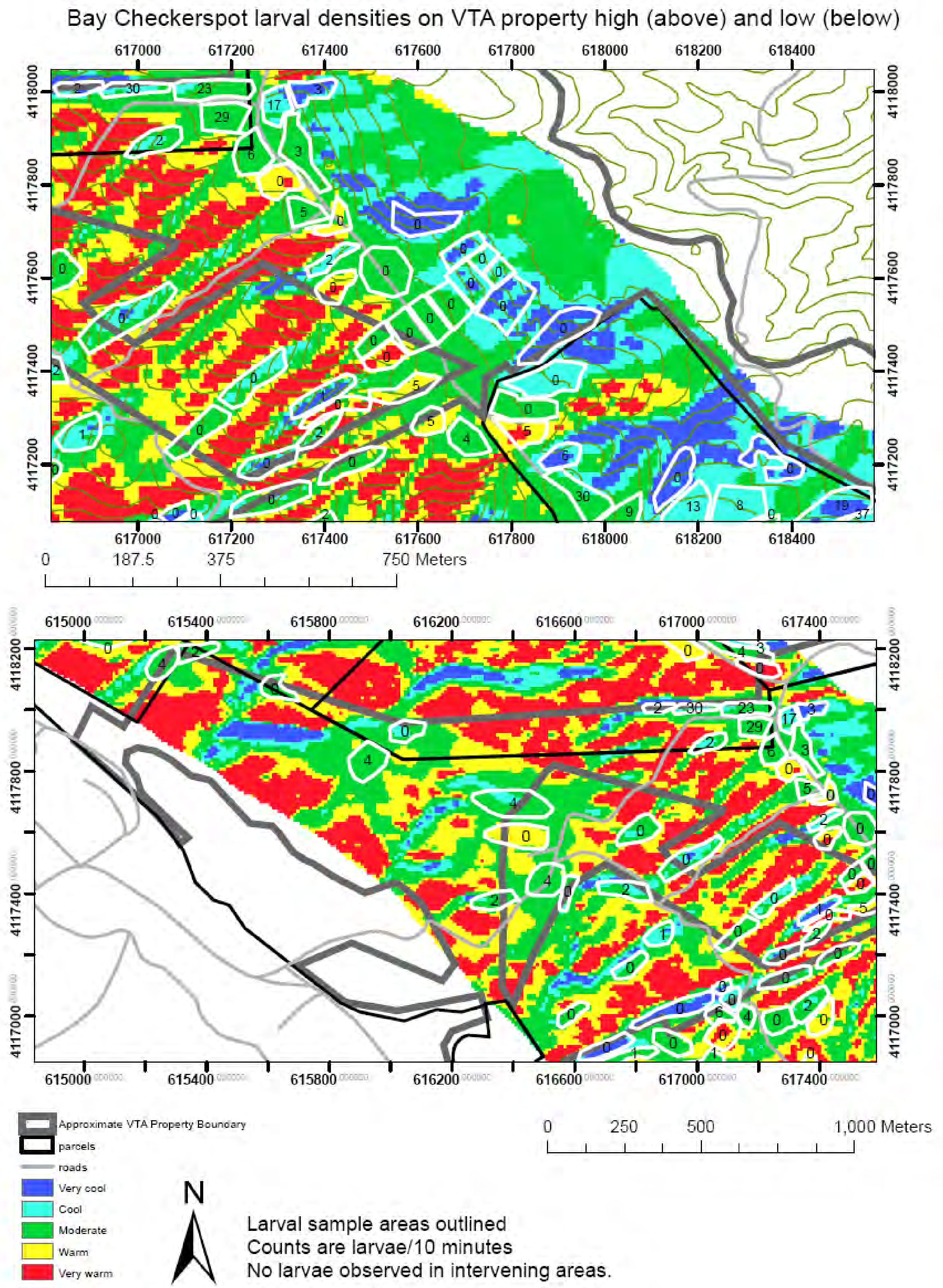
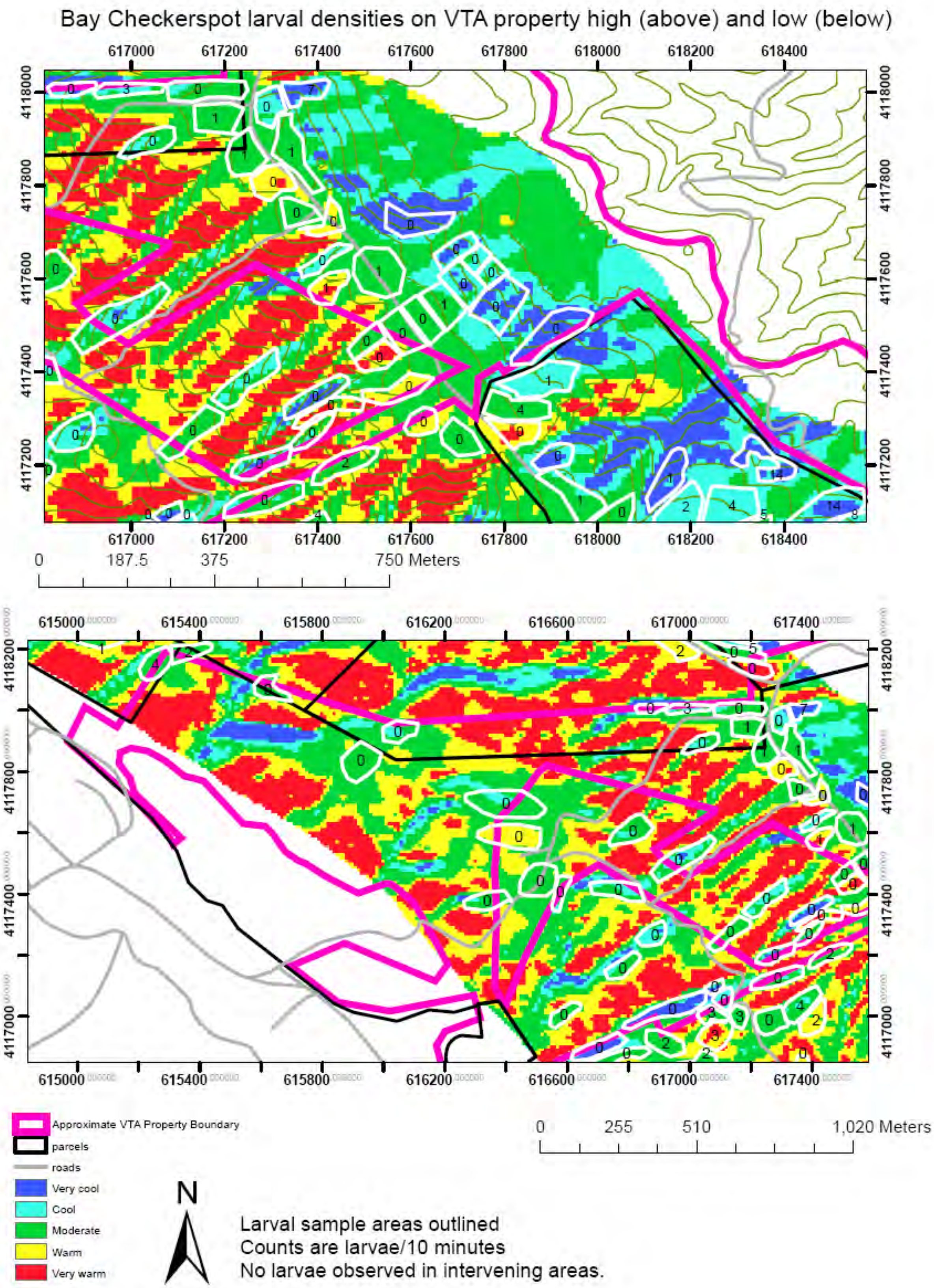
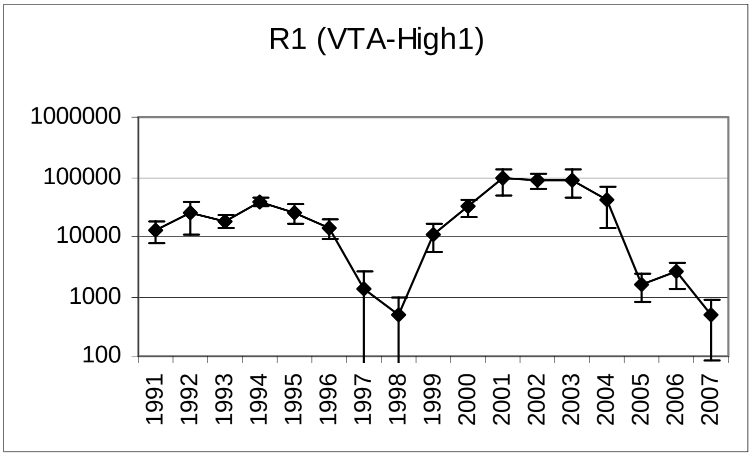


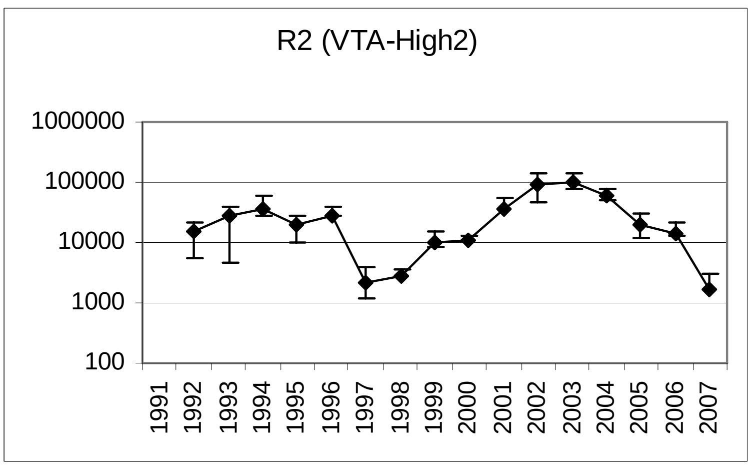
Figure 33. Larval Densities in 2007.

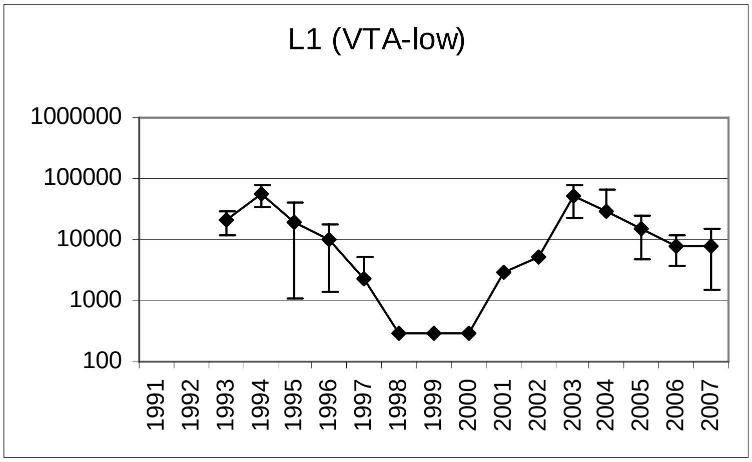


In 2006, there were ~25,000 larvae on VTA as a whole (Figure 34). In 2007 numbers declined to ~10,000, with the majority on the lower slopes (VTA-Low1). Note that confidence intervals at low densities are wide on the log scale (see graphs in Figure 34), and inferences about trends and fluctuations at low densities are difficult. No checkerspot larvae were recorded on VTA-Mid slopes in 2007; these slopes were only sporadically sampled adequately for population estimates prior to 2006, so no time series is shown.

Figure 34. Bay Checkerspot Population History on Coyote Ridge Property.





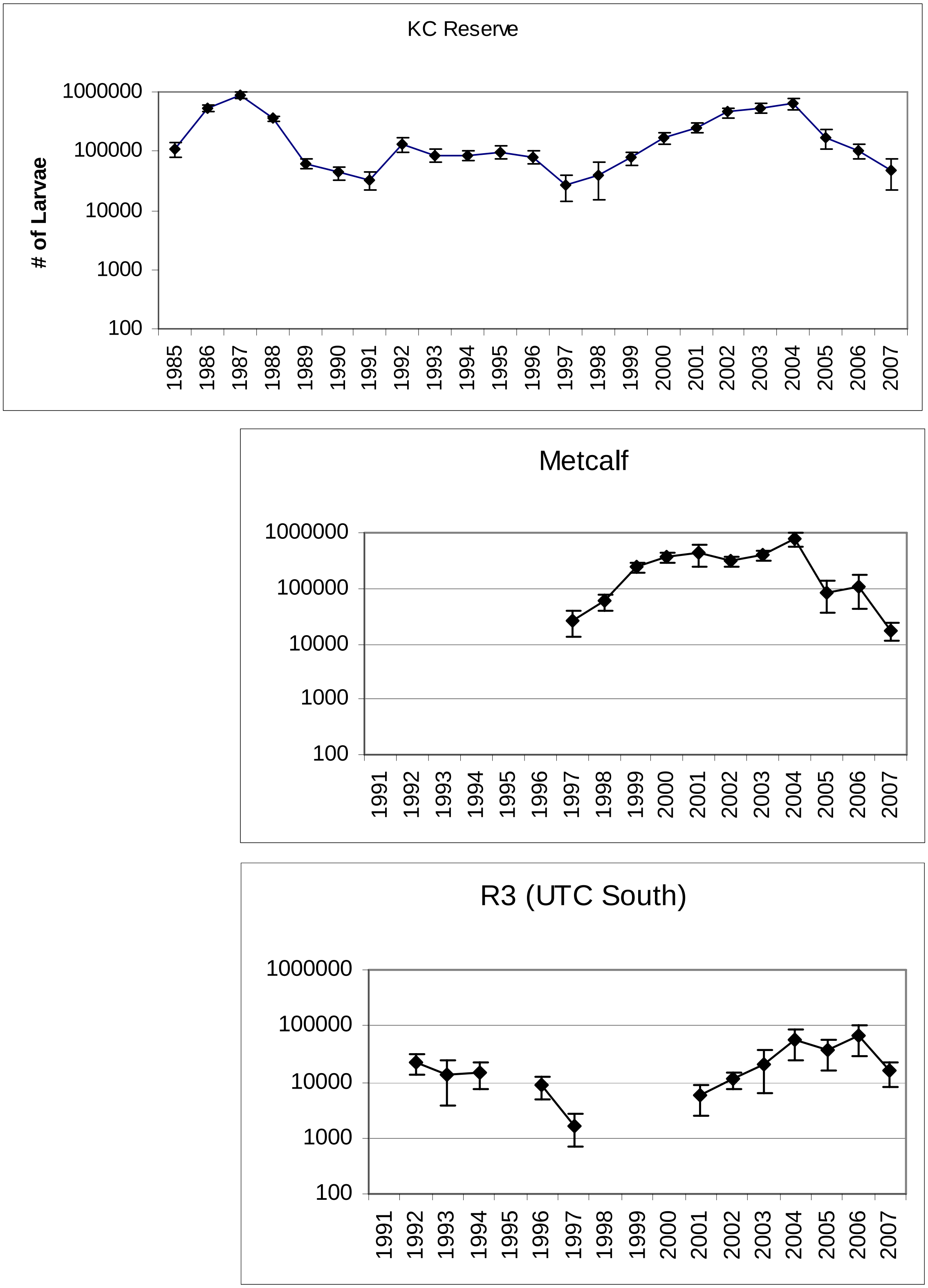


Discussion

Population History on the VTA Site. In 1992, there were an estimated 25,000 and 16,000 larvae in VTA-High1 and VTA-High2, respectively (Figure 34). VTA-Low was not sampled that year. Local populations hit a high in 1994, with 39,000 and 36,000 in VTA-High1 and VTA-High2, respectively, and 58,000 larvae in VTA-low and ~14,000 in VTA-Mid. Populations declined subsequently, especially following 1996, to a population low of 2,000 to 5,000 on the entire property. In 1998-2000, larval numbers fell below detection limits on VTA-Low, but reconnaissance-level surveys indicated that adult butterflies were present in low densities (1-2 individuals were seen around each small hilltop, but none in between). Given limits on detectability of larvae, the total population across VTA-Low was then estimated to be on the order of 100 butterflies (200 larvae). Numbers rebounded from 1999 to 2003, with a peak of more than 200,000 larvae on the entire property. Numbers have declined sharply since 2004, especially on the ridgetop zones where the high densities (> 1 larva/m^2) during the preceding few years led to local defoliation of dwarf plantain. Local larval densities declined to < 0.02 larvae/m^2 in years following defoliation, and dwarf plantain was reduced to < 1% cover in defoliated areas. The legacy of defoliation may last for several years.

Comparisons with Other Nearby Sites. Records at Kirby Canyon (KC) extend back to 1985 (Figure 35). KC experienced a peak of 800,000 larvae in 1987, followed by 4 years of decline to 30,000 in 1991. The decline coincided with the start of the 1987-1992 drought. Although 1991 was another dry year, the population increased to 100,000 larvae in 1992, held steady until a sharp decline in 1997 to a low of 25,000. Over the next 6 years, numbers increased to 630,000 larvae in 2004, followed by a decline to 50,000 larvae in 2007.

Figure 35. Other Checkerspot Populations on Coyote Ridge



Other populations have followed the same general trend of sharp declines in 1997, a build-up from 1997 to 2004, followed by a sharp decline through 2007. Across-the-board declines of this magnitude are generally attributable to weather, but the fine-scale timing of declines was also influenced by the history of defoliation during the recent population peak around 2004.

Further analysis of these time series is beyond the scope of this report, but it is possible to extract key weather variables (monthly rainfall and temperatures) that predict population fluctuations. Also, the stratified sampling design reveals important spatial processes (Weiss et al. 1988; Weiss et al. 1993) that provide insights into the roles that topography plays in creating resilience in these populations, especially the key role played by cooler slopes as refugia from poor phenological coincidence between butterflies and hostplants.

SANTA CLARA VALLEY DUDLEYA

The Santa Clara Valley dudleya is a federally endangered, perennial, succulent herb endemic to the ultramafic formations (serpentinite and peridotite) of the Santa Clara Valley. On the Coyote Ridge property, Santa Clara Valley dudleya is concentrated on areas of serpentine bedrock that were exposed or fractured relatively recently. This type of substrate is found along recent roadcuts, on the eroded banks of drainages, and on scree piles associated with several old mine trenches. Plants also occur on “islands” of exposed bedrock within the larger matrix of serpentine grassland along the ridgeline. The grazing program at the Coyote Ridge property is intended to manage the serpentine grasslands on the property specifically for the benefit of rare, serpentine-associated plants such as the dudleya without leading to excessive grazing that might adversely affect dudleya populations. The RMP requires monitoring of dudleya populations on the site to ensure that long-term stewardship of the property continues to benefit special-status serpentine-associated species, and to identify the nature of (and need for) any modifications to the management program that become necessary to protect these species.

Methods

A total of 5 permanent Santa Clara Valley dudleya monitoring plots were established in areas supporting dudleya stands within the study area. Metal rebar stakes were installed in the corners of the monitoring plots and a GPS unit was used to map each plot location; these locations are shown on Figure 8. H. T. Harvey & Associates plant ecologist Brian Cleary performed sampling in these plots on 11 September 2007 and 14 February 2008. A 4-m^2 quadrat constructed of PVC material was placed on the ground, and the number of Santa Clara Valley dudleya plants within each plot were visually counted.

According to the RMP, age classes of dudleya were to be determined, and evidence of reproduction noted, within the monitoring plots. In 2007, age classes for the dudleya plants within the plots were not recorded since there was little evidence of newly-germinated plants due to the timing of the monitoring period. The vast majority of plants observed on Coyote Ridge all appear to be mature plants of at least 10 years of age. Additionally, because the census effort occurred during the fall and winter of 2007, well outside of the plant’s blooming period (April through June), reproductive evidence, including the presence of floral structures and health and vigor, was not recorded.

Results

Results of the Year 1 Santa Clara Valley dudleya monitoring effort are shown in Table 9.

Table 9. Total Numbers of Santa Clara Valley Dudleya by Plot for 2007 Monitoring.

Plot Number	Total Plants
1	13
2	16
3	31
4	40
5	13
Total	**113**

The mean density of dudleya plants on the 4-m^2 quadrats was approximately 22.6 plants/quadrat, or 5.7 plants/m^2.

Only minimal grazing damage to individual dudleya plants was noted at these monitoring stations. Photos of dudleya monitoring plots are provided in Appendix B.

Discussion

The 5 dudleya monitoring locations selected during Year-1 monitoring are appropriate for long-term monitoring of this species on the Coyote Ridge property, representing a diversity of slopes, aspects, and elevations. Conducting the Year 1 Santa Clara Valley dudleya monitoring during the fall and winter did not facilitate an accurate estimate of the number of individual plants occurring within each monitoring plot for the following reasons: 1) a complete estimate of the number of first year and second year seedlings was not possible during this time of year as seedling mortality for Santa Clara Valley dudleya is typically very high during any given year following the onset of the summer dry season; 2) as an adaptive strategy to surviving the summer drought period in the San Francisco Bay Area, individual dudleya plants frequently contract within and behind outcroppings of serpentine rocks to conserve water creating difficulties in detecting plants; and 3) recording census data during the spring when the plants are in full flower is the ideal time of year to document the reproductive health and vigor for each plant. Therefore, it is recommended that future surveys adhere to the spring monitoring period to optimize the census effort within each permanent plot.

At this time, cattle grazing does not appear to adversely affect dudleya populations on the property.

MT. HAMILTON THISTLE

Mt. Hamilton thistle (*Cirsium fontinale* var. *campylon*) is a perennial herbaceous moisture-loving plant restricted to seeps and creek channels on serpentine soils in Santa Clara, Alameda and Stanislaus counties. On Coyote Ridge, this species occurs within drainages that are recharged by seeps or on sedimentary soils that are influenced by adjacent serpentine seeps. Mt. Hamilton thistle is listed as a CNPS List 1B (plants rare, threatened or endangered in California and elsewhere) special-status plant species by the California Native Plant Society. On the Coyote Ridge property, large occurrences of Mt. Hamilton thistle are present in nearly all the creeks and seeps that drain the southwest-facing serpentine slopes. Management of Mt. Hamilton thistle on the Coyote property is focused on conserving and protecting existing populations.

Methods

A total of 5 permanent Mt. Hamilton thistle monitoring plots were established in several seeps and drainages within the study area. Metal rebar stakes were installed in the corners of the monitoring plots and a GPS unit was used to map each plot location; these locations are shown on Figure 8. H. T. Harvey & Associates plant ecologist Brian Cleary performed sampling in these plots on 11 September 2007 and 14 February 2008. A 4-m^2 quadrat constructed of PVC material was placed on the ground and the number of Mt. Hamilton thistle plants within each plot were visually counted.

Results

Results of the Year 1 Mt. Hamilton thistle monitoring effort are shown in Table 10.

Table 10. Total Numbers of Mt. Hamilton Thistles by Plot for 2007 Monitoring.

Plot Number	Total Plants
1	16
2	33
3	163
4	45
5	19
Total	**276**

Because monitoring surveys in September 2007 and February 2008 were timed appropriately for detecting this species, a crude estimate of populations on the Coyote Ridge property can be obtained, as required by the RMP. The mean density of thistle plants on the 4-m^2 quadrats was approximately 55.2 plants/quadrat, or 13.8 plants/m^2. Based on the linear distance of drainages supporting this species on the site, the large/broad stands present in some areas, and the mean density of 13.8 plants/m^2 on the monitoring plots, the population of Mt. Hamilton thistle on the Coyote Ridge property likely exceeds 50,000 individuals.

Very little grazing damage to individual thistle plants was noted on these monitoring stations. Photos of Mt. Hamilton thistle monitoring plots are provided in Appendix B.

Discussion

The 5 Mt. Hamilton thistle monitoring locations selected during Year-1 monitoring are appropriate for long-term monitoring of this species on the Coyote Ridge property. Each station is located in a different drainage, and the plots represent a diversity of slopes and aspects. Monitoring was conducted at an appropriate time of year, and Year 1 monitoring results provide an appropriate basis for comparison of future monitoring efforts.

Management of Mt. Hamilton thistle will focus on conserving and protecting existing populations. At this time, cattle grazing does not appear to adversely affect Mt. Hamilton thistle on the Coyote Ridge property. Wooly, spiny mature plants are unpalatable to livestock. However, colonies have reportedly been severely trampled by cattle, which tend to congregate near the water sources that support Mt. Hamilton thistle, and young plants may be eaten by certain varieties of cattle (Pat Congdon, pers. comm., 2005). Monitoring will continue to determine whether management measures are needed to protect the property's large population of Mt. Hamilton thistle.

MOST BEAUTIFUL JEWELFLOWER

Most beautiful jewelflower (*Streptanthus albidus* ssp. *peramoenus*) is an annual herbaceous plant that occurs primarily on serpentine soil formations around the San Francisco Bay Area including the Diablo Range and in Monterey County. Although not a state or federally listed plant, most beautiful jewelflower is listed as a CNPS List 1B plant species (i.e., a plant that is rare, threatened or endangered in California and elsewhere) by the California Native Plant Society. On the Coyote Ridge property, most beautiful jewelflower is extremely abundant within serpentine grassland on the ridge and southwestern slopes, along roadcuts and drainage channels, and within coastal sage scrub habitat. Fewer plants are present northeast of Coyote Ridge where serpentine intergrades with clay soils and the cooler, moisture microclimate favors the growth of non-native grasses. The grazing program at the Coyote Ridge property is intended to manage the serpentine grasslands on the property specifically for the benefit of rare, serpentine-associated plants such as the most beautiful jewelflower without leading to excessive grazing that might adversely affect jewelflower populations. The RMP requires monitoring of most beautiful jewelflower populations on the site to ensure that long-term stewardship of the property continues to benefit special-status serpentine-associated species, and to identify the nature of (and need for) any modifications to the management program that become necessary to protect these species.

Methods

A total of 5 permanent monitoring plots were established in select locations on serpentine soils within the study area. An effort was made to stratify the plots by slope and aspect, but otherwise plot locations were determined randomly. Metal rebar stakes were installed in the corners of the monitoring plots and a GPS unit was used to map each plot location; these locations are shown on Figure 8. H. T. Harvey & Associates plant ecologist Brian Cleary performed sampling in these plots on 11 September 2007. Metal rebar stakes were installed in the corners of the monitoring plots and a GPS unit was used to map each plot location. A 4-m^2 quadrat constructed of PVC material was placed on the ground and the number of most jewelflower plants within each plot were visually counted.

Because the census effort occurred during the fall when all of the individual jewelflower plants were dead, it is likely that a significant number of plants occurring within each plot were not detected, as this plant blooms in the spring and early summer. Thus, density estimates from the fall 2007 census effort were not used to estimate population size on the property.

Results

Results of the Year 1 most beautiful jewelflower monitoring effort are shown in Table 11.

Table 11. Total Numbers of Most Beautiful Jewelflower by Plot for 2007 Monitoring.

Plot Number	Total Plants
1	28
2	13
3	13
4	14
5	12
Total	**80**

The mean density of most beautiful jewelflower plants on the 4-m^2 quadrats was approximately 16.0 plants/quadrat, or 4.0 plants/m^2. Photos of most beautiful jewelflower monitoring plots are provided in Appendix B.

Discussion

The 5 most beautiful jewelflower monitoring locations selected during Year-1 monitoring are appropriate for long-term monitoring of this species on the Coyote Ridge property, representing a diversity of slopes, aspects, and elevations. Conducting the surveys during the fall of 2007 prevented an accurate count of most beautiful jewelflower plants within each of the 5 monitoring plots, as this plant blooms primarily during the spring, and all of the individual plants are dead by the onset of fall. Therefore, it is recommended that future surveys adhere to the spring monitoring period to optimize the census effort within each permanent plot in order to estimate the population size of this plant on the property.

SMOOTH LESSINGIA

Smooth lessingia (*Lessingia micradenia* var. *glabrata*) is an erect annual herbaceous plant endemic to serpentine soils in Santa Clara County. It is a delicate, many-branched plant with thread-like leaves along the stem and small, white-to-lavender flowers that are produced in late summer (July through September). Smooth lessingia is listed as a CNPS List 1B plant species (i.e., a plant that is rare, threatened or endangered in California and elsewhere) by the California Native Plant Society. On the Coyote Ridge property, smooth lessingia occurs within grassland along the toe of the southwestern slopes, and presumably within areas of coastal sage scrub and chaparral. Farther upslope, the population grades into the common slender-stemmed lessingia (*Lessingia meamaclada*; Don Mayall, pers. comm. 2005). The RMP specifies that incidental observations of smooth lessingia made during other special-status plant monitoring efforts will be compiled and that evidence of declines in abundance or threats from grazing or invasive species will be noted. If numbers appear to be declining, more focused surveys could be conducted and/or remedial measures identified.

Methods

While conducting the fall 2007 special-status plant monitoring effort, H. T. Harvey & Associates plant ecologist Brian Cleary made incidental observations in an attempt to identify general locations of smooth lessingia and differentiate populations of smooth lessingia from those of the closely related slender-stemmed lessingia on site. His observations documented the extreme difficulty in distinguishing these taxa, both because of their similarity and because of the potential presence of hybrids. In an attempt to determine the taxonomic identity of a subset of these plant populations, voucher specimens were collected in the vicinity of Santa Clara Valley dudleya monitoring station 3, where Cleary suspected at least some of the plants were smooth lessingia, and sent them to the Jepson Herbarium at U.C. Berkeley for taxonomic analysis.

Results

Results of the taxonomic analysis for the lessingia voucher specimens collected along the lower western shoulder of Coyote Ridge revealed that some of these plants were approaching the phenotype of smooth lessingia while some were more obvious hybrids between smooth lessingia and slender-stemmed lessingia (Stacy Marcos, pers. comm. 2007). None of the specimens appeared to be "pure" smooth lessingia. However, Brian's incidental observations documented the presence of what are likely to be primarily smooth lessingia throughout much of the lower elevations of the Coyote Ridge property.

Discussion

Because smooth lessingia blooms from July through November, we believe that the fall 2007 surveys were conducted during the appropriate time of year to document the overall presence and distribution of this plant on site. At this time, site management, including grazing, does not appear to be adversely affecting this species, and rather, the species appears to be responding well to managed grazing. Therefore, no more focused surveys are absolutely necessary at this time. However, due to hybridization between smooth lessingia and slender-stemmed lessingia on this site, more focused surveys and further taxonomic studies to more clearly differentiate the geographic extent and distribution of these 2 species of lessingia on the site are recommended if population estimates or more refined distributional information on smooth lessingia is desired.

SAN FRANCISCO WALLFLOWER

San Francisco wallflower (*Erysimum franciscanum*) is a biennial herb/subshrub associated with serpentine or granitic substrates within a variety of plant communities. The range of San Francisco wallflower includes Marin, Santa Clara, Santa Cruz, San Francisco, San Mateo, and Sonoma counties. San Francisco wallflower is listed as a CNPS List 4 plant species (i.e., a plant of limited distribution) by the California Native Plant Society. Populations are typically associated with exposed areas of little soil development, including serpentine outcrops and granitic cliffs. San Francisco wallfower reportedly occurs on the Coyote Ridge property (Don Mayall, pers. comm. 2005), and elsewhere on Coyote Ridge, San Francisco wallflower has been observed within the California sagebrush/California poppy association and various serpentine grassland associations (Evans and San 2004). The RMP specifies that incidental observations of San Francisco wallflower made during other special-status plant monitoring efforts will be compiled and that evidence of declines in abundance or threats from grazing or invasive species will be noted. If numbers appear to be declining, more focused surveys could be conducted and/or remedial measures identified.

Methods

The Year 1 special-status plant monitoring effort did not include an attempt to observe San Francisco wallflower, as H. T. Harvey & Associates' surveys occurred well outside of the blooming period (March-June) for this species. Creekside Center for Earth Observation personnel looked for this species incidentally during their plant species/composition monitoring efforts in spring 2007.

Results

No individuals of the San Francisco wallflower were noted incidentally during Year 1 monitoring efforts.

Discussion

The distribution of the San Francisco wallflower on Coyote Ridge is patchy, and the lack of observations of this species during Year 1 monitoring efforts does not necessarily indicate that it is absent from the Coyote Ridge property or that activities on the property are having an adverse effect on the species. Personnel should continue to look for this species on the site while conducting other monitoring efforts. If it is not observed by the end of Year 3 (i.e., the 2009 monitoring season), the SCCOSA should consider conducing a focused survey to determine the species' status on the site.

EROSION PROBLEMS AND FERAL PIGS

Degradation of habitat quality resulting from erosion and rooting by feral pigs could potentially have adverse effects on biological resources on the Coyote Ridge property. Erosion could also damage on-site roads. As a result, problems resulting from erosion and feral pigs will be noted during monitoring so that they can be addressed as needed.

Methods

Year 1 monitoring did not begin early enough for the spring reconnaissance survey to be conducted to qualitatively assess potential erosion problems along on-site drainages. However, staff of the SCCOSA, H. T. Harvey & Associates, and the Creekside Center for Earth Observation were on the lookout for erosion issues and damage caused by feral pigs during Year 1 monitoring.

Results

No erosion problems were noted during 2007 monitoring. Feral pigs were seen occasionally on the property during monitoring, and rooting is evident throughout the ridge. However, pigs were noted in low numbers (typically no more than 5-10 individuals per visit).

Discussion

Currently, the rooting by feral pigs that does occur on the Coyote Ridge property is on a small scale and appears to have some minor net benefit for the establishment of some forbs. These disturbances appear similar to gopher mounds, which create bare mineral soil that enhance native annual forb recruitment. Larger-scale rooting could become problematic, and incidental monitoring of pig disturbance and numbers will continue.

CALIFORNIA RED-LEGGED FROG

The Coyote Ridge property includes a ± 98-acre site, located east/northeast of the U.S. 101/Coyote Creek Golf Drive intersection that had been preserved by Castle & Cooke as mitigation for impacts to the California red-legged frog from expansion of the Coyote Creek Golf Course (BonTerra Consulting 1999). This parcel includes two perennial stream systems and associated wetlands that provide potential red-legged frog habitat. Although red-legged frogs have not been observed on the Coyote Ridge property, they are known to breed in wetlands along the Kirby Canyon Landfill entrance road south of the Coyote Ridge property, and red-legged frogs are expected to use drainages on the Coyote Ridge property as summer aquatic refugia and as foraging and dispersal habitat, and possibly as breeding habitat. To ensure that management of the property maintains suitable habitat for red-legged frogs within this 98-acre area, focused surveys for red-legged frogs will be conducted every 2 years in this area, both to detect frogs and to determine whether conditions remain suitable for the species' use.

Methods

H. T. Harvey & Associates herpetologist Steve Carpenter conducted a daytime survey of the 98-acre red-legged frog mitigation area on 25 September 2007 and nighttime surveys on 26 September and 2 October 2007. During all three site visits, he thoroughly surveyed all the drainages within the red-legged frog mitigation area, paying particular attention to pools, and looking in vegetation and under debris for frogs. He also looked for bullfrogs (*Rana catesbeiana*), a non-native predator and competitor of the California red-legged frog.

Results

No red-legged frogs or bullfrogs were observed during these surveys. However, habitat conditions appear suitable for use by red-legged frogs, and no habitat degradation or other adverse conditions that might inhibit the site's use by red-legged frogs was observed during Year 1 monitoring.

Discussion

The drainages within the red-legged frog mitigation area do not appear to provide high-quality breeding habitat for this species. Although some pools are present, and many reaches of the streams in these drainages are perennial (and thus hold water long enough for use by breeding frogs), these pools are shallow, mostly 6-12 inches deep at most. Most of these pools also lack emergent vegetation due to shading by the brushy canopy. The habitats that contain the highest densities of red-legged frogs are typically associated with deep-water pools more than 2 feet deep with stands of overhanging willows (*Salix* spp.) and an intermixed fringe of cattails (*Typha* spp.), tules (*Scirpus* spp.), or sedges (*Carex* sp.) (Hayes and Jennings 1988).

California red-legged frogs occur in a number of locations along Coyote Ridge. In the vicinity of the VTA-Coyote Ridge property, the largest potential source population for red-legged frogs consists of the frogs present in three features at the Kirby Canyon landfill, along the entrance road: a mitigation wetland, a pond created specifically for red-legged frogs, and a sedimentation basin. Since 2001, Biosearch Associates (2004) has monitored red-legged frogs in these three features. Breeding has been documented in the sedimentation basin, and a high count of 33 adults and one subadult were present there in 2004. Up to 26 adults (in 2004) have been counted in the frog mitigation pond, although successful breeding has not been documented there. Breeding occurs in the mitigation wetland, and up to 11 adults (in 2004) have been counted there (Biosearch Associates 2004).

Because the red-legged frog mitigation area is only 2500 ft or so from the red-legged frog breeding areas on the landfill property, it is likely that there is interchange of individuals between the two locations. During the wet season in particular, red-legged frogs likely disperse overland among these drainages, crossing the grasslands along the southwestern slope of the Coyote Ridge property. Thus, the lower slopes on the southwestern side of the Coyote Ridge property, including the red-legged frog mitigation area, serve as dispersal habitat for the species.

It is possible that the drought during the 2006-2007 wet season adversely affected the hydrology in the pools on the Coyote Ridge property, and that red-legged frogs would be more likely to be found on the site after a year of average or above-average rainfall. Monitoring will continue to assess this species' use of the site and to ensure that management continues to maintain at least ostensibly suitable red-legged frog habitat.

INVASIVE PLANTS

Invasive annual grasses represent the greatest threat to the diversity of native serpentine plant communities and the persistence of populations of special-status serpentine-associated species on the Coyote Ridge property. Most such grasses can be managed through grazing, as described previously. However, some invasive plants, including yellow star-thistle (*Centaurea solstitialis*), Italian thistle (*Carduus pycnocephalus*), purple star-thistle (*Centaurea calcitrapa*), and barbed goatgrass (*Aegilops triuncialis*), are less palatable to livestock. These species present a serious invasion risk to sensitive native grasslands, and infestations of these species may need to be controlled by means other than grazing.

The 3 thistles are not currently supported on the serpentine soils throughout the bulk of the Coyote Ridge property, but are found on nonserpentine areas low on the northeastern and southwestern slopes of the ridge. No formal monitoring or treatment is currently underway for these species. Barbed goatgrass, however, has made significant headway into establishing itself within prime serpentine habitat. Its ability to invade serpentine in the absence of nitrogen deposition, and its resistance to control through grazing, make control of this species a major goal on Coyote Ridge. This section addresses treatment and monitoring associated with barbed goatgrass.

Barbed goatgrass is regarded among the wildland weed community as particularly invasive and difficult to control. It sets seed later than most annual grasses, remaining green into May or June in most years. The seeds remain viable in the soil for 2 or more years (DiTomaso and Healy 2007). Its roots reach deeper than many other annual grasses, allowing it to use high amounts of soil moisture and further enhancing its competitive ability. Goatgrass can decrease forage production in rangelands from 50 to more than 75%, especially after it flowers and develops its sharp, long, barbed awns. Heavy grazing, either throughout the season or in short durations, appears to increase density (DiTomaso and Healy 2007). It can be dispersed by livestock, wild animals, people, and vehicles (Peters et al. 1996). Roads provide primary invasion routes at Coyote Ridge.

Rice's (2007) research suggests that goatgrass is evolving a tolerance to serpentine. Native European strains survive but do not thrive on serpentine. Some California ecotypes perform similarly to the native strains, while others can thrive on serpentine.

Known Distribution on Coyote Ridge

Regionally, the infestation is estimated to be on the order of hundreds of acres, although the entire ridge has not been mapped. Many of the PG&E towers along the lower ridge have populations of goatgrass near them (Heath Bartosh, pers. comm., 2007). The infestations cross property lines, and are known from the Coyote Ridge property, Silicon Valley Land Conservancy, UTC, and Kirby Canyon Butterfly Trust properties.

The Coyote Ridge property infestation on the top of the ridge is less than 5 acres, and is thus considered controllable. The large infestation on UTC property to the north, however, presents a source that is threatening to continually invade into neighboring parcels. It is unknown at this point whether goatgrass infests other areas of the Coyote Ridge property.

A comprehensive goatgrass management plan for Coyote Ridge has been designed and implemented by the Creekside Center for Earth Observation, along with the SCCOSA. This U.S. Fish and Wildlife Service-approved plan uses a combination of spraying graminicide, burning, handpulling, and string cutting. Tarping and flaming may also be considered in the future. The predicted effects of treatment on bay checkerspots, their host and nectar plants, and other sensitive species have been taken into consideration and are detailed in the management plan (Weiss and Niederer 2007).

Methods

In 2006, treatment on Coyote Ridge property consisted of spraying the graminicide Envoy, which is approved for wildland and rangeland use. Spraying was conducted on 5 May, after plants had flowered. Spraying was done at half strength, from a boom-mounted ATV. A limited amount of handpulling was also conducted at small infestations or on the leading edges of larger ones. Handpulled plants were bagged.

In 2007, Envoy was used again, once on 16 March, before the plants had bolted, and on 13 May, after plants had flowered. The product was delivered at full strength from handheld wands attached to a tank pulled by an ATV. Spraying was again conducted by SCCOSA staff.

Glyphosate was considered for resprouts and spot spraying but was not used, although it may be appropriate in the future.

A crew of 4 contracted from Shelterbelt Builders mowed an acre of goatgrass with string cutters for a half day on 1 June, when plant seeds were in the soft dough stage. This was a follow up to both early and late spraying. Mowers were instructed to trim the plant as low as possible, preferably hitting the soil surface. Cutting the plants low was intended to minimize resprouting and to ensure decumbent individuals were treated. Creekside personnel assisted by flagging a general perimeter where goatgrass was found, as well as flagging or simply pulling or hoeing outliers. Treated infestations and outliers were mapped and permanently marked in May and June 2007. These permanent markers allow the spread of this grass to be more carefully assessed. They also allow for easier treatments (such as spraying) when the grass is in its vegetative state.

All treated areas on the Coyote Ridge property were additionally followed up with handpulling. These treatments were also used at other infested properties as mentioned. A 10-acre burn was also conducted on UTC property on 18 June.

There are currently no formal monitoring efforts underway on Coyote Ridge property, but several transects have been installed to detect changes in frequency and reproductive output on UTC property to the north. These results will be mentioned briefly in the discussion.

Results

The density of individuals at the Kirby Canyon site and the small VTA site is decreasing to the point where it is difficult to find goatgrass plants. Due to the sensitivity of each area, there is an ongoing effort to walk through slowly at least once a week while plants are flowering to pull any recalcitrant individuals.

The May 2006 and 2007 spraying treatments had no visible effects. The 16 March 2007 spraying, however, was very successful. A “line of death” was clearly visible after a few weeks (Figure 36). This line illustrated how remarkably different our pre-invasion grasslands must have looked, with lots of native forbs such as *Lessingia* spp., *Hemizonia congesta luzilifolia*, *Sanicula bipinnatifida*, and *Chloragalum pomeridianum*. The most beautiful jewelflower appeared unaffected by the spraying. Many perennial bunchgrasses seemed to survive the spraying, although mortality appeared to increase over several weeks, as compared to the quicker mortality of the annual grasses. There was some resprouting of goatgrass by early June, but clearly the spraying had knocked back this thick infestation in the road corridor.

Figure 36. The "Line of Death" Shown Twelve Days after Spraying. The Sprayed Area along the Road Is Filled with Native Forbs, while the Unsprayed Area to the Right Is Dominated by Nonnative Grasses.

Three things changed in 2007 that improved the success of Envoy compared to 2006:

- spraying was completed earlier,
- herbicide was applied at the maximum rate, and
- herbicide was applied with a hand wand, with the tank pulled by an ATV.

The 13 May 2007 spraying was too late to be effective, with no visible spray line seen over time.

Stringcutting appeared to be effective, with the dry year limiting potential for resprouts. Weeks later, a survey of several cut inflorescences showed no seed maturation.

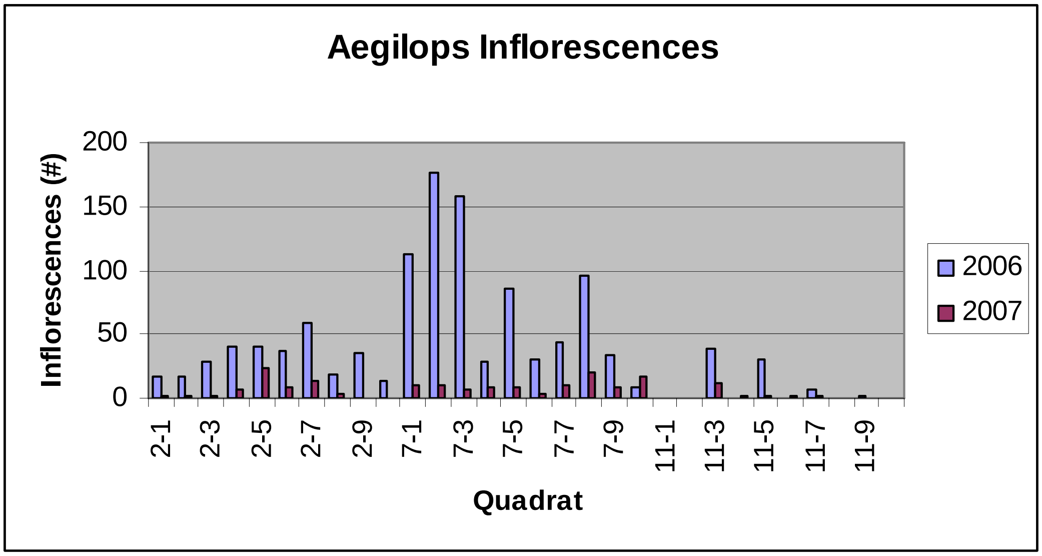
Again, no formal monitoring efforts are taking place on Coyote Ridge property, but initial results from efforts on UTC will be included in the discussion section below.

Discussion

2007 was a dry year, and barbed goatgrass on Coyote Ridge seemed to suffer from it. Transects were installed in 2006 on UTC property to gauge burn effects on reproductive output of goatgrass. The fire did not carry along these transects, essentially giving us 2 years of baseline data, with no treatment other than ambient grazing that occurred in both years (Figure 37).

These transects are located in a spring and fall grazed paddock. Additional transects were installed in 2007.

Figure 37. Change in Goatgrass Inflorescences from Wet to Dry Year, Grazed UTC Paddock



While reproductive output of barbed goatgrass declined dramatically in the dry year under similar grazing pressure, resource managers from other areas infested with goatgrass reported opposite observations, stating that goatgrass seemed to have increased or held steady (Karen Cotter of Santa Clara County Parks, Pete Frye of Marin County Open Space, pers. comm. 2007). Clearly weather alone did not reduce goatgrass cover and reproductive output at Coyote Ridge. Cattle appeared to be a contributing factor. In 2006 we saw few signs of cattle herbivory, but in 2007 grazing pressure may have been higher on goatgrass due to lower overall annual grass cover and quicker die-off of other annual grasses (Figures 38-40). Previous wetter years may have offered cattle more palatable grass choices, as species such as Italian ryegrass and soft chess remained green longer into the season.

Figure 38. This Quadrat on the UTC Property Had 158 Inflorescences in 2006 and Only 6 in 2007. It Appears Heavily Grazed and Dried Out. Although This Area Was in the 2006 Burn Unit, None of the Monitoring Transects Burned.

Figure 39. Examples of Grazed and Dry Goatgrass Plants from UTC Property, May 2007.

Figure 40. Dense Growth of Goatgrass in an Ungrazed Area on UTC Property, off Serpentine Soil, May 2007. Goatgrass Did Not Appear to Decline Regionally in 2007.

Regardless of the cause, the lack of robustness of our target plant offered an excellent opportunity to provide control throughout the various Coyote Ridge properties. With densities low, total area treated by mowing and handpulling was higher than expected. The dry year also limited opportunities for resprouting following spraying and mowing. Because of this plant's seedbank, follow up in 2008 is critical to build on low reproductive output of 2007.

Monitoring. Formalized monitoring is being conducted on UTC property, and will be briefly discussed here. Eleven 50-m transects were installed to measure reproductive output (inflorescences per 0.25m^2 quadrat) and frequency per 50-cm line across different treatments (Table 12). This information will be compared with results in 2008.

Table 12. Treatment per Transect.

Transect #	Treatment
1	Herbicide
2	Mow
3	Mow
4	Mow
5	Burn
6	Burn
7	Burn

Transect #	Treatment
8	Mow
9	Mow
10	Mow
11	Control

Transects 2-4 were intended to be mowed, then burned. This was suggested as a technique for increasing fuel load, however the burn did not carry through these transects. The burned transects did not burn completely. Transect 1 was not monitored for reproductive output and Transect 11 was not monitored for frequency.

Pre-treatment results are as follows (Figures 41 and 42). Post-treatment results are given for transect 1 herbicide treatment only. Pre-treatment monitoring of the sprayed transect found 64 50-cm segments with live goatgrass. Post-treament monitoring 9 weeks later found frequency had dropped to 5. While plants may have continued to resprout later in the season, initial results seem very positive.

Figure 41. Frequency of Live Goatgrass Plants along a 50-cm Transect on UTC Property.

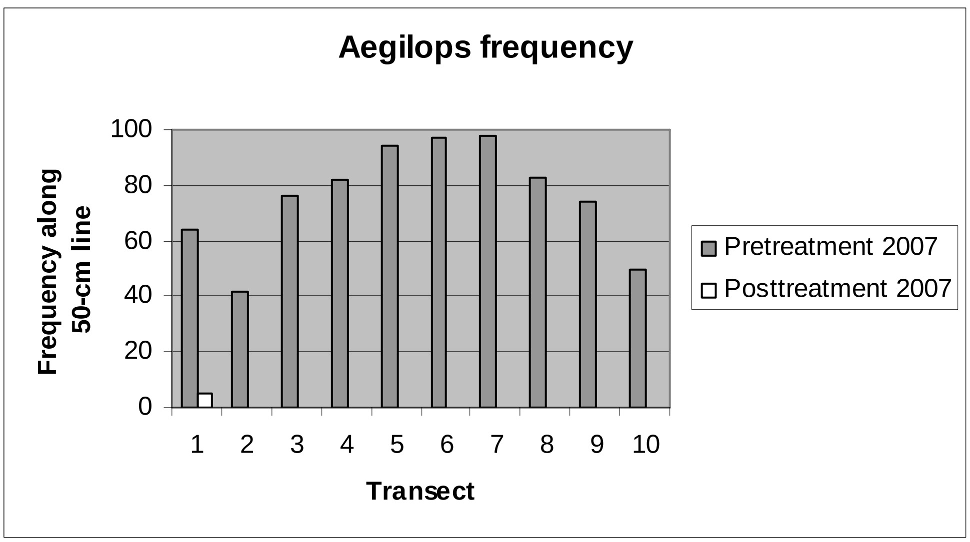
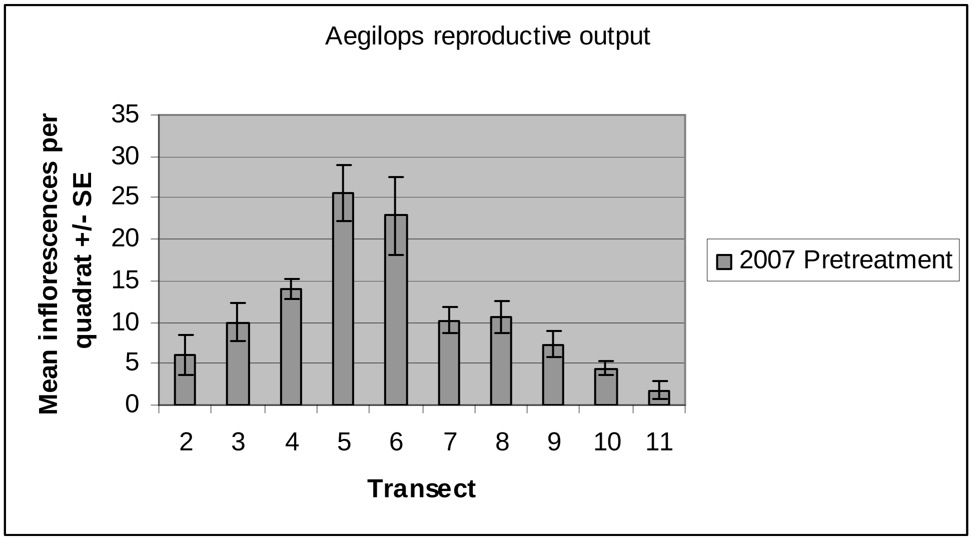


Figure 42. Mean Number of Goatgrass Inflorescences on UTC Property.



All transects will be read again before treatment in 2008, allowing differing treatments to be better assessed. Initial impressions are that the low rainfall in 2007 minimized potential for resprouts in sprayed and mowed areas. Each of these may be less effective in a wetter year without extensive follow up treatment.

It is unclear whether the burn was hot enough over a large area to destroy significant numbers of goatgrass seeds. There are plans to continue burning on UTC property, with a push toward burning larger areas and/or units with larger fuel loads.

SUMMARY AND RECOMMENDATIONS

MONITORING SUMMARY

The managed grazing that has occurred for years on VTA's Coyote Ridge property has been effective at maintaining suitable habitat for serpentine-associated plants and animals, including the bay checkerspot butterfly, while maintaining the integrity of aquatic, wetland, and riparian communities. Monitoring during the first year of management according to the Coyote Ridge RMP generally documented that suitable conditions for these resources continued to be maintained in 2007. Management in 2007 continued to provide quality habitat for checkerspots, sensitive plants and animals, and serpentine vegetation. Management should continue with 2 different grazing regimes, which favor different species in different years.

Because the commencement of monitoring activities did not coincide with optimal timing for some monitoring parameters, establishment of the baseline for comparison of future monitoring results will depend on a combination of data from 2007 and subsequent years.

Five of 15 RDM monitoring transects on and immediately adjacent to the Coyote Ridge property in 2007 were in the RMP's initial target range of 500-750 lbs/acre. Three were in the range of 751-1000 lbs/acre, 6 were between 1001 and 2000 lbs/acre, and one was above 2000 lbs/acre. These values were all lower than those on ungrazed reference sites, but were somewhat higher than the target range (500-750 lbs/acre) for ideal bay checkerspot butterfly habitat.

Grazing period/season sampling was conducted in order to monitor forage utilization within a given season. Within a grazing exclosure in the spring/fall-grazed paddock in the northwestern part of the site, the dry weight of the biomass clippings increased by 50% inside the exclosure between 13 September and 6 December, whereas outside the exclosure, dry weight declined by 75 g (15%). Although some of the difference in dry weight of herbage biomass from one sampling event to another may reflect spatial variability in biomass, the pattern observed in the Fall 2007 results is as would be expected – standing biomass increased within the exclosure as plants began to grow in late fall, but decreased outside the exclosure, likely due to grazing. Additional grazing exclosures will be constructed and monitored per the RMP to determine whether stocking rates need to be adjusted within a grazing season.

Baseline data on plant species composition and cover were collected along 6 transects on the Coyote Ridge property. Comparison of future monitoring results with 2007 results will provide a reliable system for detecting major changes in grassland composition in response to climate, topography, and management. Data from the Coyote Ridge property transects from 2005 and 2006, and from other serpentine sites, were also analyzed and discussed to provide a spatiotemporal context for the 2007 monitoring results on the Coyote Ridge property.

In 2007, livestock stocking rates continued as they have in the past, at approximately one cow-calf pair per 10 acres. As per the RMP, the majority of the property was grazed in winter and spring in 2007. In 2007, the paddock in the northwestern portion of the site was grazed in spring and fall, rather than in summer and fall as in previous years (and as specified in the RMP). This change from summer/fall to spring/fall grazing may only be temporary, and was not observed to result in any adverse changes to any monitoring parameters.

Bay checkerspot butterfly populations were estimated on the Coyote Ridge property based on larval surveys, and compared with results from 2006 (and earlier, where such data were available) to provide a temporal context for 2007 results, since populations of this species can show dramatic fluctuations. In 2006, there were ~25,000 larvae on VTA as a whole. In 2007, numbers declined to ~10,000, with the majority on the lower western slopes of the property.

Five monitoring plots were established for each of 3 special-status plant species (Santa Clara Valley dudleya, most beautiful jewelflower, and Mt. Hamilton thistle), and the following densities were determined within the monitoring plots: 5.7 plants/m^2 for Santa Clara valley dudleya, 4.0 plants/m^2 for most beautiful jewelflower, and 13.8 plants/m^2 for Mt. Hamilton thistle. Because of the time of year in which monitoring began in 2007, the density estimates for the dudleya and jewelflower were likely lower than actual densities on these monitoring plots, and future monitoring should occur during the peak flowering periods for these species. Two other rare plant species were monitored by recording incidental observations made during other monitoring. The smooth lessingia is likely present throughout most of the lower (at least western) slopes of the Coyote Ridge property, although herbarium identification of voucher specimens collected in 2007 determined the presence of large numbers of hybrids between the rare smooth lessingia and the more common slender-stemmed lessingia (which dominates higher slopes on the site). No individuals of the San Francisco wallflower were observed during monitoring, much of which was conducted outside the species' peak flowering period.

Surveys for California red-legged frogs were conducted within a 98-acre portion of the property that had been acquired for red-legged frog habitat mitigation by a previous owner. No red-legged frogs, nor any bullfrogs or evidence of red-legged frog habitat degradation, was observed during 2007 surveys. Likewise, no major erosional problems or feral pig damage was noted during 2007 monitoring. Although pigs were regularly observed on the site, pig damage is limited and may be beneficial by uncovering bare mineral soil that enhances native annual forb recruitment.

Measures to control invasive plants in 2007 were focused on the barbed goatgrass. In 2007, the graminicide Envoy was applied to known goatgrass infestations on the Coyote Ridge property on 16 March, before the plants had bolted, and on 13 May, after plants had flowered. The product was delivered at full strength from handheld wands attached to a tank pulled by an ATV. An acre of goatgrass was mown using string cutters on 1 June. These measures complemented a 10-acre burn in a more heavily infested area on the adjacent UTC property on 18 June. The 16 March 2007 spraying was very successful, and the June mowing knocked back resprouted plants. Continued monitoring and treatment of this highly invasive species will be necessary.

RECOMMENDATIONS

- **RDM**
  - All treatment groups produced total RDM values above the initial target range. It is generally agreed that current management is maintaining healthy populations of target species and a diverse serpentine plant community. Data collected over the

next few years should be analyzed with existing RDM data to adjust the initial target range, rather than to begin initiating management changes.
  - RDM sampling should continue at least on the 10 RDM monitoring transects (all 3 VTA_NORTH_SF and VTA_NORTH_WS transects and 2 each of the VTA_SUMMIT_WS and VTA_MID_WS transects) located on the Coyote Ridge property itself according to Figure 3. If feasible, and if access to other adjacent sites allows, sampling on the additional 6 transects would be useful in capturing the desired range of slopes, aspects, and elevations. The sites where RDM is measured would become permanent composition plots as well.
  - In the longer term, RDM monitoring would be facilitated by implementing photo-monitoring to replace clipping. Photo sites would be established using the range-pole and golf ball method, existing photos would be calibrated to measurements (see Appendix A), and SCCOSA staff would be trained to implement photo-monitoring and RDM estimation and replace clipping when appropriate. While these changes to the monitoring protocol are not required, we recommend that SCCOSA staff investigate these changes to facilitate long-term monitoring.

- **Grazing Period/Season Standing Forage**
  - The 9 additional grazing period standing forage monitoring areas to be constructed by the SCCOSA should ne constructed within the same grazing management area as RDM monitoring plots in order to make results comparable with the RDM data.

- **Barbed Goatgrass**
  - Continue intensive monitoring and treatment. Progress was made in the 2007 dry year, and multi-year treatment will be required to deplete the seedbank. At a minimum, last year's treatments should be repeated. SCCOSA should continue working with neighboring landowners to reduce their source populations of goatgrass.
  - Dye should be added to the herbicide mix in order to ensure even coverage. Dye also improves applicators' personal safety, as they can more easily tell if they have been accidentally exposed. Because the area is not visited by the public, aesthetic concerns in treated areas should not be an issue.

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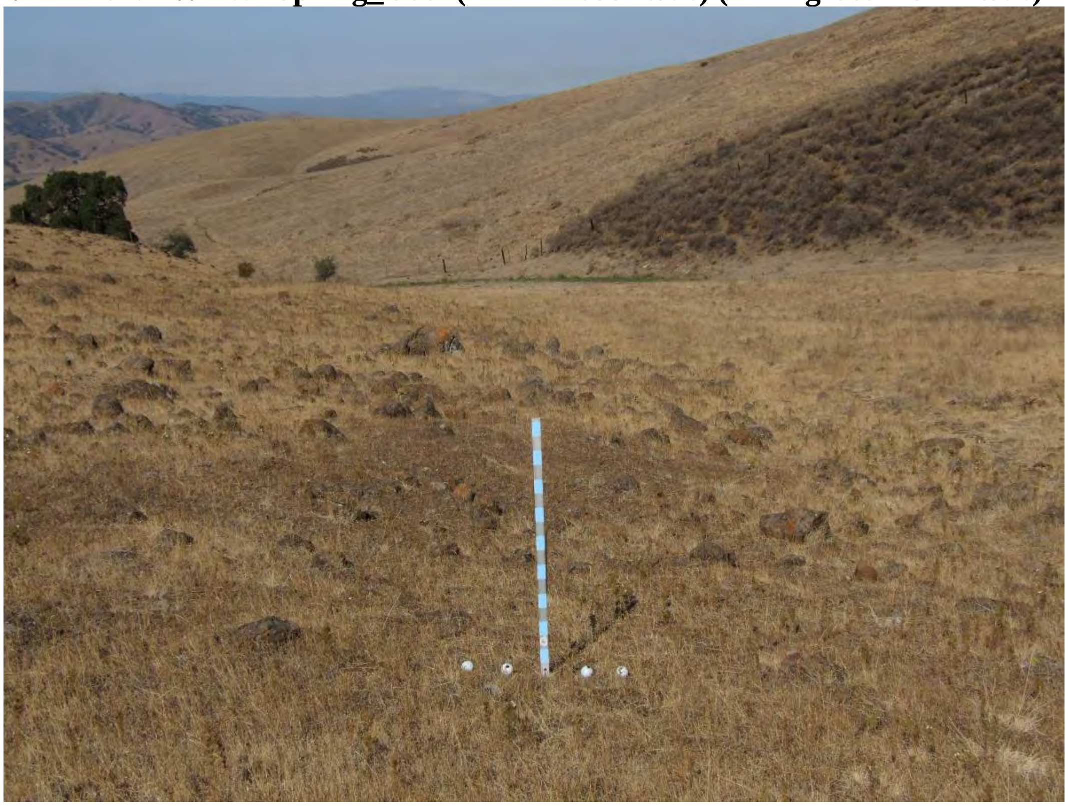
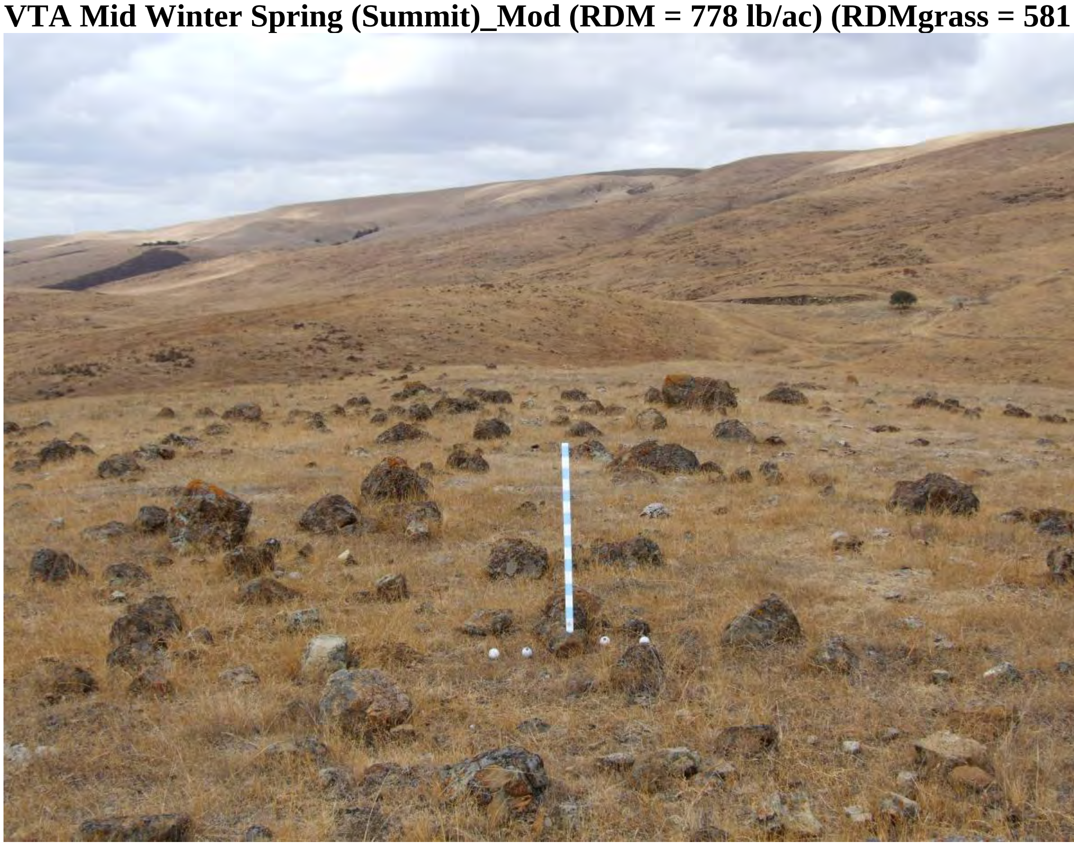
APPENDIX A.
RDM DATA, SELECTED PHOTOS
SEPTEMBER 2007, COYOTE RIDGE

VTA North Winter Spring_Cool (RDM = 655 lb/ac) (RDMgrass = 377 lb/ac)

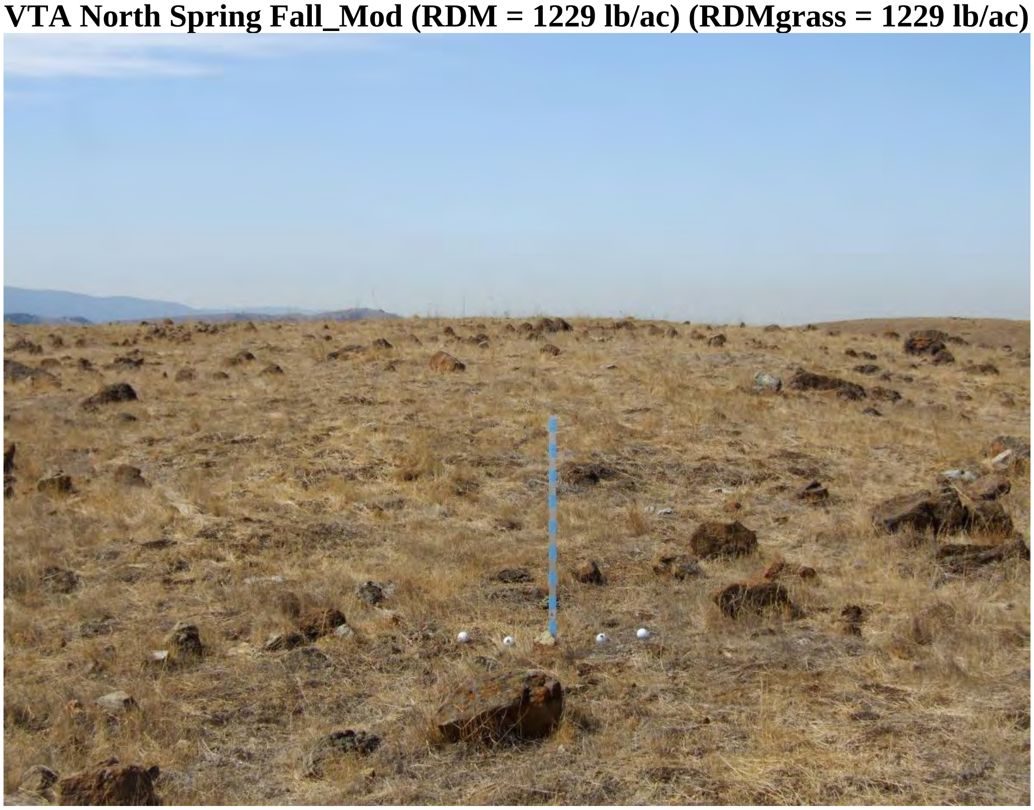


VTA Mid Winter Spring (Summit)_Mod (RDM = 778 lb/ac) (RDMgrass = 581 lb/ac)

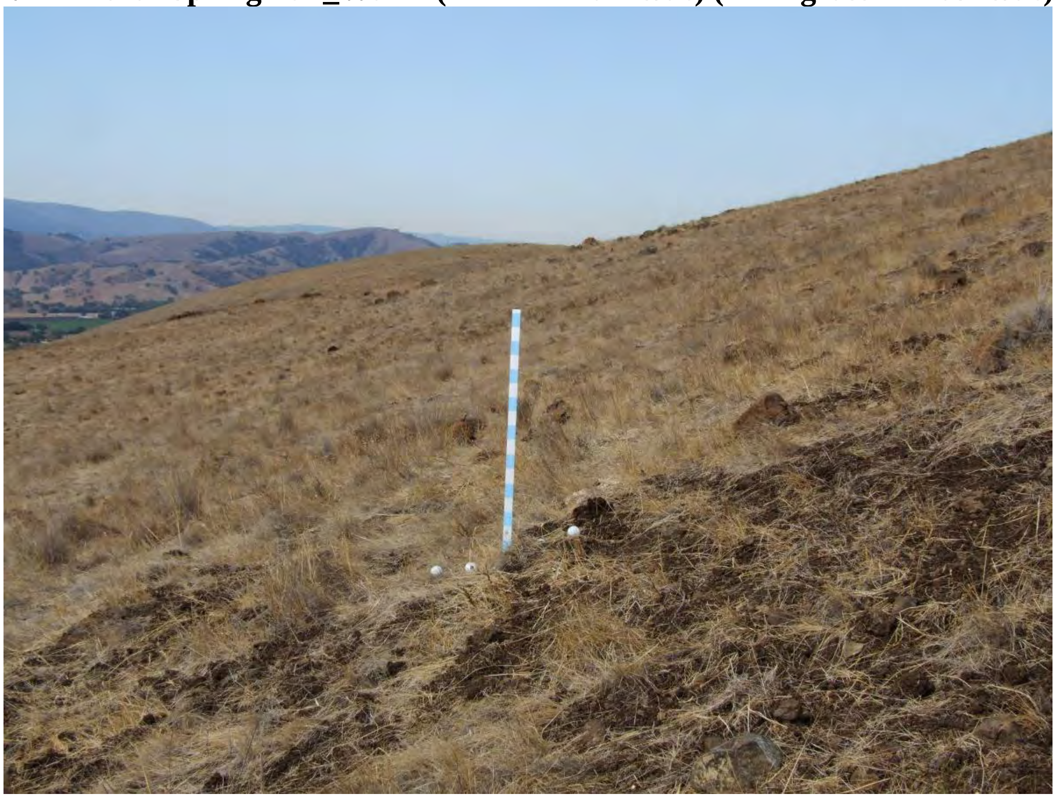


VTA Mid Winter Spring_Cool (RDM = 912 lb/ac) (RDMgrass = 714 lb/ac)

VTA North Spring Fall_Mod (RDM = 1229 lb/ac) (RDMgrass = 1229 lb/ac)



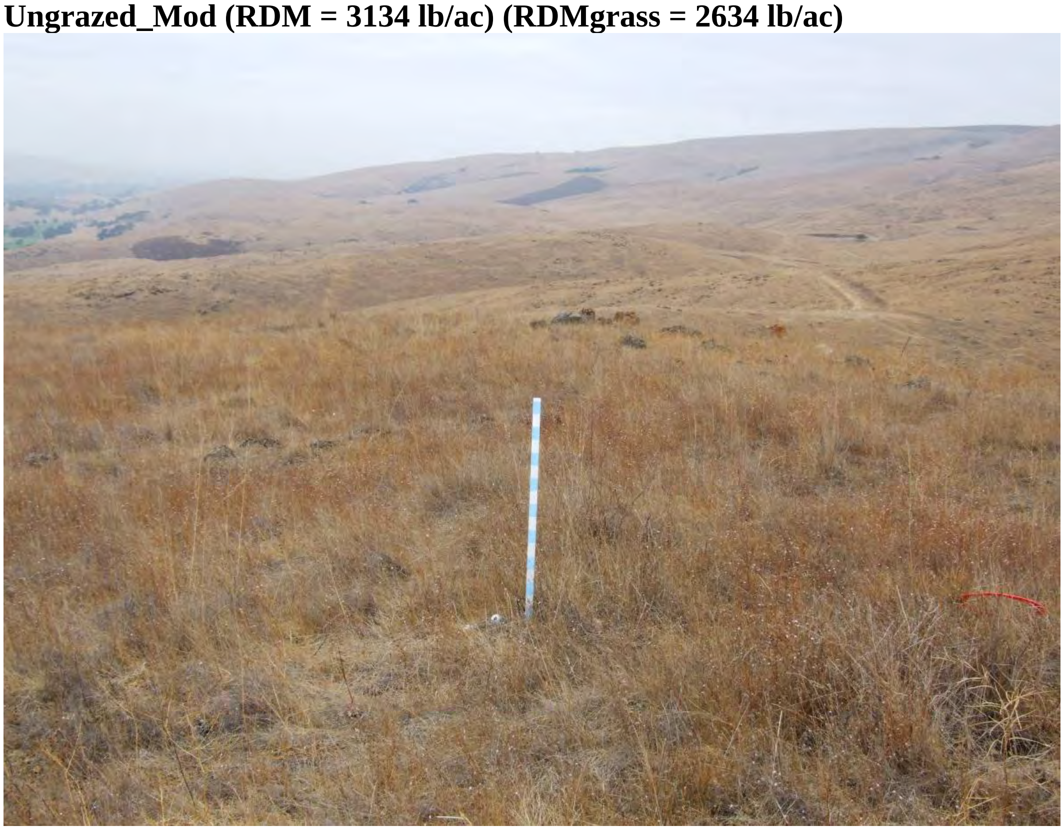
VTA North Spring Fall_Warm (RDM = 1704 lb/ac) (RDMgrass = 1405 lb/ac)



VTA North Spring Fall_Cool (RDM = 2187 lb/ac) (RDMgrass =1940 lb/ac)

Ungrazed_Warm (RDM = 3131 lb/ac) (RDMgrass = 2465 lb/ac)

Ungrazed_Mod (RDM = 3134 lb/ac) (RDMgrass = 2634 lb/ac)



TOP PHOTOS of RDM samples

VTA North Winter Spring_Cool
(RDM = 655 lb/ac) (RDMgrass = 377 lb/ac)

VTA Summit Winter Spring_Mod
(RDM = 778 lb/ac) (RDMgrass = 581 lb/ac)

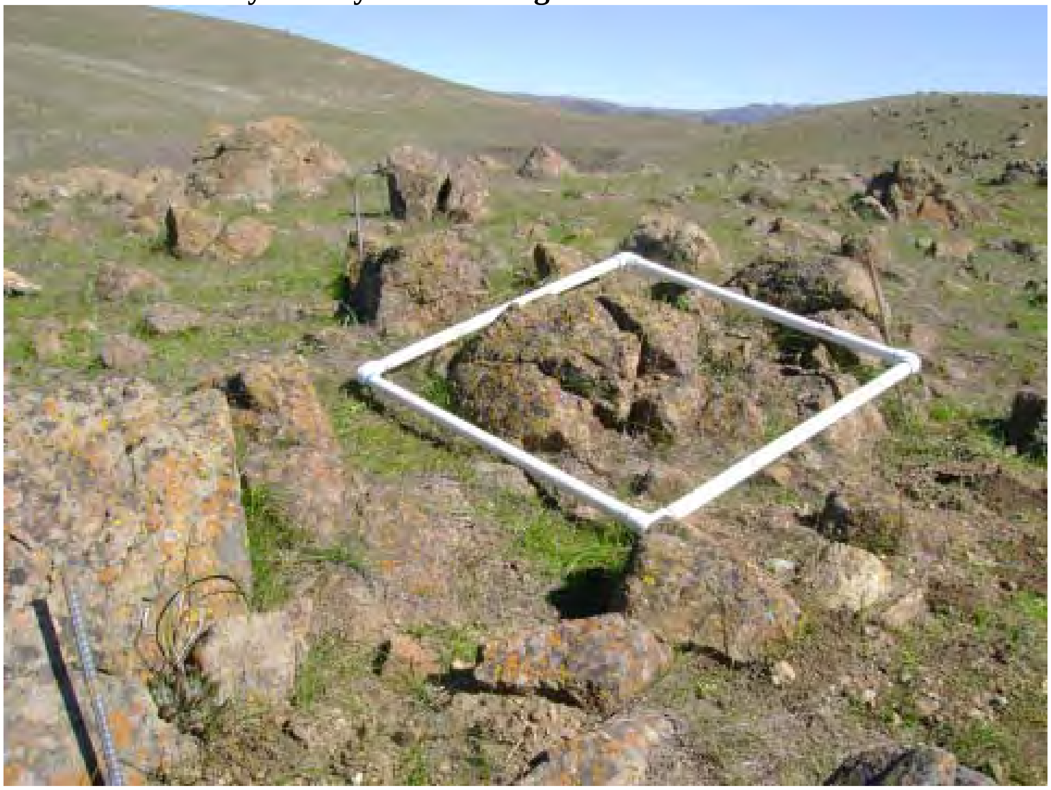
VTA Mid Winter Spring_Cool
(RDM = 912 lb/ac) (RDMgrass = 714 lb/ac)

VTA North Spring Fall_Mod
(RDM = 1229 lb/ac) (RDMgrass = 1229 lb/ac)

VTA North Spring Fall_Cool (RDM = 2187 lb/ac) (RDMgrass =1940 lb/ac)	Ungrazed_Mod (RDM = 3134 lb/ac) (RDMgrass = 2634 lb/ac)
	

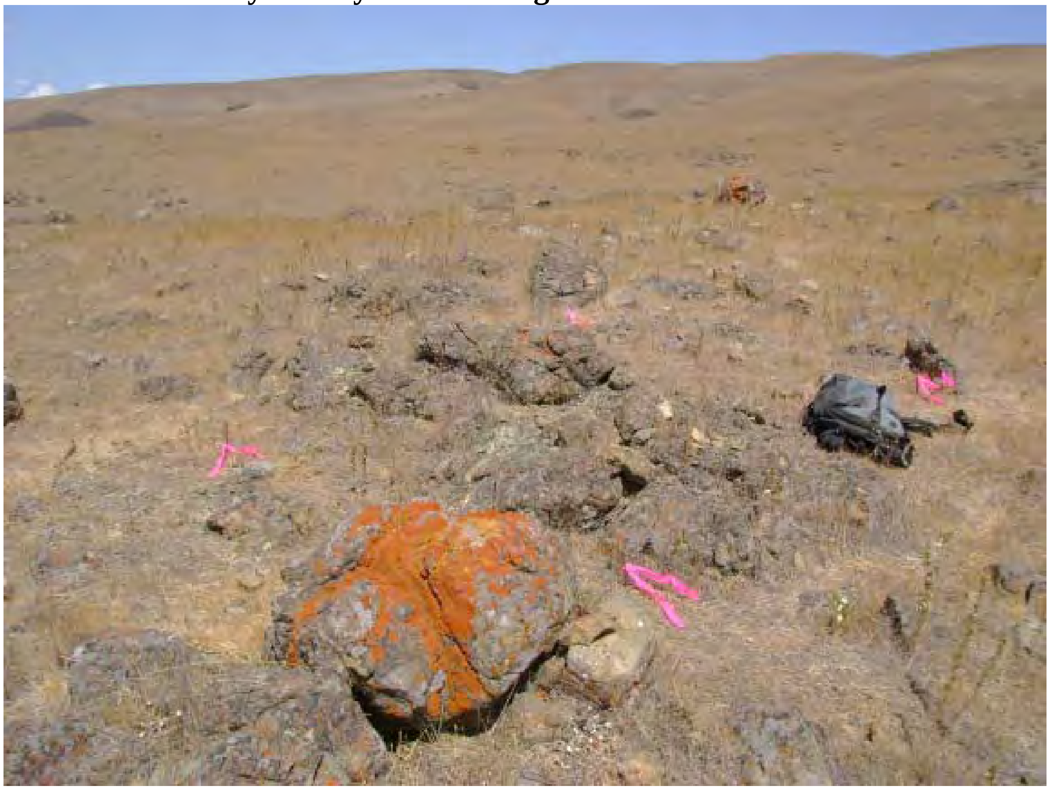
APPENDIX B.
PHOTOS OF SPECIAL-STATUS PLANT MONITORING PLOTS

Santa Clara Valley Dudleya Monitoring Station 1

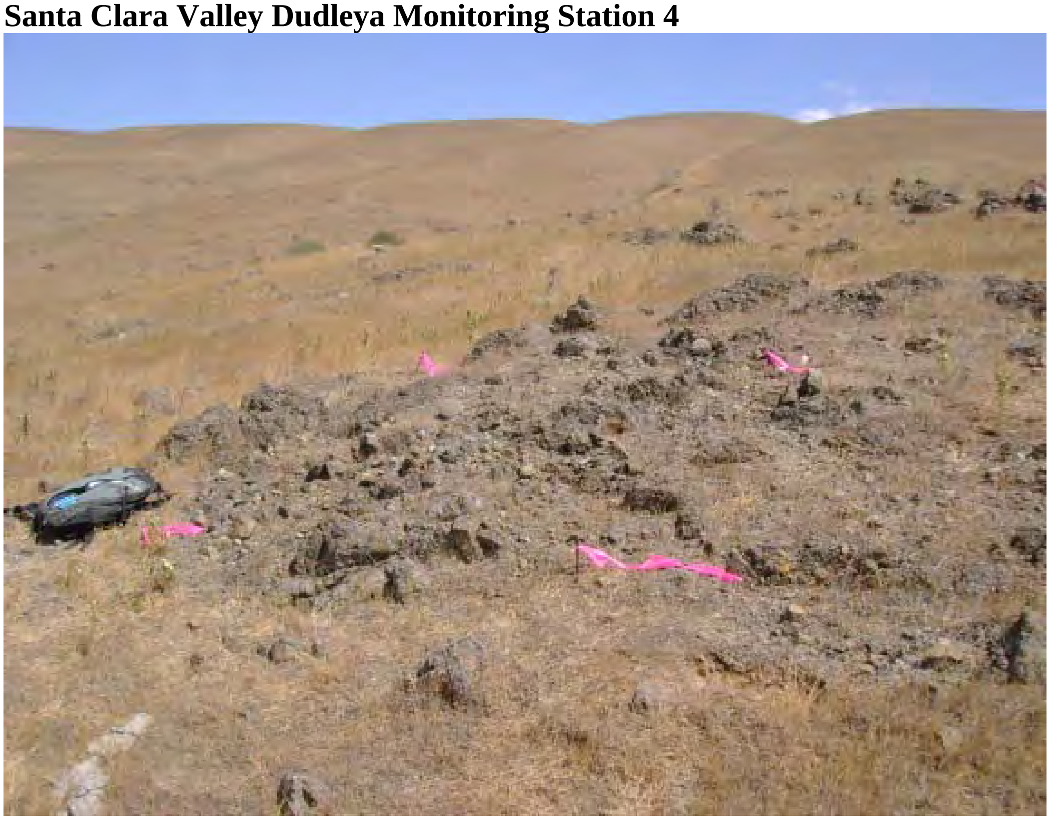


Santa Clara Valley Dudleya Monitoring Station 2

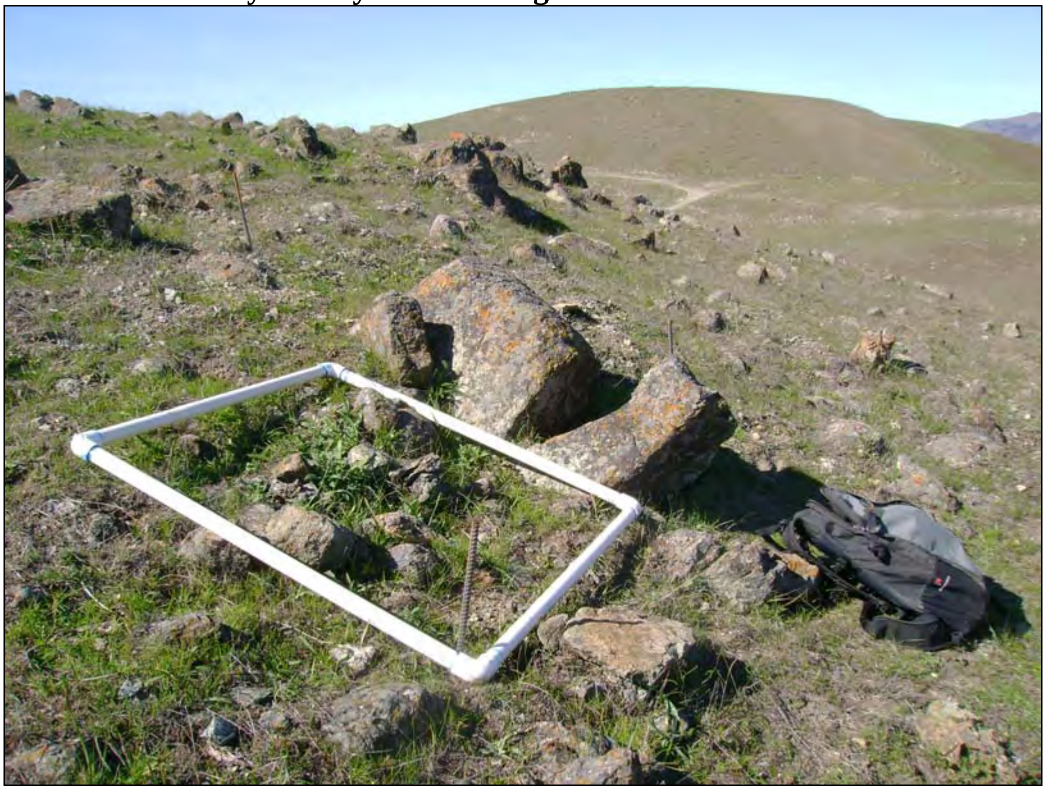
Santa Clara Valley Dudleya Monitoring Station 3



Santa Clara Valley Dudleya Monitoring Station 4



Santa Clara Valley Dudleya Monitoring Station 5



Mt. Hamilton Thistle Monitoring Station 1

Mt. Hamilton Thistle Monitoring Station 2

Mt. Hamilton Thistle Monitoring Station 3

Mt. Hamilton Thistle Monitoring Station 4

Mt. Hamilton Thistle Monitoring Station 5

Most Beautiful Jewelflower Monitoring Station 1

Most Beautiful Jewelflower Monitoring Station 2

Most Beautiful Jewelflower Monitoring Station 3

Most Beautiful Jewelflower Monitoring Station 4

Most Beautiful Jewelflower Monitoring Station 5