Range Ecology Grassland Management and Monitoring options for the East Bay Regional Park District: Final Report 2011 Grassland Monitoring Project (Year 10)

Brushy Peak,
Lake Chabot-Fairmont Ridge,
Morgan Territory,
Pleasanton Ridge,
Sunol-Ohlone,
Sycamore Valley,
and
Vasco Caves

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1.0 Grassland Monitoring Project Summary

1.1 *Introduction*

The U.C. Berkeley long-term grassland monitoring study (Grassland Monitoring Project) was designed to assist the East Bay Regional Park District to manage and monitor their different grassland communities. The District invested in basic work to better understand the structure and function of the grassland because spatial arrangement is directly related to designing efficient monitoring. Because other Mediterranean-type grasslands are known to have highly site-specific reactions to management by grazing, fire, or other means, it was deemed important to establish permanent plots and measure them over several growing seasons. District conservation goals require monitoring and measurement of environmental features, plants, and animals. The work reported here forms the basis for specific management and monitoring recommendations, which should be tied into park-specific management plans.

In this report, we present range ecology grassland management and monitoring options for seven parks: Brushy Peak Regional Preserve, Lake Chabot Regional Park (Fairmont Ridge), Morgan Territory Regional Preserve, Pleasanton Ridge Regional Park, Sunol Regional Wilderness-Ohlone Regional Wilderness, Sycamore Valley Regional Open Space Preserve, and Vasco Caves Regional Preserve.

For the ten years of the study, 2002-2011, we produced nine annual reports for the District as well as this final report. These annual reports contain analyses of many components of the District's grassland ecosystems. This final report for Year 2011 incorporates the field data from 2010 and 2011into the management and monitoring recommendations and the individual park descriptions. The Year 2011 management and monitoring options report (as well as the 2010: Year 9 pilot management and monitoring report) is informed by Project analyses, and we refer readers to previous year reports and published peer-reviewed and student work for greater baseline ecosystem description and fuller analytic detail.

More details on the park, plot locations, year, and type of data collection over the length of the Grassland Monitoring Project is in the first appendix for the report (Appendix A: Grassland Monitoring Project research summary).

1.2 *Monitoring overview* (see Section 4.0 for vegetation and sections 7.0 and 8.0 for avian details)

<u>Prioritization of goals</u>: District staff have described their conservation management priorities as focusing on:
1) maintaining or enhancing native plant and grassland bird abundance,
2) controlling invasive plant species, and
3) understanding and managing the effects of livestock grazing on native plant and grassland bird populations.

<u>Monitoring timing and scale</u>: Because District grasslands are highly diverse communities and differ significantly among parks, monitoring needs to account for site variations if the goal is to detect differences caused by management. Monitoring could occur at enough locations within each park and compare management types (e.g., grazed or ungrazed) to account for variability within that park and from year to year. Our analyses show that, compared to spatial differences, annual differences are not as great as previously thought. This means that monitoring need not be

conducted every year and reading plots every few years provides adequate information to detect trends in the native vegetation (see monitoring suggestions from 2006 and 2009 annual reports). Much of the District grassland's year-to-year variation is driven by seasonal weather rather than management. These changes differ depending on location and site. Site-specific trends in native plant abundance measured over a 5 to 10 year period may be more suitable indicators of native species abundance for management purposes than tracking short-term changes. A longer-term perspective is also necessary for understanding grassland bird distribution and abundance in relation to site and management.

Invasive species: Noxious invasive plant species are locally present in District grasslands and because early detection is a key to effective control, targeted annual monitoring may be appropriate.

Native plant monitoring: Numerous native species are present in District grasslands but purple needlegrass (*Nassella pulchra*) is the only species that could be considered abundant. Monitoring native plant cover is warranted only in locations with large purple needlegrass populations and in native forb-dominated sites, such as those at Sunol-Ohlone (Valpe Ridge). For other parks and sites, tracking native species richness (the number of native species) is likely to prove the more suitable and cost-effective monitoring method.

Grassland bird monitoring: Continued monitoring of grassland bird species is recommended in the parks where guild species are present. Because grassland birds respond to grassland management (e.g., livestock grazing, native plant restoration, prescribed fire, infrastructure development) they are a good indicator of community response. Monitoring the long-term presence and diversity of grassland birds on District land should continue on a regular basis.

1.3 *Suggested general vegetation management goals for each park*

We found that grassland communities differed significantly within and between parks, which requires that each park develop its own specific goals, management, and associated monitoring. Some general goals are described below and should be incorporated into individual park plans.

• maintain native species richness in parks with fairly low native cover (e.g., Brushy Peak, Sycamore Valley);
• maintain purple needlegrass cover at parks with a significant population (e.g., Chabot-Fairmont Ridge, Pleasanton Ridge, Vasco Caves);
• maintain native forb cover and species richness at parks with sites containing significant forb cover (e.g., Sunol-Ohlone); and
• reduce or eliminate cover of invasive plants (e.g., Sycamore Valley, Sunol-Ohlone).

Various management activities may be planned and implemented to achieve these goals; the success of the management activities is evaluated through monitoring tailored to assess specific management goals. See section 4.0 for more detailed overall monitoring suggestions and section 5.0 for more detailed individual park monitoring suggestions.

1.4 *Restoration using targeted grazing management* (See Section 2.3 for restoration details and Section 4.0 for restoration monitoring suggestions)

Before designing a grassland restoration plan, it is necessary to realize that the general goal of returning to a pristine, exclusively native ecosystem is unrealistic. Within reach may be the goal of ecosystem restoration or "creating a landscape that is more weed-resistant, maintains its productivity over time and other ecosystem services, and is somewhat tolerant or resilient to a variety of stresses" (Stromberg et al. 2007: 254) and that contains greater native plant diversity and provides higher-quality habitat for wildlife.

That being said, restoration can be approached in two different ways, active restoration or passive restoration, depending on the size or area to be restored, site characteristics, and resources available for restoration (Stromberg et al. 2007). Active restoration implies native species seeding or planting and ongoing weed removal or eradication. Passive restoration involves applying lower cost standard management tools, such as burning or grazing, to specific restoration goals. Passive restoration can be less expensive than active restoration and, importantly, can be applied over large areas. This report's grassland restoration suggestions will take a passive restoration approach.

Passive restoration tools like livestock grazing and prescribed burning are commonly used in the District's grasslands. Cattle grazing can be employed as a management tool for enhancing wildlife habitat and promoting native plant abundance, and is considered to work by changing the height and patchiness of the grassland (bare ground) and by removing the grass and promoting the native forb diversity (Barry et al. 2006, Weiss 1999). Modifying the amount of Fall residual dry matter (RDM) has an impact on nutrient cycling, species composition, and cover structure and all grazed District units should continue regular RDM monitoring (Bartolome et al. 2006). These kinds of responses, however, are site and time specific. For example, this study has shown that soil properties predict the presence of native species on what are quite small and distinctive ecological sites (Gea-Izquierdo et al. 2006). It is also important to note that targeted specialized grazing systems have a spotty record of success (Stahlheber and D'Antonio 2013). Any restoration project should be part of an overall vegetation management plan that identifies site potential and includes both adaptive management considerations and a monitoring plan with clear and measurable objectives for the park.

Below is a list of parks in alphabetical order from the Grassland Monitoring Project that could be prioritized for their potential to respond to restoration management efforts to maintain or enhance native-like grassland and suitable grassland bird habitat. For each park the key descriptive elements used for this prioritization are explained.

Lake Chabot Regional Park-Fairmont Ridge (details Section 5.2 and 10.2):

- Restoration suggestions: continue cattle grazing with monitoring of RDM and native plant species
- Nativeness: Consistent relatively high level of native cover of purple needlegrass, native forbs and lilies; two rare native plants big scale balsamroot (*Balsamorhiza macrolepis* var. *macrolepis*) and fragrant fritillary (*Fritillaria liliacea)*
- Soils: includes sites with serpentine-derived soils
- Land-use history: no evidence of cultivation
- Threats: oak tree planting/management in vicinity (Alameda County Children's Memorial Grove); planted Harding grass.

Grassland bird guild: None present in breeding season; Fairmont Ridge grassland patch potentially too small and impacted by urban proximity

Sunol Regional Wilderness-Ohlone Regional Wilderness (details Section 5.5 and 10.5)

Restoration suggestions: continue cattle grazing; apply adaptive management approach to native grassland enhancement while monitoring RDM and following native forb response to livestock grazing; apply targeted grazing and prescribed burning to reduce medusahead.

Nativeness: highest levels of native species cover and richness observed during the course of the Project; Valpe Ridge and High Valley locations

Soils: thin and rocky soil on Valpe Ridge

Land-use history: no evidence of cultivation on Valpe Ridge; likely cultivation on High Valley

Threats: High Valley medusahead (*Taeniatherum caput-medusae*) population

Grassland bird guild: Park had presence of Grasshopper Sparrows (*Ammodramus savannarum*), Horned Larks (*Eremophila alpestris*), and Western Meadowlarks (*Sturnella neglecta*)

Vasco Caves Regional Preserve (details Section 5.7 and 10.7)

Restoration suggestions: continue sheep grazing; develop and apply adaptive management approach to native grassland enhancement guided by monitoring effect of sheep grazing on purple needlegrass; determine if local site variations influence purple needlegrass abundance.

Nativeness: moderate levels of native cover, significant populations of purple needlegrass

Soils: shallow, rocky soil with limestone outcrops

Land-use history: no evidence of cultivation due to rocky soils

Threats: areas of Annual ryegrass (*Lolium multiflorum*) dominance and Black mustard (*Brassica nigra*) may impact long-term presence of native bunchgrass population without proper management

Grassland bird guild: Vasco Caves had the highest consistent numbers of Western Meadowlarks (highest overall relative abundance); all other species of the guild were present

1.5 *Invasive plant control prioritization*

Early detection of and rapid response to small or new populations of invasive plants is perhaps the most important grassland conservation priority. Livestock grazing can be used to control already common invasive species by not allowing them to dominate the grassland. Several of the major Valley grassland noxious invasive species found on District property can be reduced, if not entirely eliminated, with targeted grazing, e.g., yellow starthistle (*Centaurea solstitialis*) and medusahead (*Taeniatherum caput-medusae*) (Jackson and Bartolome 2007).

Black mustard (*Brassica nigra*) could be prioritized for control in Vasco Caves by livestock grazing and possibly herbicide or mechanical treatment in areas of high native plant abundance. Medusahead and yellow starthistle could also be prioritized for control by livestock grazing and possibly herbicide where they occur. (See Section 3.0 for further details.)

1.6 *Future research recommendations summary*

1) Site-specific studies of historic cultivation or dry-land farming, coupled with soil analyses within the parks may help prioritize sites for restoration.

2) Continue focus of the effect of livestock grazing on plant species community structure. Continue sampling of the Project's paired ungrazed/grazed plots at parks where purple needlegrass and native forb cover are high. Sunol-Ohlone and Vasco Caves have potential for an informative long-term monitoring study because of the high level of native plants and available both permanent and movable electric livestock exclosure fencing.

3) Purple needlegrass population trends need continued monitoring. One or two permanent line-point transects could be established in the purple needlegrass stands to monitor changes in cover. Another option would be to track trends in purple needlegrass with frequency plots.

4) Determine long-term presence and diversity of breeding grassland birds on District land. Repeat current permanent breeding season (April-June 15) grassland point count surveys on a rotation of 5-7 years in order to detect if grassland guild bird species are still present in grassland areas where they are currently located.

5) For fall and wintering grassland bird species long-term presence and diversity, conduct area searches in accessible areas in October - February. Rotation of 5-7 years.

1.7 *Overview of livestock grazing ecology and management*

The science base for grazing management has been significantly improved and enhanced over the past five years, culminating in reviews, analyses, and recommendations for rangeland management practices in North America (Briske et al. 2011); reviews of the effect of practices on California grasslands (Stahlheber and D'Antonio 2013, Huntsinger et al. 2007); and general management recommendations for California rangelands (Huntsinger et al. 2007). Those authors concluded that the result of any specific grazing practice is highly site-specific or restricted to the area of the study (in some cases, this is roughly equivalent to soil type) and primarily depends on the interactions of site and weather with grazing. This means that even if there were experimental results from local grazing studies, those types of results have limited predictive value for grazing planning and adaptive management decision-making processes (Bartolome et al. 2009). A fundamental principle of grazing management on Californian rangelands is the need for flexibility in both planning and application (Bush 2006, Huntsinger et al. 2007).

Published research evaluating the use of grazing as a conservation tool for native vegetation restoration and management report mixed results for California (Kimball and Schiffman 2003, Huntsinger et al. 2007). In a meta-analysis of grazing experiments in California's Mediterranean-type grasslands, Stahlheber and D'Antonio (2013) reported that grazing often increased native grasses, but also non-native forbs; and sometimes increased native forbs, but the results all appeared to be highly site-specific and dependent on weather patterns. Grazing has also been a successful conservation management tool for specific plant taxa in some herbaceous wetland communities (Marty 2005; Pyke and Marty 2005), probably through the reduction of competing non-native species; e.g., non-native annual grasses and associated thatch accumulation resulting in high Residual Dry Matter (RDM). RDM is the dry aboveground plant material remaining after the growing season is completed and is an important indicator of the degree of grazing use on annual rangelands (Bartolome et al. 2006).

A plan is necessary to implement management strategies and outline monitoring required to track success in reaching goals and to adapt new or revised strategies to achieve success (Bush 2006). Good grazing plans include well defined strategic goals, evaluate existing conditions, identify and propose management practices, and suggest options for implementation and monitoring. An adaptive management approach to livestock grazing applies general principles for informed best grazing management practice under a monitoring approach sufficient to inform management decisions (Herrick et al. 2012).

Adaptive management requires development of goals, a process for evaluating adaptive management needs, recommendations for best management practices to achieve goals, and monitoring of compliance and effectiveness of the management practices (Herrick et al 2012). Adaptive management can be generally defined as an iterative decision-making process that incorporates formulation of management objectives; actions designed to address these objectives and applied in a manner to reliably inform future management; monitoring of results; and repeated adaptation of management until desired results are achieved.

Semi-arid, annual-dominated systems such as the District's grasslands often exhibit non-equilibrium ecosystem dynamics: multiple vegetation states exist, transitions between states are not necessarily linear or reversible, predictability is low, and abiotic factors (e.g., weather, soil) rather than biotic interactions (e.g., grazing, competition) tend to drive the system (Bartolome et al. 2007). Jackson and Bartolome (2002) found, on nine California grassland sites that include the area of the District, that when the effects of site and weather were removed only a small portion (about 40%) of the variation in species composition remained. Of that remainder, only about 10% was explained by residual dry matter, a surrogate for grazing intensity.

One of the important findings from the Project is that species composition varies significantly over fairly small scales. This variation hinders the development of simple, generalized management prescriptions, especially if the conservation goal is to maintain and enhance numerous native species simultaneously (Harrison et al. 2003). Research has shown that grazing and other management practices can be effective but that their effects are likely to be very localized or site-specific. This means that management for conservation goals will likely need to be adaptive management and developed for specific objectives with long-term, rigorous monitoring procedures in place (Bartolome et al. 2009).

2.0 General vegetation management and restoration overview

2.1 Valley grassland

Valley grassland is the primary herbaceous vegetation type at the seven parks. The Valley grassland type is found in the foothills surrounding the Central Valley, including the central and southern Coast Ranges, and parts of the Transverse and Peninsular Ranges (Bartolome et al. 2007). Non-native annual plants have dominated this grassland type for many decades, and in most areas, including the East Bay, native plants make up only a very small percentage of the total grassland cover (see for example 2007 annual report). Despite this, numerous native species remain and can make up a significant proportion of the species richness. The majority of these native Valley grassland species are forbs (more generally known as wildflowers).

On slight evidence, it has long been posited that perennial bunchgrasses, in particular purple needlegrass (*Nassella pulchra*[1]), dominated the "original" Valley grassland (with native annual forbs filling the interstices) (Bartolome et al. 2007). Consequently, conservation research has, until recently, focused almost exclusively on purple needlegrass (Bartolome et al. 2007). In the last several years, other native grass species and the sizable native forb component of the Valley grassland have received attention, but knowledge is still in the formative stages. However, it is important to understand that the species composition, dominance relationships, cover, and many of the ecosystem processes of the pre-European contact Valley grassland are largely unknown and probably unknowable (Schiffman 2007a, b; Reiner 2007; D'Antonio et al. 2002).

The factors that caused the conversion of the "original" Valley grassland to a non-native annual-dominated ecosystem are unknown, although several have been proposed, including intensive livestock grazing and agricultural cultivation in the 19th century, drought in the mid-1880s, and the introduction of competitively superior non-native species. Unfortunately, simply ceasing the accused land-use activities does not reverse the type conversion in most cases (Harrison et al. 2003). Many studies have shown that stopping livestock grazing or agricultural cultivation does not lead to increased native dominance, even after several decades (D'Antonio et al. 2002; Keeley et al. 2003). Therefore, even if the composition of the "original" Valley grassland is unknown, it is likely that pro-active conservation management and restoration would be necessary (although possibly not sufficient) for landscape-scale recovery of native-dominated Valley grasslands.

The Valley grassland exhibits considerable spatial and temporal variation at many scales. Annual rainfall amount and pattern, temperature during the growing season, variation in soil chemistry and texture, topographic variation, and land-use history, among other variables, affect species composition, biomass production, and dominance relationships. One of the important findings from the Project is that species composition varies significantly over fairly small scales. For example, Vasco Caves plant species community changes drastically between the "exotic" and "native" areas stratified by the Project; native area plots have high levels of purple needlegrass cover or native species richness and yet within the boundaries of the park there are plot locations where there is very little to zero native plant cover or richness (also see 2006 annual report). This variation hinders the development of simple, generalized management

[1] All plant scientific names follow the first edition of *The Jepson Manual* (Hickman 1993), although as of the date of this report, the second edition of the *Manual* is available.

prescriptions, especially if the conservation goal is to maintain and enhance numerous native species simultaneously (Harrison et al. 2003). Research has shown that grazing and other management practices can be effective but that their effects are likely to be highly site-specific. This means that management for conservation goals will likely need to be adaptive and developed for specific objectives with long-term, rigorous monitoring procedures in place (Bartolome et al. 2009).

2.2 Livestock grazing

Semi-arid, annual-dominated systems such as the Valley grassland often exhibit non-equilibrium ecosystem dynamics: multiple vegetation states exist, transitions between states are not necessarily linear or reversible, predictability is low, and abiotic factors (e.g., weather, soil) rather than biotic interactions (e.g., grazing, competition) tend to drive the system (Bartolome et al. 2007; Jackson and Bartolome 2002). In the Valley grassland, variation in annual weather conditions and in soil characteristics has an over-riding influence on the vegetation. Management activities such as livestock grazing may achieve small-scale vegetation goals, but they generally do not cause spatially or temporally consistent changes in grassland community composition at the landscape level (Jackson and Bartolome 2002).

Livestock grazing is a complex ecosystem process for which management involves site-specific control of intensity, timing, and distribution (Jackson and Bartolome 2007). This complexity has reduced the generality of results from grazing experiments. For example, an evaluation of 30 grazing studies in California grasslands showed that effects on vegetation were primarily dependent on soil properties and weather, with variable and probably site-dependent effects of the grazing treatments (Huntsinger et al. 2007).

In their comprehensive review of grazing studies in California grasslands, D'Antonio et al. (2002) reported that a meta-analysis suggested livestock grazing had a positive effect on native plant species, especially perennial grasses. They found that livestock grazing had little effect on native forbs as a functional group, although other studies have shown both positive and negative grazing effects on native forbs, probably due to site-, time-, and/or species-specific factors (Jackson and Bartolome 2007; HilleRisLambers et al. 2010). The results from the Project indicate that in those parks with a native species component, grazed sites generally have higher native plant diversity than ungrazed sites do (see 2006 and 2009 annual reports).

Purple needlegrass, the state's most intensively studied native grass, has shown varied responses to grazing: increasing in some instances, decreasing in others, or exhibiting no change (D'Antonio et al. 2002). Again, inconsistent responses probably reflect site- and/or time-specific factors rarely evaluated in grazing studies. One previous study in the East Bay (Sather Canyon on EBMUD property), that specifically looked at the effect of cattle grazing on purple needlegrass, found that cover of the bunchgrass increased most with spring grazing compared to continuous or summer grazing (Bartolome et al. 2004). However, because such studies are usually site- and year-dependent, purple needlegrass monitoring would be necessary to determine if these results would hold true on District property. Because this Project was set up to evaluate the effect of livestock grazing on the Valley grassland species community, it is not possible to generate specific trends for individual plant species. The data generated by the Project can only suggest that purple needlegrass populations in the District fluctuate due to causes other than livestock grazing, probably weather-related factors (see 2009 annual report).

There is some limited evidence to suggest that other California native perennial grass species react differently to grazing (Dennis 1989). Therefore, a grazing system that maintains a mosaic of grazing timings and intensities over the landscape level may optimize native perennial grass biodiversity (Huntsinger et al. 2007; D'Antonio et al. 2002); the same almost certainly also holds true for the numerous native forbs of the Valley grassland.

Livestock grazing can also be used to control invasive species. Several of the major Valley grassland invasive species found on District property can be reduced, if not entirely eliminated, with grazing, e.g., yellow starthistle (*Centaurea solstitialis*) and medusahead (*Taeniatherum caput-medusae*) (Jackson and Bartolome 2007). Grazing prescriptions for the control of specific invasives must be designed carefully because grazing can actually benefit target weed species if improperly timed (Huntsinger et al. 2007). See Section 3.0 for further details.

In addition to invasive species control, livestock can be employed as a management tool for several other purposes (Barry et al. 2006). By changing vegetation structure primarily (but potentially species composition too), livestock can improve wildlife habitat (e.g., Germano et al. 2001; Fuhlendorf and Engle 2001). Livestock are also commonly used to manage herbaceous and woody wildland fuel (e.g., Nader et al. 2007).

2.3 Grassland restoration considerations

Ecosystem restoration can be approached in two different ways, active restoration or passive restoration, depending on the desired scale of restoration, site characteristics, and resources available for restoration (Stromberg et al. 2007). Active restoration requires resource-intensive activities, such as native species planting and ongoing weed eradication. Generally, active restoration is applied to fairly small areas (typically under 100 acres and often much smaller (Stromberg et al. 2007)) and can require substantial financial and labor resources. Passive restoration entails tailoring standard management tools, such as burning or grazing, to specific restoration goals. Passive restoration is generally less expensive per unit area than active restoration and, importantly, can be applied at the landscape-level. This report's grassland restoration suggestions will take a passive restoration approach, i.e., a management approach tailored to conservation goals.

Before designing a Valley grassland restoration plan, it is necessary to realize that the goal of returning to a pristine, exclusively native ecosystem is unrealistic. Obstacles preventing the restoration of a pristine Valley grassland include: extremely limited knowledge about the "original," pre-contact Valley grassland, missing pieces of the ecosystem (e.g., grizzly bears (Schiffman 2000, 2007b)), possibly irreversible changes in climate and soil characteristics, and the ubiquity of non-native grasses and forbs (Stromberg et al. 2007). However, within reach may be the goal of "creating a landscape that is more weed-resistant, maintains its productivity over time and other ecosystem services, and is somewhat tolerant or resilient to a variety of stresses" (Stromberg et al. 2007: 254) and that contains greater native plant diversity and provides higher-quality habitat for wildlife.

Arguably, the most significant obstacle to landscape-level (and smaller-scale) restoration success is the dominance of the Valley grassland by naturalized, non-native annual grasses and forbs (Stromberg et al. 2007). Figuring out how to reduce the space occupied by these naturalized plants and their competitive impact on water, light, and nutrients in favor of native plants is a major research challenge. The ability of some of these naturalized species to persist at high cover over a wide range of environmental conditions is impressive. For example, we analyzed to what degree the cover of common species fluctuated over five years of the Project, including wet, drought, and average years, within plots in six parks. The ubiquitous annual grasses, soft chess (*Bromus hordeaceus*) and common wild oats (*Avena fatua*), were the most stable species, producing significant cover every year and in most plots (see 2007 annual report for details). Both species appear to have broad environmental tolerances, making the task of reducing their abundance a perplexing undertaking.

Land-use history can play an important role in the conservation and restoration potential of a site. Several California grassland researchers, including a graduate student from the Project, have noted that native perennial bunchgrasses and native annual forbs are generally not found in former agricultural fields (Stromberg and Griffin 1996; Hamilton et al. 2002; Robertson 2004). At sites with a known cultivation history and a concomitant low abundance of native species (like Brushy Peak), Valley grassland restoration may be more challenging and expensive. Determining land-use history can, therefore, inform prioritization of sites for restoration.

Another large-scale restoration concern is the impact of nitrogen deposition from automobile exhaust and other sources (Weiss 2006, 1999). Some parts of the East Bay receive significant nitrogen deposition (Tonnesen et al. 2007), including areas near Brushy Peak and Chabot-Fairmont Ridge. Weiss (2006: vii, 1) explains the consequences:

> Atmospheric nitrogen deposition alters the structure and function of terrestrial ecosystems, because nitrogen is often a primary limiting nutrient on overall productivity. These alterations can drive losses of biodiversity, as nitrophilous species increase in abundance and outcompete species adapted to more oligotrophic conditions. . . The major documented impact of N-deposition on California terrestrial biodiversity is to increase growth and dominance of invasive annual grasses in low biomass ecosystems such as coastal sage scrub, serpentine grassland, and desert scrub. . . , resulting in species loss.

At least part of the grassland at Chabot-Fairmont Ridge is on serpentine soil, an environmental condition generally associated with high native biodiversity (Sánchez-Mata 2007); the park is also adjacent to a high-use freeway, I-580. Weiss (1999) describes the loss of native plant and animal diversity at serpentine grassland sites in south San Jose, adjacent to I-101, due to high levels of nitrogen deposition. Non-native grasses, particularly Italian ryegrass (*Lolium multiflorum*), also common in many District grasslands (see 2006 annual report), successfully invaded Weiss' serpentine sites, probably due to the fertilizing effect of the nitrogen; native forb cover, including larval host plants, dropped precipitously, resulting in the local extinction of the threatened Bay checkerspot butterfly (*Euphydryas editha bayensis*). Measuring nitrogen deposition is difficult, but Weiss (1999) estimates that for the Bay Area, 3-5 lbs of total nitrogen/acre/year is on the lower end, while 9-13 lbs of total nitrogen /acre/year, the level at his San Jose sites, is high and appears to have significant ecosystem effects. In the absence of better societal control of nitrogen pollution, Weiss (1999) recommends cattle grazing as a solution: cows generally prefer grass to forbs and so will typically eat the non-native grass and leave the native forbs. Several studies including Weiss' (1999) have shown that cattle-grazing maintains native forb diversity in some California grasslands.

The implications of high nitrogen deposition in <u>non-serpentine</u> Valley grassland are unknown. For the most part, this community is already dominated by non-native grasses, and native cover is commonly <5% (see 2006 annual report). Whether increased nitrogen makes the situation even worse remains to be seen. Almost all of the Project's study sites are non-serpentine Valley grassland, and at least two of the parks, Brushy Peak and Chabot-Fairmont Ridge, have levels of nitrogen deposition approaching the high level (Table 2-1). Please see Appendix D for a nitrogen deposition table for all plots within the parks.

Table 2-1: Total nitrogen deposition (lbs/acre/year) estimates, from California model developed by Tonnesen et al. (2007); Total N deposition for each park is an average over all park's plots; level of N deposition from Weiss (1999)

Park	Total N (lbs/ac/year)	N deposition level
Brushy Peak	8.9	Medium
Chabot-Fairmont Ridge	8.7	Medium
Morgan Territory	5.4	Low
Pleasanton Ridge	6.7	Medium
Sunol-Ohlone	5.4	Low
Sycamore Valley	5.0	Low
Vasco Caves	6.5	Medium

A vital restoration consideration is whether there is an adequate in-situ source of native seed, either from plants adjacent to the restoration site or within the site's soil seed bank. Recent studies have found that many native species are strongly seed-limited and that when native seed is added to a seed-poor site, cover of native species increases significantly (Corbin et al. 2007). In parks with very low levels of native cover (e.g., Sycamore Valley and Brushy Peak), only active grassland restoration strategies that introduce native seed or plant material are likely to have a chance of success in increasing native plant abundance. However, in parks with high levels of native cover and diversity such as Chabot-Fairmont Ridge and Sunol-Ohlone, on-site stocks of natives may increase following passive restoration activities.

Another essential consideration is spatial variation in soil characteristics, such as nutrients, texture, and pH. Data from the Project were used in an analysis that found that cover of the native bunchgrass purple needlegrass (*Nassella pulchra*) was strongly associated with low phosphorus in sandy soils, and that native species richness (mostly forbs) was highest in soils with low available nitrogen (Gea-Izquierdo et al. 2007). The implication of these results is that low fertility soils may provide refugia for native species; such soils may fall below the threshold required for non-native annuals to completely dominate a site (Gea-Izquierdo et al. 2007). Unfortunately, soil fertility typically varies on a smaller scale than soil mapping units, and the pattern of variation is likely to be highly site-specific. Assessing these spatial patterns is likely to require small-scale analysis of soil nutrients, which can be cost-prohibitive on a landscape-scale.

3.0 Invasive species control overview

Three major invasive plant species have been observed in our study plots: yellow starthistle (*Centaurea solstitialis*), fennel (*Foeniculum vulgare*), and medusahead (*Taeniatherum caput-medusae*). All three species are major Valley grassland weeds, especially yellow starthistle and medusahead (DiTomaso et al. 2007). Yellow starthistle was found in all seven parks; fennel at Brushy Peak, Chabot-Fairmont Ridge, and Sunol-Ohlone; and medusahead at Morgan Territory, Pleasanton Ridge, and Sunol-Ohlone. These invasive species are rated as "high" in the California Invasive Plant Council's Invasive Plant Inventory (Cal-IPC 2006)[2]. Cal-IPC describes species with an invasive plant score of "high" as follows: "These species have severe ecological impacts on ecosystems, plant and animal communities, and vegetational structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. These species are usually widely distributed ecologically, both among and within ecosystems" (Cal-IPC 2003a: 4).

In addition to these three major invasives, three other species of concern were encountered. Black mustard (*Brassica nigra*) was found at six of the seven parks (never found on plot at Pleasanton Ridge) and is particularly notable in ungrazed areas of Sycamore Valley and in areas of Vasco Caves with soil disturbance. Harding grass (*Phalaris aquatica*) is found at Chabot-Fairmont Ridge and Sycamore Valley. Purple false-brome (*Brachypodium distachyon*) was found at four of the seven parks (never on plot at Brushy Peak and Sycamore Valley; only once at Vasco Caves). Cal-IPC rates these three species with an invasive plant score of "moderate" (Cal-IPC 2006). Although several of the common Valley grassland species found in the parks are rated as "moderate" (see Appendix B for full species lists), we highlight these three "moderate" invasive species because they can form near-monocultures and displace other species (black mustard and Harding grass) or may be spreading on District properties (purple false-brome; see 2007 and 2009 annual reports).

In general, invasive species that are not already ubiquitous should be categorized as top priority for eradication of newly located populations (DiTomaso et al. 2007). Early detection of and rapid response to small populations of potentially harmful invasive plants is increasingly considered an effective method of preventing invasives from becoming widespread, and thus almost certainly not eradicable and expensive even to control (DiTomaso et al. 2007).

3.1 Yellow starthistle

Yellow starthistle is one of the worst grassland weeds in California, occupying over 3 million hectares of California grasslands and continuing to spread (Bossard and Randall 2007). Much research effort has been devoted to the control of yellow starthistle in California (DiTomaso et al. 2006), and several management activities, including prescribed burning, livestock grazing, herbicide application, and biological control by insects, can help control, if not eliminate, the species (DiTomaso et al. 2007). Grazing prescriptions must be carefully designed because research has shown that grazing yellow starthistle at the wrong phenological stage can actually benefit the plant, and excessive trampling by livestock can increase yellow starthistle density (Huntsinger et al. 2007). In addition, yellow starthistle is toxic to horses.

[2] An additional species, red brome (*Bromus madritensis* ssp. *rubens*), found at several of the parks and rated by Cal-IPC as "high", is not discussed here because its high Cal-IPC rating is due to the species' deleterious effects in the Mojave Desert; in the Valley grassland, red brome is not likely to have severe ecological impacts (Cal-IPC 2003b).

Bossard et al. (2000) report that intensive grazing of yellow starthistle by sheep, goats, or cattle before the spiny stage but after bolting can reduce biomass and seed production. DiTomaso et al. (2007) describe a successful long-term control program using a prescribed burn in the first year, followed by a second-year clopyralid treatment. Bossard et al. (2000) recommend burning after native species have dispersed their seeds but before yellow starthistle produces viable seed in the summer months. Unfortunately, use of prescribed burning may increase other undesirable plants, such as black mustard.

3.2 Fennel

Fennel is a perennial that can reproduce rapidly and form monocultural stands in annual grassland and other vegetation communities in California (Bossard et al. 2000; Bell et al. 2008). There is limited published research on control of fennel (Bell et al. 2008). Livestock grazing in infested areas can spread fennel seed into uninfested areas (Bossard et al. 2000). Bell et al. (2008) evaluated several variations of herbicidal fennel control and concluded that for large infestations of fennel, broadcast application, rather than spot spraying, of several combinations of triclopyr and glyphosate was the most effective method (typically >90% control after 1 year), with negligible injury to purple needlegrass. Fall burning with 2 years of subsequent herbicide application to new foliage during the growth period can also control large fennel stands (DiTomaso and Healy 2007). Gwinn (2009) investigated control of small fennel infestations and found that chopping each plant close to the base and then immediately spraying it with glyphosate was almost as effective (96% control) as digging plants out and considerably less expensive than digging.

3.3 Medusahead

Medusahead, a non-native, annual grass, is a noxious rangeland weed, increasing in California and the western U.S. (DiTomaso and Healy 2007). Medusahead and yellow starthistle are the two most common invasives in the Valley grassland (DiTomaso et al. 2007). Medusahead can form dense stands and persistent thatch layers that displace native species and reduce forage values and wildlife habitat (DiTomaso and Healy 2007). Its awns can injure grazing animals, and its thatch layer can increase fuel for wildfire (DiTomaso and Healy 2007).

Several methods of medusahead control have been investigated. Burning under certain prescriptions can reduce populations, and a crown rot fungus is under evaluation (DiTomaso and Healy 2007; Kyser et al. 2008). Although livestock typically avoid medusahead as it matures, DiTomaso et al. (2007) report that high intensity grazing by sheep in April and May can reduce populations significantly. Kyser et al. (2007) evaluates medusahead control with imazapic.

3.4 Black mustard

Dense stands of black mustard, which grows up to 6 feet tall, can occupy large areas and outcompete other species, including native plants. It accomplishes this both by shading out smaller-statured species and by producing allelopathic compounds that inhibit germination and growth of other species (DiTomaso and Healy 2007; Bell and Muller 1973). Black mustard also matures early and so may reduce soil water availability to other plants (Cal-IPC 2003b). Furthermore, black mustard produces a large and persistent (50+ years) seedbank (DiTomaso and Healy 2007).

Control of black mustard has proven difficult to accomplish in California grasslands. Burning usually results in increased black mustard cover (DiTomaso and Healy 2007).

Anecdotally, cattle may reduce cover of black mustard by trampling, and sheep can completely strip mustard of all foliage (P. Hopkinson, pers. obs.), though whether these are effective controls in the long-term is unknown.

DiTomaso and Healy (2007) note that annual removal of black mustard before seeds mature can eventually deplete the seedbank. This technique was initiated on a San Clemente Island site by a group from San Diego State University (Soil Ecology and Research Group 2003). In areas without sensitive native species, treatment included application of 2% glyphosphate solution and removal of flowers and seedheads with string trimmers; in areas with sensitive species, only the mechanical treatment was used. Sites were then planted with native seedlings. Unfortunately, follow-up data were not collected, but in the absence of further treatment, black mustard appears to have reoccupied the site (E. Howe, San Diego State University, pers. comm., March 2010). Such labor-intensive treatments are likely to be expensive to implement. However, for small infestations with few associated sensitive species, an annual herbicide and mechanical control program may be worth considering.

3.5 Harding grass

Harding grass is a non-native, perennial grass that has been widely planted as a forage species. Cultivars were developed in California in the 1940s, and during the first two post-war decades, Harding grass was extensively seeded for range improvement, post-fire revegetation, and erosion control in California (EBRPD 2005; Barry 2007). For example, in the 1950s, the rancher who owned Sycamore Valley before the District seeded 90 acres to “Sunol-grass”, a Harding grass cultivar (EBRPD 2005). Despite its use as a forage species, Harding grass can be toxic to livestock, causing a neurological condition known as phalaris staggers (DiTomaso and Healy 2007). Although Harding grass has difficulty establishing, once established, it often forms dense stands, displacing other species (DiTomaso and Healy 2007).

Bossard et al. (2000) suggest that burning after mid-January may help control Harding grass. Glyphosate and other herbicides are also effective in controlling Harding grass; following herbicidal control, revegetation with desirable species can help eliminate newly emerging Harding grass seedlings (Bossard et al. 2000).

3.6 Purple false-brome

Purple false-brome, a non-native, annual grass, may be spreading regionally and locally in California (Cal-IPC 2003c), including on District properties (see 2007 and 2009 annual reports). During the course of the study, it has been the dominant species on several plots. The ecological impacts of purple false-brome are unknown, although the Cal-IPC’s Plant Assessment Form (Cal-IPC 2003c) for this species notes that purple false-brome can “form dense stands in some locations, particularly in oak woodlands” which could “reduce diversity and prevent native species from establishing”. In addition, DiTomaso and Healy (2007) note that purple false-brome makes poor forage because it has fibrous stems, sparse foliage, and long awns, which can also injure animals.

Unfortunately, almost no information about control of this grass was found (DiTomaso and Healy 2007; Gelbard 2004). Gelbard (2004) briefly notes that asulox may provide some control. The Conservation Biology Institute (CBI) in collaboration with San Diego State University is currently conducting purple false-brome control trials with herbicide (Fusillade II) and mowing in San Diego. Preliminary results after the first year indicate some measure of control with both the herbicide and the mowing; effects on neighboring species have not yet been evaluated (pers. comm., Patricia Gordon-Reedy, CBI, March 2012).

4.0 Vegetation monitoring and adaptive management overview

Monitoring accomplishes two objectives: 1) effectiveness monitoring determines if management actions are achieving the desired results; and 2) compliance monitoring determines if an action complies with expectations or regulations (necessary for monitoring livestock programs) (Bush 2006). The results from a properly designed monitoring program provide guidance both for effectiveness and compliance and are used to improve management practices. A good monitoring program efficiently produces the information required to accomplish stated goals at minimum cost.

Developing management goals is an essential preliminary step in designing a monitoring program: you have to know why you are monitoring and for what you are monitoring before you can decide how to monitor. Different goals will require different monitoring methods.

In addition, an evaluation of the funding and personnel available for monitoring is necessary before a monitoring program can be designed. Different monitoring methods and levels of monitoring intensity will vary in cost and will produce information that varies in precision and accuracy (Elzinga et al. 1998). The level of precision and accuracy necessary depends on the management goals.

The purpose of these two initial steps is to ensure that the monitoring program provides the necessary data to meet management goals at the lowest cost.

4.1 Developing vegetation management goals

First, priorities must be set. District staff have described their conservation management priorities as focusing on:

1) maintaining or if possible enhancing native plant abundance,
2) controlling invasive plant species, and
3) determining the effect of livestock grazing on native plant populations.

A monitoring program may, therefore, want to collect data that measure trends in the dynamics of native and invasive plants and that compares grazed and ungrazed plots.

Second, the appropriate spatial scale and time/cost intensity of the monitoring need to be determined. Deciding on the spatial scale and the time/cost intensity involves assessing the trade-off between costs and the underlying variability of the resource being monitored. The District has indicated that it would like to monitor its grassland areas at a landscape scale, as well as on a local scale such as a rare plant population, so large areas may be monitored.

The Project's analyses indicate that the District's grasslands are fairly heterogeneous. Species composition and cover (especially of native plants) vary significantly from park to park and even within a park from plot to plot. In addition, composition and cover can fluctuate drastically from year to year due to weather. These sources of natural variation may be so large that they drown out differences caused by management activities. Because the District's grasslands exhibit high variability in space and time, monitoring may need to be intensive to discern differences caused by management.

Ideally, monitoring should occur at enough locations within a park and within a management type (e.g., grazed or ungrazed) to account for spatial variation; exactly how many locations depends on the magnitude of change (for example, a 25% increase or decrease in yellow starthistle or in purple needlegrass) the District wants to be able to detect and can afford to detect.

In theory, monitoring should occur annually at each location to account for year-to-year variation. However, the Project analyses suggest that temporal variation is not as great as generally believed and that longer monitoring cycles may suffice; that is, monitoring every few years may provide adequate data to discern trends in the native vegetation (see monitoring suggestions from 2006 and 2009 annual reports). In addition, much of the Valley grassland's year-to-year variation is caused by seasonal rainfall and temperature rather than management activities so general trends over 5 to 10 year periods may be more suitable for native species management purposes than focusing on changes from one year to the next. Given their potential for rapid spread, annual monitoring may be more appropriate for invasive species.

Native cover in all of the Project study areas, except Sunol-Ohlone, is largely a function of purple needlegrass (*Nassella pulchra*), the most abundant native species in the study. For the most part, purple needlegrass grows in fairly circumscribed populations rather than as individual plants scattered uniformly throughout a park. Sunol-Ohlone has large areas of abundant native forb cover, especially on Valpe Ridge. However, in parks without large purple needlegrass populations or abundant native forbs, native species cover is high only over very small areas or in favorable years. In most of the Project parks, native grassland species occur at very low cover (<1%). Detecting change in the cover of these infrequently-occurring species would entail an intensive monitoring effort. Monitoring native cover, therefore, is probably cost-effective only in locations with large purple needlegrass populations and in native forb-dominated areas, such as those at Valpe Ridge. For other parks, monitoring native species richness (the number of native species) is likely to prove the more suitable and cost-effective monitoring method.

We offer the following as examples of general management goals for each park:

- maintain native species richness in parks with fairly low native cover (e.g., Brushy Peak, Sycamore Valley);
- maintain purple needlegrass cover at parks with a significant population (e.g., Chabot-Fairmont Ridge, Pleasanton Ridge, Vasco Caves);
- maintain native forb cover and species richness at parks with areas of significant forb cover (e.g., Sunol-Ohlone); and
- reduce or eliminate cover of invasive plants (e.g., Sycamore Valley, Sunol-Ohlone).

Various management activities may be implemented to achieve these goals, and the success of the management activities is evaluated through monitoring tailored to assess the specific management goals.

4.2 Effectiveness monitoring

Effectiveness monitoring is usually more complex and expensive than compliance monitoring and requires longer-term data collection. The general approach to effectiveness monitoring is to establish permanent plot locations and measure critical response variables. Plots can be located in areas both representative of vegetation types and in areas of special concern such as perennial-rich grasslands, areas with grazing-affected listed species, and sites with invasive species.

Once management goals have been defined, effectiveness monitoring methods appropriate for assessing progress towards the desired goals can be selected. Based on the

potential management goals above, the District's monitoring objectives might be, for example, to determine:
1) whether native species richness exhibits a decreasing, static, or increasing trend over 5 years at a specified site;
2) whether this trend in native species richness is related to grazing status of the site;
3) whether purple needlegrass cover exhibits a decreasing, static, or increasing trend over 5 years at a specified site;
4) whether this trend in purple needlegrass cover is related to grazing status of the site;
5) whether invasive species cover is changing significantly from year to year on a site; and
6) whether significant invasive cover change is related to grazing status (or herbicide use or prescribed fire).

Table 4-1 lists effectiveness monitoring methods, ranked from least to most expensive, the kind of information that the method provides, and the goals that each method is best suited to meet. By matching goals with appropriate methods, a suitable monitoring methodology can be developed. For example, the District may wish to establish permanent relevé plots in forb rich areas and visually estimate cover of all species occurring in the relevé. The relevé plot method generates data on rare species, is fairly time- and labor-efficient, and is likely to provide data robust enough for adaptive management needs. It is a technique used by the California Native Plant Society for classifying vegetation and so could allow for comparisons between District data and alliances in the new *Manual of California Vegetation* (Sawyer et al. 2009).

Permanent (i.e., at a GPS-ed location) photo points retaken every year can be an inexpensive but broadly effective method of monitoring for large changes in cover of invasive plants like yellow starthistle and black mustard. Line-point transects work well to monitor cover of a dominant species, including purple needlegrass in areas where it is abundant. Transects would also be useful for monitoring cover of native forbs in areas such as Valpe Ridge that have abundant cover of multiple forb species. Frequency plots are also a time- and labor-efficient method of evaluating changes in abundance of a species of interest (e.g., yellow starthistle or purple needlegrass) and may be easier to implement than line-point transects. The District may wish to use some of the pre-existing Project research plots (but perhaps sampling fewer points) if feasible so as to maintain the long-term dataset, especially for the grazed-ungrazed comparison plots. Please see Appendix C for further information on monitoring methodology.

Table 4-1: Vegetation effectiveness monitoring methods, ranked based on relative cost of the technique and how much information the technique generates: from top to bottom – inexpensive to expensive, limited information to most information

Sampling method	Data generated	Typical goals
Permanent photo points	Visual evidence of large changes in biomass and species composition	Independent check on plant changes indicated by quantitative data; changes in abundance for some invasive species; public presentations
Species list	Species richness, presence of species	Changes in species richness; presence or absence of species of concern (rare species, invasive species)

Frequency	Presence/absence of species of interest	Broad changes in species abundance, estimates of species richness
Cover: relevé plot	Small-scale cover, including rare species; species richness, including rare species;	Presence of rare plants; localized changes in species composition, richness, and abundance
Cover: line-point transects	Cover of dominant species especially; species richness	Changes in species composition, abundance; estimates of species richness; functional group analysis; effect of management
Density	Number of individuals of species of interest	Demographic trends in plant populations, vulnerable life-history stages (e.g., germination, seedling)
Residual dry matter (RDM) sampling	Dry weight of above ground biomass	Monitoring distribution and intensity of grazing; compliance with minimum RDM standards
Biomass	Dry weight of (above ground) biomass of species of interest	Production of individual species

An important component of effectiveness monitoring is the continuous process of developing, through monitoring, a response dataset that is adequate for testing the effectiveness of management actions in achieving management goals and then using the dataset to refine specific management goals and actions: a process often called adaptive management (Reever-Morghan et al. 2006). An adaptive management process can be a powerful tool for creating data-based feedback that improves management outcomes.

The crux of adaptive management is to monitor both areas under management and control areas (locations in which management is not applied but which are as similar as possible to the areas under management). Generally, a quasi-experimental monitoring design is desirable, with multiple management and control plots (replication), as well as randomized location of plots and randomized assignment of treatment(s) to plots if feasible. Monitoring data must then be analyzed and, importantly, the analysis fed back into the management decision-making process. For example, establishing a paired grazed/ungrazed plot monitoring program would allow the District to evaluate site-specific effects of the grazing program. Adaptive management techniques can also help determine which invasive control techniques are most effective. Such an approach may be especially useful for conservation management plans that focus on native species restoration; because so little is known about successful restoration techniques for many native species, especially forbs, and because successful outcomes often appear to be site-specific, a quasi-experimental, adaptive management approach may be the most efficient method of developing knowledge about effective restoration techniques for a specific area.

4.3 Compliance monitoring, including RDM monitoring for livestock-grazed areas

Compliance monitoring determines whether an action complies with the expectations or regulations of a management program. For a livestock grazing program, compliance monitoring might collect information, based on lease provisions or similar program controls, about the number of animals, timing of livestock grazing, distribution of livestock grazing, and the intensity of livestock grazing:

1) Number of animals: Livestock can be counted as they are brought on to the property. Because counts are supervised by responsible range personnel, bringing animals on requires prior notification. These counts can be used to verify compliance of the lessee or livestock operator to an animal unit month (AUM) specification of a lease. AUMs are standard measurements for grazing intensity and, coupled with RDM monitoring, are an important component of livestock grazing management (Bush 2006).

2) The presence of animals (timing and distribution of grazing) on a property can be documented by regular surveys by responsible range personnel.

3) The distribution and intensity of grazing can be monitored through assessment of residual dry matter (RDM). Traditionally, the standard method for monitoring RDM requires the establishment of several permanent monitoring locations in a grazed site. In each location, RDM is determined in early fall, before the onset of germinating rain, through the use of photo guides and the comparative yield method (Bartolome et al. 2006; Bush 2006; Guenther and Hayes 2008).

More recently, the RDM mapping technique has been developed and implemented in California, an innovation that allows for a clearer picture of the spatial distribution of RDM. RDM mapping is easy to learn and often requires less time to complete than the traditional permanent plot-based method, while still producing robust information. Sites with too little or too much RDM can be quickly identified, and solutions based on manipulating animal distribution may also be more easily developed. RDM mapping is the RDM monitoring technique that we recommend the District consider. The traditional plot-based technique would also be a suitable RDM monitoring method. Please see Appendix C for further information on RDM monitoring methods.

If RDM minimum standards are not achieved over a sizable area, stocking rate for the following year can be adjusted. See Table 4-2 for current recommended minimum RDM standards for California's coastal and foothill annual grassland (Bartolome et al. 2006). Note that these are minimum standards, and range managers may choose to leave greater RDM for conservation, habitat, or other purposes.

Table 4-2: current recommended minimum RDM standards for annual grassland (Bartolome et al. 2006)

0-10 % slope	**10-20 % slope**	**20-40 % slope**	**>40 % slope**
500 lbs/acre	600 lbs/acre	700 lbs/acre	800 lbs/acre

5.0 Vegetation management and monitoring options for individual parks

The District may wish to develop park-specific vegetation management plans with goals and objectives informed by vegetation mapping, habitat assessment, and data on plant and animal species of concern for that park. If this information is not available for a park, the District may wish to generate the information before creating a management plan.

For each park, we provide 1) management and monitoring options, 2) a site description with a table of the ten highest cover species and of all native species found on plot, 3) a land-use history[3] that highlights implications for current vegetation management, and 4) an aerial photograph map of plot locations. Please see Appendix B for complete species lists for each park and Appendix G for plot centroid coordinates for each plot in all parks.

5.1 Brushy Peak Regional Preserve

Park summary and options

Over the course of the Project, we sampled thirteen plots at Brushy Peak Regional Preserve (Figures 5.1-1 and 5.1-2). Six of the plots (BP4-9) occurred in annual Valley grassland and had among the lowest levels of native species in the study; these six plots were sampled from 2003 through 2007. Three plots (BP1-3) were located in a wet, alkaline zone and supported high cover of native perennial grasses and forbs; the three wet plots were sampled from 2002 through 2004. These nine plots were seasonally grazed by stocker cattle. There also were an additional four Valley grassland plots (BP11-13) sampled in 2003 only, as part of master's thesis research (Figure 5.1-2).

In the six years that we sampled at Brushy Peak, we observed 22 native species, including 6 grasses, 14 forbs, and at least 2 non-grass graminoids; and we observed approximately 45 non-native species.

Invasive plants management

Two major pest plant species were found on plot at Brushy Peak: yellow starthistle (*Centaurea solstitialis*) and fennel (*Foeniculum vulgare*). The District may wish to target these species for control and, if feasible, elimination.

In addition, there is black mustard (*Brassica nigra*) at Brushy Peak, although at low abundance in our plots (<3% absolute cover[4]). Current grazing management probably provides some measure of control for the black mustard.

Grassland restoration considerations

Historical evidence collected as part of the Grassland Monitoring Project shows that the Brushy Peak area was cultivated for wheat in the late 1800s to the early 1900s (Robertson 2004). Researchers, including Robertson (2004), have found that native perennial bunchgrasses and native annual forbs are often absent from areas with a history of cultivation. This may explain in

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[3] Unless otherwise noted, land-use histories for the parks are drawn from District land-use plans provided by District staff.

[4] Unless otherwise noted, all cover values in this report are absolute cover (that is, all transect hits, including non-live plant material such as soil, rock, and litter, are included in the calculation of cover values).

part the low abundance of native species in Brushy Peak's Valley grassland. Valley grassland restoration at Brushy Peak may be more challenging and expensive as a consequence of its land-use history. In addition, the low levels of Valley grassland (upland) native species at Brushy Peak mean natives are probably very seed-limited on site, increasing the difficulty of restoration. In contrast, the wet, alkaline zone already has high levels of native species and so may be suitable for enhancement, for example by weed control and native species planting.

A model of nitrogen deposition for the Bay Area (Tonnesen et al. 2007) suggests that the Brushy Peak area may receive fairly high levels of nitrogen (~9 lbs/acre/year). If this is the case, it may help account for the very high levels of non-native cover over much of the park. Continued cattle grazing at moderate levels may mitigate the impact of the nitrogen fertilization to some extent.

Grazing management

Brushy Peak had seasonal cattle grazing management throughout the years of the Project. However, there were no ungrazed plots within the park so data generated do not elucidate the site-specific impact of grazing compared to no grazing. Livestock grazing probably contributes to black mustard and possibly fennel control at Brushy Peak but may exacerbate the yellow starthistle infestation as stockers (weaned calves grazed for production until shipped for fattening) are only on-site during the spring, a grazing period that can favor yellow starthistle (Huntsinger et al. 2007). When grazing is removed in the summer, yellow starthistle can complete its growth cycle without disturbance and set seed in July.

Based on evidence from other District parks with paired grazed/ungrazed plots, the very low level of native species in the upland grassland at Brushy Peak suggests that grazing makes little difference to presence or cover of any native species in the upland grassland. Because of the deep soils and history of cultivation, nitrogen deposition status, and lack of natives, there are limited opportunities at Brushy Peak for using grazing management to achieve native plant species goals. Livestock grazing can still provide services such as wildlife habitat enhancement and invasive plant and fuel management.

Because the wet, alkaline area is flat, bottom land, cattle tend to congregate there; this livestock use notwithstanding, native plant species are abundant. The high levels of native grasses and the relatively low cover of non-native species in the three wet, alkaline plots are likely driven by abiotic conditions, namely soil chemistry and moisture.

Monitoring

The District may wish to conduct RDM mapping at Brushy Peak for protection of natural resources. Effectiveness monitoring at Brushy Peak could focus on invasive species, especially yellow starthistle and fennel. The areas of infestation could be mapped. Then permanent GPS photo points could be established and photographed every year. If the extent of the population has changed significantly, it could be re-mapped at the same time. Both the permanent photo points and the population extent mapping could be completed at the same time as RDM mapping, if desired. Another option would be to establish frequency plots to monitor these two invasives.

The wet, alkaline vegetation could be mapped, and several permanent photo points established to monitor any notable changes in vegetation. For maximum value, these photo points are sampled in spring while the grasses and forbs are flowering.

Land-use history

Fairly detailed land use history is available for parts of Brushy Peak because Dina Robertson (2004), a graduate student with the Project, investigated the area's land use history for her thesis. The first land-use impact that is potentially relevant to modern management and conservation began with the introduction of livestock grazing in the late 1700s. During the Spanish occupation from 1787-1836, Brushy Peak was within the outskirts of Mission San Jose, which ran a free ranging herd of cattle of 350,000 head. Mexico controlled California by 1836, splitting up Mission San Jose lands and forming two large ranchos encompassing lands of the southern Diablo range (Robertson 2004; EBRPD 2002).

Further split up into individual homesteads for tenant ranchers and farmers until the 1940s, Brushy Peak continued to be grazed by cattle. Native bunchgrass cover is believed by some to have declined following a severe drought in the early 1860s, which may have amplified the effect of the high-intensity cattle grazing. From the late 1800s to early 1900s, dry-land cultivation was also an important land use. During this period, sheep and cattle grazing were often rotated with cultivation. The area including Brushy Peak was sold to local land owners by the 1950s; mixed cultivation and livestock grazing continued as the primary management regimes (Robertson 2004).

By the 1990s, most of the land was incorporated into open space districts and water resource conservation areas and was managed with cattle and sheep grazing (Robertson 2004). In 1994, the Livermore Area Recreation and District acquired land that included Brushy Peak, laying the foundation for the Brushy Peak Regional Preserve.

Brushy Peak's history of cultivation may help to explain its very low cover of native herbaceous species. Several California grassland researchers have noted that native perennial bunchgrasses and native annual forbs are generally not found in former agricultural fields (Stromberg and Griffin 1996; Hamilton et al. 2002; Robertson 2004).

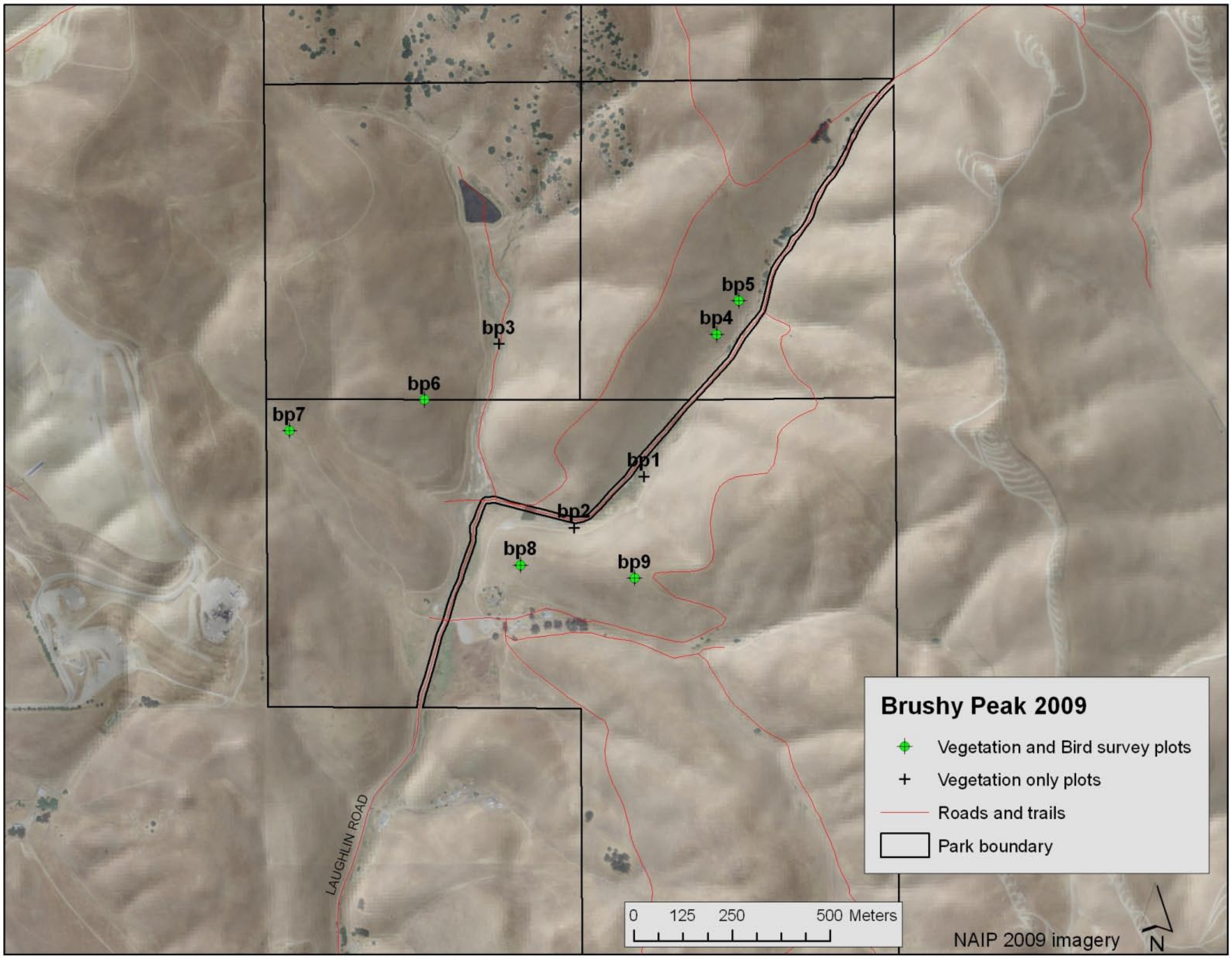

Figure 5.1-1: Brushy Peak plot locations, BP1-9

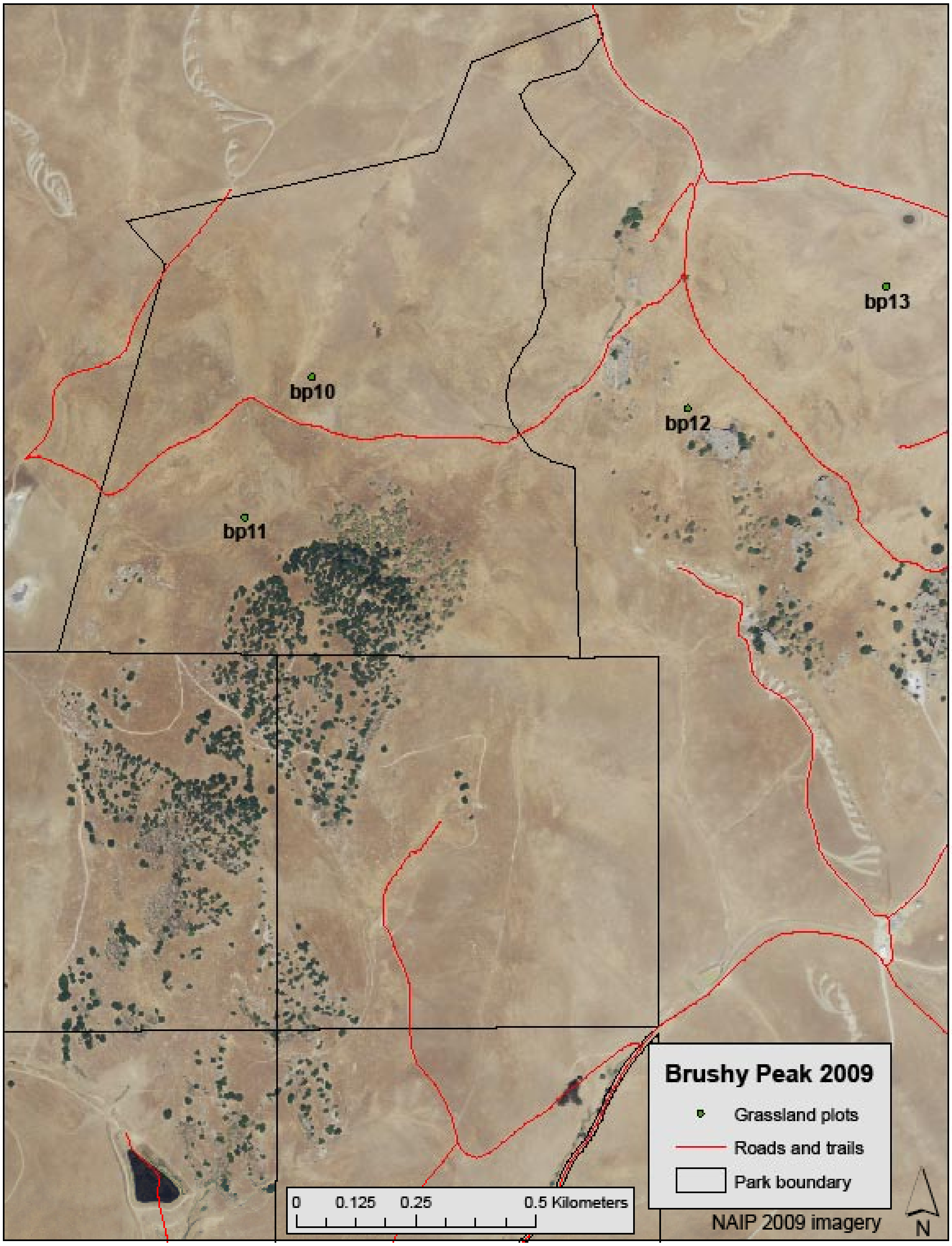

Figure 5.1-2: Brushy Peak plot locations, BP10-13

Full site description and vegetation

Over the course of the Project, we sampled nine primary plots at Brushy Peak, all grazed by stocker cattle. Six of the nine Brushy Peak plots are in the Valley grassland (BP4-9) and were sampled for 5 years, from 2003 through 2007. These six plots were dominated by non-native species (Table 5.1-1) and consistently had among the lowest levels of native plant cover: in the highest native cover year, 2003, the six Valley grassland plots had only 0.9% total native cover (absolute cover; 15 native hits out of 1680 total hits); in 2007, zero native plants were hit on transect (Tables 5.1-2). The total annual number (species richness) of native species found on transect was also low, varying from 0 to 5 (Table 5.1-2). Table 5.1-3 lists all native species either hit on transect or observed within plot at the six Valley grassland plots from 2003-2007.

Table 5.1-1: **Brushy Peak Valley grassland plots (BP4-9)**: top 10 species by percent average annual absolute cover, 2003-2007; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Lolium multiflorum	exotic	Moderate	28
Bromus hordeaceus	exotic	Limited	17
litter			9
soil			7
Erodium cicutarium	exotic	Limited	6
Carduus pycnocephalus	exotic	Moderate	5
Avena fatua	exotic	Moderate	4
Bromus diandrus	exotic	Moderate	3
Hordeum murinum	exotic	Moderate	3
Centaurea sp.	exotic	Moderate/High	2

Table 5.1-2: **Brushy Peak Valley grassland plots (BP4-9)**: percent total annual native absolute cover and total annual native species richness, 2003-2007 (6 plots)

Year	Total native absolute cover (%)	Total native species richness
2003	0.9	4
2004	0.5	3
2005	0.7	5
2006	0.3	3
2007	0.0	0

Table 5.1-3: **Brushy Peak Valley grassland plots (BP4-9)**: native species found 2003-2007, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Native Species	Average absolute cover (%)

Achyrachaena mollis	0.1
Castilleja exserta	0.1
Lupinus microcarpus var. *microcarpus*	0.1
Amsinckia menziesii var. *intermedia*	0.1
Lupinus microcarpus ssp. *densiflorus*	0.05
Leymus triticoides	0.04
Lupinus sp.	0.02
Crassula connata	0.01
Hesperevax sparsiflora	0.01
Achillea millefolium	observed
Amsinckia menziesii	observed
Asclepias fascicularis	observed
Danthonia californica	observed
Eremocarpus setigerus	observed
Eschscholzia californica	observed
Marah fabaceus	observed
Triphysaria pusilla	observed

In contrast to the upland Valley grassland plots, the three wet, alkaline plots (BP1-3) had much higher native species cover (Table 5.1-4), although they were not especially native species rich (Table 5.1-5). These three plots were usually fairly moist and appeared to have alkaline soils. We sampled these plots from 2002 through 2004, after which we narrowed the Project's focus to upland Valley grassland. At least one of the plots (BP2) was submerged under the pond created by the District in 2005 or 2006. Inland saltgrass (*Distichlis spicata*), a native alkaline wetlands grass, dominated 2 of the 3 (BP1 and BP3) plots every year; the third plot (BP2) was dominated by non-native annual grasses but had an appreciable native component. One of the plots (BP3) had >85% native relative cover in all three years.

Table 5.1-4: **Brushy Peak wet, alkaline plots BP1-3**: top 10 species by percent average annual absolute cover, 2002-2004; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
soil			28
Distichlis spicata	native		17
Bromus hordeaceus	exotic	Limited	12
Lolium multiflorum	exotic	Moderate	10
litter			7
Hordeum marinum	exotic	Moderate	6
Hordeum murinum	exotic	Moderate	6
Bromus diandrus	exotic	Moderate	2
Leymus triticoides	native		2
Juncus bufonius	native		1

Table 5.1-5: **Brushy Peak wet, alkaline plots BP1-3**: native species found 2002-2004, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Native Species	Average absolute cover (%)
Distichlis spicata	17
Leymus triticoides	2
Juncus bufonius	1
Juncus sp.	1
Hordeum brachyantherum	1
Carex sp.	1
Frankenia salina	1
Juncus sp. 2003a	0.1
Achillea millefolium	0.04
Amsinckia menziesii var. *intermedia*	0.04
Juncus sp. 2003b	0.04
Puccinellia nuttalliana	0.04
Nassella pulchra	observed

Appendix Table B.1 lists all species, both native and non-native, either hit on transect or observed within plot area at the nine primary Brushy Peak plots from 2002-2007. Twenty-two native species were observed (twenty-four if a *Lupinus* and a *Juncus* were different from the congeners identified to species). Some *Juncus* and *Carex* taxa were not identified to species and so may represent multiple species. The 22 native species included 4 grasses in the wet, alkaline zone, 2 bunchgrasses in the Valley grassland, 10 annual forbs, 4 perennial forbs, and at least 2 graminoids. We also observed approximately 45 non-native species at Brushy Peak (Appendix Table B.1).

An additional four plots at Brushy Peak (BP10-13) were sampled in 2003 only, as part of master's thesis research investigating the relationship between historical land use and plant species composition (Robertson 2004); two of the plots (BP 12-13) were on Livermore Area Recreation and District property. BP10-13 had greater native cover and species richness than the other six upland Valley grassland plots in Brushy Peak (cf. Table 5.1-7 with Table 5.1-2, 2003). Please see Robertson (2004) for further details regarding these four plots.

Table 5.1-6: **Brushy Peak plots BP10-13** (2003 only): top 10 species by percent average annual absolute cover; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Erodium botrys	exotic		26
Bromus hordeaceus	exotic	Limited	24
Lolium multiflorum	exotic	Moderate	11
litter			8
Bromus diandrus	exotic	Moderate	6
Nassella pulchra	native		5
soil			4

Avena fatua	exotic	Moderate	3
Bromus madritensis	exotic		2
Avena barbata	exotic	Moderate	1

Table 5.1-7: **Brushy Peak plots BP10-13**: native species found (2003 only), with percent average annual absolute cover

Native Species	Average absolute cover (%)
Nassella pulchra	5
Achillea millefolium	1
Grindelia sp.	0.4
Ranunculus californicus	0.3
Amsinckia menziesii var. *intermedia*	0.2
Plantago erecta	0.2
Aphanes occidentalis	0.1
Dichelostemma capitatum	0.1
Melica sp.	0.1
Poa secunda	0.1

5.2 Lake Chabot Regional Park-Fairmont Ridge

Park summary and options

We sampled six plots at Lake Chabot Regional Park in the Fairmont Ridge area from 2002 through 2007 (Figure 5.2). All six plots were Valley grassland; the vegetation may alternately be classified as Coast Range grassland (Bartolome et al. 2007; Jackson and Bartolome 2002). Fairmont Ridge is known to have serpentine-derived soils (Lorge et al. 2005; Barry 2003), which are often associated with high native plant abundance (Sánchez-Mata 2007), but it is not known whether any of the Project plots sit on serpentine soils. Plots at this park had a mix of management regimes involving cattle grazing, removal of grazing, and occasional mowing. Native species cover and richness were fairly high at Chabot-Fairmont Ridge, especially on two plots (CR2 and 3) close to the Alameda County Children's Memorial Grove. These two plots contained a sizable population of purple needlegrass (*Nassella pulchra*) and a rare plant, as well as several other native species.

In the six years that we sampled at Chabot-Fairmont Ridge, we observed 29 native species (2 of which were rare, see Table 5.2-5), including 3 perennial grasses, 6 annual forbs, 19 perennial forbs, and 1 shrub, and at least 56 non-native species.

Invasive plants management

Two major pest plant species were found on plot at Chabot-Fairmont Ridge: yellow starthistle (*Centaurea solstitialis*) and fennel (*Foeniculum vulgare*). The District may wish to target these species for control and, if feasible, elimination.

In addition, there is a Harding grass (*Phalaris aquatica*)-dominated patch in the Alameda County Sheriff installation area (plot CR1). Although we observed no evidence that this population was spreading, it contributes 75-95% of cover where it occurs, almost completely excluding any other species, native or exotic. Black mustard (*Brassica nigra*) also occurred at low abundance in the plots (<2% absolute cover); current grazing management probably provides some black mustard control. Purple false-brome (*Brachypodium distachyon*) is also present on most plots. We first encountered it on two plots in 2003 at very low cover; by 2007, it had spread to five of the six plots, reaching over 20% cover on CR4 and 5% on CR5.

Grassland restoration considerations

Chabot-Fairmont Ridge had a significant native plant component, including two CNPS-listed species and a notable population of purple needlegrass (Barry 2003). No evidence was found that Fairmont Ridge was cultivated in the past, and the purple needlegrass population corroborates this. The oak planting, watering, herbiciding, mulching, and mowing associated with the expansion of the Alameda County Children's Memorial Grove into the high native diversity area of plots CR2 and CR3 may be deleterious to the native herbaceous community there. The potential for preservation and restoration of this fairly small area seems high if oak planting could be continued away from CR2 and CR3; possibly, the oak planting could continue downslope from the native diversity area or in place of the eucalyptus. The Alameda County Sheriff installation area, which is heavily disturbed, almost 100% non-native, and possibly on a different soil type than the native diversity area (NRCS 2011), is likely to be of lower restoration priority than the rest of Fairmont Ridge.

A model of nitrogen deposition for the Bay Area (Tonnesen et al. 2007) suggests that the Chabot-Fairmont Ridge area may receive fairly high levels of nitrogen (~9 lbs/acre); the park is adjacent to a high-use freeway, I-580. At least part of the grassland at Chabot-Fairmont Ridge is on serpentine soil, and serpentine grassland diversity is vulnerable to nitrogen deposition (Weiss 1999). Cattle grazing may mitigate the impact of the nitrogen fertilization to some extent.

Grazing management

The Project area within Chabot-Fairmont Ridge had seasonal cattle grazing management for the years of the Project. This park had paired cattle-grazed/ungrazed plots from 2002 to 2006 (Tables 5.2-1 and 5.2-2). Plots had a significant native component, including two CNPS-listed species, one in the ungrazed area and one in the grazed area. Purple needlegrass cover was substantially greater in the ungrazed area, but it is not clear whether the greater cover was due to absence of grazing or to soil or other environmental factors. The serpentine soil confounds the issue, as does the mowing, oak planting, and watering that occurred on and near the ungrazed plots. Grazed and ungrazed purple needlegrass exhibited similar temporal trends in cover, pointing to the overriding influence of annual weather. Please see the Vasco Caves section for more detailed discussion of purple needlegrass dynamics and grazing.

Table 5.2-1: **Chabot-Fairmont Ridge**: percent average absolute native cover for ungrazed and grazed plots, 2002-2006

Year	Ungrazed	Grazed
2002	36	23
2003	19	10
2004	17	6
2005	10	7
2006	15	6

Table 5.2-2: **Chabot-Fairmont Ridge**: average native species richness for ungrazed and grazed plots, 2002-2006

Year	Ungrazed	Grazed
2002	2.0	3.0
2003	3.3	4.3
2004	2.0	3.3
2005	1.0	3.0
2006	3.3	2.7

Monitoring

The District may wish to conduct RDM mapping at Chabot-Fairmont Ridge for protection of natural resources. Effectiveness monitoring could focus on the purple needlegrass population, on the two listed species, on the suite of native species, and on the invasive species yellow starthistle and fennel. One or two permanent line-point transects could be established in the purple needlegrass population to monitor changes in cover. Another option would be to track trends in purple needlegrass with frequency plots. A relevé plot located in the native species-rich area (plots CR2 and CR3) would provide information on forb species diversity. If the District wants to collect data on the effect of grazing on the native species at Chabot-Fairmont Ridge, ungrazed (fenced) plots would need to be established in the area of interest (i.e., the native forb-rich area).

For the invasive species, areas of infestation could be mapped. Then, permanent GPS photo points could be established and photographed every year. If invasive cover has changed significantly, the extent of the population could be re-mapped at the same time. Both the permanent photo points and the population extent mapping could be done at the same time as RDM mapping, if desired. Another option would be to establish frequency plots to monitor the invasives.

Land-use history

As at Brushy Peak, cattle ranching at Chabot-Fairmont Ridge was likely introduced by the Spanish in the late 1700s. The southern half of Anthony Chabot Regional Park (ACRP) became part of Rancho San Lorenzo in 1843. Cattle grazing for hides became the major land use at this time (EBRPD 1984).

The Contra Costa Water Company (CCWC) began public acquisition of the ACRP lands in 1875, securing lands for both watershed area and construction of Lake Chabot reservoir. Other than watershed management, cattle grazing continued as the major land use of the Fairmont Ridge area. People’s Water Company, which became the East Bay Municipal Utility District, began large-scale eucalyptus plantings around 1910, adding to existing wind block plantings (EBRPD 1984).

Fairmont Ridge was acquired by the District in the early 1990s (Lorge et al. 2005). Prior to the acquisition, Fairmont Ridge was “heavily grazed by horses year-round” (Barry 2003). The Fairmont Ridge area of the Anthony Chabot/Lake Chabot Regional Park has likely had heavy recreational use since becoming part of the District; the area today sees frequent use by hikers from surrounding communities and is designated as an off-leash dog walking area.

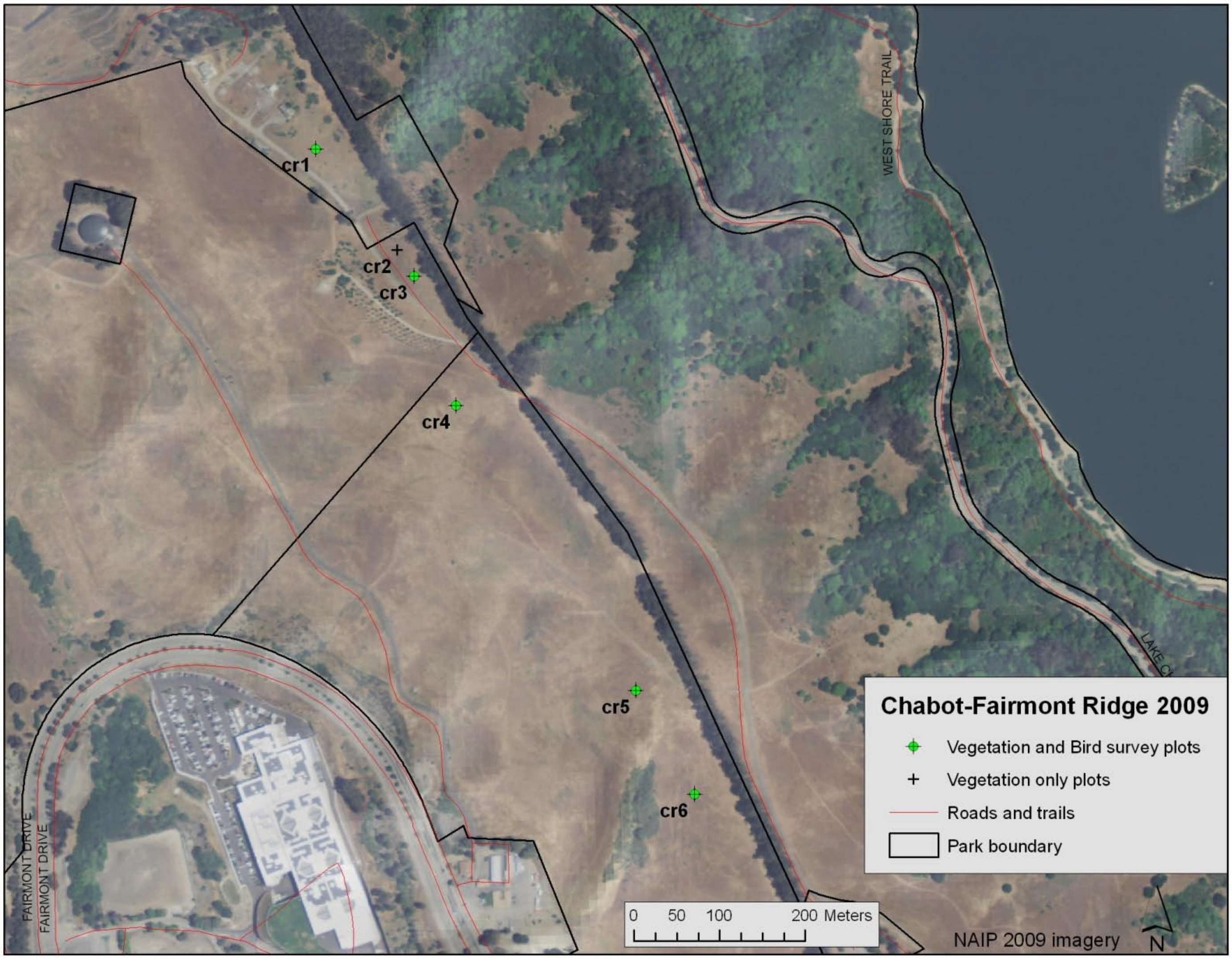

Figure 5.2: Lake Chabot-Fairmont Ridge plot locations, CR1-6

Full site description and vegetation

We sampled six plots at Chabot-Fairmont Ridge from 2002 through 2007: three grazed by cattle (CR4-6), two ungrazed from 2002-2006 and then grazed by cattle in 2007 (CR2-3), and 1 plot ungrazed (CR1). All plots were classified as Valley grassland. However, given their proximity to the San Francisco Bay, these plots might be provisionally described as Coast Range grassland, a recently proposed California grassland type which has mesic conditions similar to coastal prairie but is generally dominated by typical Valley grassland annual species (Jackson and Bartolome 2002; Bartolome et al. 2007). Chabot-Fairmont Ridge plots were dominated by common non-native annuals (Table 5.2-3) but also had some native perennial cover (Table 5.2-4), primarily of purple needlegrass (Table 5.2-3). Fairmont Ridge is known to have serpentine-derived soils (Lorge et al. 2005; Barry 2003), which are often associated with high native plant abundance (Sánchez-Mata 2007), but it is not known whether any of the Project plots are sited on serpentine soils.

Table 5.2-3: **Chabot-Fairmont Ridge plots CR1-6**: top 10 species by percent average annual absolute cover, 2002-2007; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Lolium multiflorum	exotic	Moderate	16
litter			12
Nassella pulchra	native		12
Phalaris aquatica	exotic	Moderate	10
Erodium botrys	exotic		8
Avena fatua	exotic	Moderate	6
Bromus diandrus	exotic	Moderate	6
Bromus hordeaceus	exotic	Limited	6
soil			3
Vulpia bromoides	exotic		3

Table 5.2-4: **Chabot-Fairmont Ridge**: percent total annual native absolute cover and total annual native species richness, 2002-2007 (6 plots)

Year	Total native absolute cover (%)	Total native species richness
2002	30	6
2003	15	11
2004	11	8
2005	8	6
2006	10	9
2007	7	8

Purple needlegrass was for the most part found on two plots (CR2-3) close to the Alameda County Children's Memorial Grove. The Grove area was mowed and watered, and during the course of the study, the oak planting area was expanded upslope, adjacent to plots CR2 and CR3 and the purple needlegrass population. In 2007, these two plots were also opened to cattle grazing. The annual fluctuations and general declining trend in purple needlegrass cover at Chabot-Fairmont Ridge were also observed at other parks and have no clear relationship to grazing status or site variables. We hypothesize that annual rainfall patterns may play a role.

Total annual number (species richness) of native species found on transect varied from 6 to 11 (Table 5.2-4). Table 5.2-5 lists all native species either hit on transect or observed within plot at the six Chabot-Fairmont Ridge plots from 2002-2007, with average annual cover for the species hit on transect.

Table 5.2-5: **Chabot-Fairmont Ridge plots CR1-6**: native species found 2002-2007, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Native Species	**Average absolute cover (%)**	**CNPS status**
Nassella pulchra	12	
Wyethia angustifolia	1	
Sisyrinchium bellum	0.30	
Calystegia subacaulis	0.12	
Eriogonum nudum	0.10	
Grindelia hirsutula	0.08	
Sanicula bipinnatifida	0.08	
Calochortus luteus	0.05	
Galium aparine	0.05	
Lomatium utriculatum	0.04	
Sanicula bipinnata	0.04	
Lomatium sp.	0.03	
Trifolium gracilentum	0.03	
Calystegia collina ssp. *collina*	0.02	
Eremocarpus setigerus	0.02	
Ranunculus californicus	0.02	
Sanicula sp.	0.02	
Triteleia laxa	0.02	
Dichondra sp.	0.01	
Epilobium brachycarpum	0.01	
Hordeum brachyantherum	0.01	
Baccharis pilularis	observed	
Balsamorhiza macrolepis var. *macrolepis*	observed	list 1B.2
Brodiaea elegans	observed	
Calochortus argillosus	observed	
Chlorogalum pomeridianum	observed	
Dichelostemma capitatum	observed	
Elymus multisetus	observed	

Eschscholzia californica	observed	
Fritillaria liliacea	observed	list 1B.2
Orobanche fasciculata	observed	

Appendix Table B.2 lists all species, both native and non-native, either hit on transect or observed within plot at the six Chabot-Fairmont Ridge plots from 2002-2007. At least twenty-nine native species were observed, including 3 perennial grasses, 6 annual forbs, 19 perennial forbs, and 1 shrub. One of the native species observed was rare (CNPS Inventory of Rare and Endangered Plants list 1B.2): big scale balsamroot (*Balsamorhiza macrolepis* var. *macrolepis*). In addition, we observed a second native rare species on plot: fragrant fritillary (*Fritillaria liliacea*; CNPS Inventory of Rare and Endangered Plants list 1B.2); this latter observation did not occur during our standard field season but earlier in the spring (March 3, 2005). We also observed at least 56 non-native species (Appendix Table B.2).

5.3 Morgan Territory Regional Preserve

Park summary and options

We sampled between six and sixteen plots at Morgan Territory from 2003 to 2011 (Figure 5.3). All plots were Valley grassland, and in all years, half of the plots were cattle-grazed (MT4-8, 14-16) and half ungrazed (MT1-3, 9-13). In general, non-native grasses and forbs dominated Morgan Territory. Native cover was generally very low, and native species richness was also fairly low, although native clovers were consistently present in a few plots (MT6, 8, 15).

In the nine years that we sampled at Morgan Territory, we observed 67 native species, including , including 6 perennial grasses, 33 annual forbs, 25 perennial forbs, 1 non-grass graminoid, 1 shrub, and 1 oak tree seedling; and we observed 59 non-native species.

Invasive plants management

Two major pest plant species, yellow starthistle (*Centaurea solstitialis*) and medusahead (*Taeniatherum caput-medusae*), were found on plot at Morgan Territory, albeit either infrequently and at low cover or only in a single location. Yellow starthistle was a transect hit on plot in 2003 (MT5), 2010 (MT1,3,9), and 2011 (MT1), but with only 1-3 hits for all Morgan Territory plots in each of the three years. Medusahead was first observed in 2007 on plot MT2 only and by 2011 had increased to 7% cover on that plot. The District may wish to target these species for control and, if feasible, elimination.

In addition, non-native mustard species (*Brassica nigra*, *Sisymbrium officinale*, and *Sinapsis arvensis*) were found primarily in the ungrazed area of Morgan Territory (Mt. Diablo State Park property), and purple false-brome may be expanding in the park (see 2009 annual report). As of 2011, purple false-brome had been observed on 15 of the 16 Morgan Territory plots, was abundant in 5 of those plots, and was the dominant species at MT14 (2011 cover: 28%).

Grassland restoration considerations

Over the course of the study, Morgan Territory did not typically have high cover of native grassland plants, although in the notably good wildflower year of 2005, one plot had 15% cover of a native clover. Despite the low levels of native cover, the list of native species occurring in the park is substantial and indicates that there is an in-situ source of seeds for many native species, suggesting some restoration potential. Judging by the abundance patterns of both native and non-native species, native clover species may do well at Morgan Territory and so may be a suitable focus for restoration.

We were unable to determine cultivation history for Morgan Territory. Many of our plots were on steep slopes, seemingly poor candidates for cultivation. However, a District land use document for Morgan Territory (EBRPD 1997) indicates that farming occurred in Morgan Territory for decades. Further evaluation of the cultivation status of the park would help prioritize areas for restoration.

A model of nitrogen deposition for the Bay Area (Tonnesen et al. 2007) indicates that the Morgan Territory area receives fairly low levels of nitrogen (~5 lbs/acre). Whether low to moderate deposition levels affect grassland species composition is unknown, but Weiss (1999) suggests that there may be chronic, long-term impacts. Cattle grazing may help mitigate such impacts.

Grazing management

Morgan Territory had year-long cattle grazing management throughout the years of the Project. This park had a well-balanced, comparable ungrazed/cattle-grazed plot design, although the grazed plots (MT4-8, 14-16) were mostly at higher elevations than the ungrazed plots (MT1-3, 9-13). Ungrazed plots were within Mt Diablo State Park which has not had livestock grazing for approximately 25 years. In wet years, native cover tended to be higher on grazed plots; in dry years, native cover tended to be higher on ungrazed plots (Table 5.3-1; see 2007 and 2009 Annual reports). Native species richness was typically higher on grazed plots (Table 5.3-2). Annual differences in native cover and richness between Morgan Territory's grazed and ungrazed plots were rarely statistically significant (see for example 2005 and 2009 Annual reports).

Table 5.3-1: Morgan Territory: percent average absolute native cover for ungrazed and grazed plots, 2003-2011; Average=9-year average, CV=coefficient of variation

Year	Average native absolute cover (%)		Number of ungrazed plots	Number of grazed plots
	Ungrazed	Grazed		
2003	3.0	2.4	3	3
2004	0.6	0.5	3	3
2005	1.4	7.5	5	5
2006	1.3	2.8	8	8
2007	1.2	0.9	8	8
2008	1.7	0.8	8	8
2009	1.2	2.0	8	8
2010	0.7	1.9	8	8
2011	1.0	0.4	8	8
Average	1.3	2.1		
CV	0.53	1.03		

The nine-year average grazed native cover was higher (2.1%) than the nine-year average ungrazed native cover (1.3%), but this difference was not statistically significant (2-tailed t-test, p-value>0.3). Similarly, average grazed native species richness over the nine year study period was higher (2.6) than the nine-year average ungrazed native species richness (1.8), but again this difference was not statistically significant (2-tailed t-test, p-value>0.17). These statistics suggest that if there is a real difference in native plant cover and richness between grazed and ungrazed plots in Morgan Territory, the difference is likely to be small, and also that annual fluctuations are quite large (certainly true for the grazed plots).

The coefficient of variation (CV), a normalized measure of variation, for grazed native cover is almost twice that of ungrazed native cover (Table 5.3-1). Similarly, the CV for grazed native species richness is more than a third greater than ungrazed native species richness (Table

5.3-2). Grazed areas in Morgan Territory experienced greater annual fluctuations in native species than did ungrazed areas.

Table 5.3-2: Morgan Territory: average native species richness for ungrazed and grazed plots, 2003-2011; Aver.=9-year average, CV=coefficient of variation

Year	Average species richness		Number of ungrazed plots	Number of grazed plots
	Ungrazed	**Grazed**		
2003	3.7	2.7	3	3
2004	1.7	0.7	3	3
2005	2.4	5.8	5	5
2006	1.5	5.3	8	8
2007	1.3	2.0	8	8
2008	1.8	1.8	8	8
2009	1.5	2.3	8	8
2010	0.9	2.1	8	8
2011	1.1	0.9	8	8
Average	1.8	2.6		
CV	0.48	0.68		

Comparing the native species that occurred in Morgan Territory's grazed verses ungrazed plots over the course of the Project, most species occurred in both plot management types at about the same level (e.g., purple needlegrass) or occurred so infrequently in either type that drawing conclusions about them is unwarranted. Several species, however, did occur relatively frequently in either grazed or ungrazed plots; these species may be potential candidates for restoration activities in the management type in which they occurred. California poppy (*Eschscholzia californica*), notchleaf clover (*Trifolium bifidum*), and pinpoint clover (*Trifolium gracilentum*) occurred with much greater frequency or exclusively in grazed plots. Creeping wildrye (*Leymus triticoides*) and succulent lupine (*Lupinus succulentus*) occurred at relatively high frequency exclusively in ungrazed plots. Note that the distribution of these species may be related to unassessed environmental or other factors and not to grazing status.

Monitoring

The District may wish to conduct RDM mapping at Morgan Territory for protection of natural resources. Effectiveness monitoring could focus on control of invasive species. For the invasive species, especially the mustards and purple false-brome, areas of infestation could be mapped. Then, permanent GPS photo points could be established and photographed every year. If invasive cover has changed significantly, the extent of the population could be re-mapped at the same time. Both the permanent photo points and the population extent mapping could be done at the same time as RDM mapping, if desired. Another option would be to establish frequency plots to monitor the invasives.

<u>Land-use history</u>

Only limited land-use history was available for Morgan Territory. Jeremiah Morgan settled the area in the 1850s and used the land for ranching. A Morgan Territory land use document (EBRPD 1997) states that livestock grazing and farming have occurred in the area for decades.

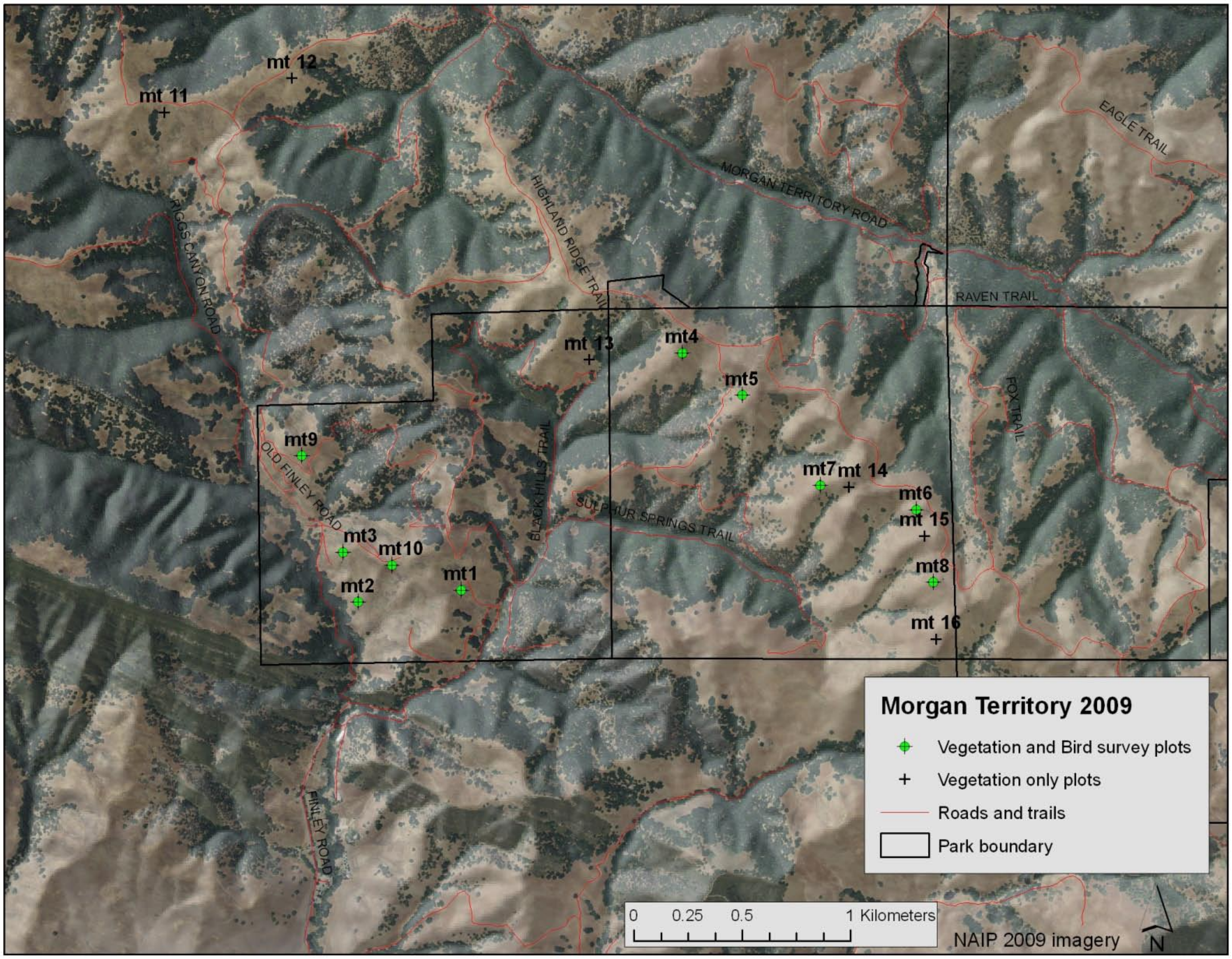

Figure 5.3: Morgan Territory plot locations, MT1-16

Full site description and vegetation

We sampled between six and sixteen plots at Morgan Territory from 2003 to 2011: six plots in 2003 and 2004, ten plots in 2005, and sixteen plots from 2006-2011. In all years, we maintained a balanced plot design in which half the plots were cattle-grazed (MT4-8, 14-16) and half ungrazed (MT1-3, 9-13). The ungrazed plots are actually located on Mt. Diablo State Park property which has been ungrazed for approximately 25 years. All sixteen plots were Valley grassland and dominated by non-native annual grasses and forbs (Table 5.3-3), with total native cover never reaching 5% (Table 5.3-4).

Table 5.3-3: **Morgan Territory plots MT1-16**: top 10 species by percent average annual absolute cover, 2003-2011; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Avena fatua	exotic	Moderate	35
Bromus diandrus	exotic	Moderate	10
Trifolium hirtum	exotic	Moderate	10
litter			9
Erodium botrys	exotic		6
Bromus hordeaceus	exotic	Limited	6
Lolium multiflorum	exotic	Moderate	5
soil			5
Brachypodium distachyon	exotic	Moderate	4
Bromus madritensis ssp. *madritensis*	exotic		1

Low native cover notwithstanding, Morgan Territory contained many native species over the park as a whole (Tables 5.3-4 and 5.3-5), including many forbs. In particular, clover species (*Trifolium* sp.), both native and non-native, played a more dominant role at Morgan Territory than at the other parks in the study, with the exception of Sunol-Ohlone. The non-native rose clover (*Trifolium hirtum*) was a co-dominant species over the nine years of the study (Table 5.3-3) in contrast to all the other parks. Although rose clover abundance may possibly reflect range improvement activities by former owners, two native clovers were also the most common native species in Morgan Territory (Table 5.3-5), and in the notably good wildflower year of 2005, the native notchleaf clover (*Trifolium bifidum*) was co-dominant in one plot (MT6) at 15% cover. We found at least six native clover species at Morgan Territory (Table 5.3-5).

Table 5.3-4: **Morgan Territory plots MT1-16**: percent total annual native absolute cover and total annual native species richness, 2003-2011; wavy horizontal lines indicate there were fewer plots prior to 2006

Year	Total native absolute cover (%)	Total native species richness	Number of plots
2003	2.7	13	6

2004	0.5	6	6
2005	4.5	20	10
2006	2.0	29	16
2007	1.0	16	16
2008	1.3	16	16
2009	1.6	18	16
2010	1.3	13	16
2011	0.7	13	16

Table 5.3-5 lists all native species either hit on transect or observed within plot at the sixteen Morgan Territory plots from 2003-2011, with average annual cover for the species hit on transect.

Table 5.3-5: **Morgan Territory plots MT1-16**: native species found 2003-2011, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Native Species	Average absolute cover (%)
Trifolium bifidum	0.227
Trifolium gracilentum	0.194
Nassella pulchra	0.163
Leymus triticoides	0.133
Calystegia subacaulis	0.094
Lupinus succulentus	0.094
Eschscholzia californica	0.082
Triteleia laxa	0.051
Amsinckia menziesii var. *intermedia*	0.048
Chlorogalum pomeridianum	0.048
Trifolium sp.	0.045
Sanicula bipinnata	0.039
Lomatium sp.	0.036
Lotus wrangelianus	0.030
Sanicula bipinnatifida	0.030
Achillea millefolium	0.027
Clarkia affinis	0.021
Clarkia sp.	0.021
Trifolium willdenovii	0.021
Calystegia purpurata	0.018
Achyrachaena mollis	0.015
Melica californica	0.015
Sisyrinchium bellum	0.015
Amsinckia menziesii	0.012

Epilobium canum	0.012
Agoseris grandiflora	0.009
Dichelostemma capitatum	0.009
Lupinus bicolor	0.009
Madia gracilis	0.009
Trifolium ciliolatum	0.009
Vicia americana	0.009
Calochortus sp.	0.006
Epilobium brachycarpum	0.006
Epilobium sp.	0.006
Sanicula sp.	0.006
Trifolium microdon	0.006
Aphanes occidentalis	0.003
Athysanus pusillus	0.003
Clarkia purpurea	0.003
Eremocarpus setigerus	0.003
Galium aparine	0.003
Lagophylla ramosissima	0.003
Lathyrus vestitus var. *vestitus*	0.003
Lepidium nitidum	0.003
Lupinus nanus	0.003
Lupinus sp.	0.003
Madia sp.	0.003
Sanicula crassicaulis	0.003
Brodiaea elegans	observed
Bromus carinatus	observed
Calandrinia sp.	observed
Calochortus venustus	observed
Carex sp.	observed
Claytonia sp.	observed
Crassula connata	observed
Delphinium patens	observed
Elymus multisetus	observed
Eriogonum nudum var. *auriculatum*	observed
Gnaphalium californicum	observed
Grindelia camporum	observed
Grindelia hirsutula	observed
Madia elegans	observed
Marah fabaceus	observed
Micropus californicus	observed
Plagiobothrys sp.	observed
Plantago erecta	observed
Poa secunda ssp. *secunda*	observed
Ranunculus californicus	observed

Solidago californica	observed
Trichostema lanceolatum	observed
Trifolium microcephalum	observed

Appendix Table B.3 lists all species, both native and non-native, either hit on transect or observed within plot at the sixteen Morgan Territory plots from 2003-2011. At least sixty-seven native species were observed, including 6 perennial grasses, 33 annual forbs, 25 perennial forbs, 1 non-grass graminoid, 1 shrub, and 1 oak tree seedling. We also observed at least 59 non-native species (Appendix Table B.3).

5.4 Pleasanton Ridge Regional Park

Park summary and options

We sampled between six and nine plots at Pleasanton Ridge from 2003-2011 (Figure 5.4). Six plots (PR4-9) were Valley grassland plots; in addition, we sampled three riparian plots (PR1-3) in 2003 and 2004. All Pleasanton Ridge plots were grazed, some by cattle (PR4-6), the rest by sheep (PR7-9). Some of the plots had moderate cover of purple needlegrass (PR4-5), and one of the cattle-grazed plots (PR4), wetter than most of the Project's Valley grassland plots, had notably high species richness, both native and non-native.

In the nine years that we sampled at Pleasanton Ridge, we observed at least 60 native species, including 6 perennial grasses, 1 annual grass, 30 annual forbs, 15 perennial forbs, 5 non-grass graminoids, 2 shrubs, and 1 spikemoss; and we observed at least 64 non-native species, with an additional 3 species of unknown origin.

Invasive plants management

Two major pest plant species were found on plot at Pleasanton Ridge: yellow starthistle (*Centaurea solstitialis*) and medusahead (*Taeniatherum caput-medusae*). Yellow starthistle was only found on transect in one plot (PR4) in 2005 and was not observed thereafter. A patch of medusahead was initially noticed near but not within plot PR4. In 2006, we observed medusahead on plot PR5, and we observed it within plots PR4 and PR5 in 2007-2009. Although medusahead was not observed in 2010, in 2011, we found it on transect at PR4 for the first time (at 1.4% cover) and observed it within plots PR5, PR6, and PR8, the last two for the first time. Medusahead may be spreading within Pleasanton Ridge, and the District may wish to target it for control.

In addition, purple false-brome (*Brachypodium distachyon*) was also present on several plots: it was abundant (e.g., 2011 cover: ~20%) on PR7 and PR9 over the entire study period and was found intermittently on PR5, PR6, and PR8. It was found on PR5 and PR8 for the first time in 2011 and so may be spreading in the park.

Grassland restoration considerations

Over the course of the study, Pleasanton Ridge had moderate levels of native cover, primarily purple needlegrass. Native species richness was also at moderate levels, driven primarily by one plot, PR4. PR4 is located in a swale area above a stock pond (Figure 5.5) and appears to have more soil moisture than most of the other Valley grassland plots in the study. PR4 has among the highest species richness, both native and non-native, of any single plot in the study. The areas surrounding plot PR4 and the purple needlegrass populations may be suitable sites for restoration and enhancement.

We were unable to determine cultivation history for the section of Pleasanton Ridge containing the Project plots; however, fruit orchards were planted in southern sections of the park (EBRPD 1990). Further evaluation of cultivation within the park may help prioritize areas for restoration.

A model of nitrogen deposition for the Bay Area (Tonnesen et al. 2007) indicates that the Pleasanton Ridge area receives moderate levels of nitrogen (~7 lbs/acre). Whether moderate deposition levels affect grassland species composition is unknown, but Weiss (1999) suggests that there may be chronic, long-term impacts. Cattle grazing may help mitigate such impacts, but the effects of sheep grazing may differ from that of cattle grazing; the two livestock species have different dietary preferences, which could affect the outcome of a conservation grazing program.

Grazing management

The Project area of Pleasanton Ridge had two forms of grazing management: seasonal fast-rotation sheep grazing and year-long cattle grazing. Pleasanton Ridge was grazed by sheep (plots PR7-9) and cattle (plots PR4-6) but had no ungrazed plots (although in spring of 2009, plots PR4-9 were not grazed by livestock) so data generated for this park do not allow for the site-specific impact of grazing compared to no grazing. The impact of sheep grazing vs. cattle grazing is also beyond the scope of this study because there is no prior information about the site or plant community before the change to sheep grazing.

Plot PR4, the most species rich plot at Pleasanton Ridge, appears to receive fairly concentrated use by cattle because it is adjacent to a stockpond; this suggests that the current grazing regime there is not incompatible with high native species richness, although there are also many non-native species, including medusahead, in or near PR4.

Monitoring

The District may wish to conduct RDM mapping at Pleasanton Ridge for protection of natural resources. If desired, effectiveness monitoring could focus on the purple needlegrass sites, the species rich area of plot PR4, and on control of invasive species. One or two permanent line-point transects could be established in the purple needlegrass sites to monitor changes in cover. Another option would be to track trends in purple needlegrass with frequency plots. A relevé plot located in plot PR4 would provide information on native species diversity. If the District wants to collect data on the effect of grazing on the native species at Pleasanton Ridge, ungrazed (fenced) plots would need to be established in the areas of interest.

For the invasive species, medusahead and purple false-brome, areas of infestation could be mapped. Then, permanent GPS photo points could be established and photographed every year. If invasive cover has changed significantly, the extent of the population could be re-mapped at the same time. Both the permanent photo points and the population extent mapping could be done at the same time as RDM mapping, if desired. Another option would be to establish frequency plots to monitor medusahead and/or purple false-brome.

Land-use history

Pleasanton Ridge comprises several private land acquisitions; historical land uses of these private parcels varied. The park offers evidence of 19th and 20th century cattle and sheep grazing and homesteading: roads, fences, stockponds, stocktrails, waterlines, water tanks, and fruit orchards from this period are still evident (EBRPD 1990, EBRPD 1995). Areas along Sinbad Creek have been denuded due to historic cattle grazing (EBRPD 1995).

Dryland farming of orchards was practiced in the area. The Thermalito Ranch grew almonds, apricots, and olives (EBRPD 1990). Five olive orchards, dating back at least 140 years, were planted along Pleasanton Ridge and, as of 1990, were still in place, along with other crop trees (EBRPD 1990).

Both cattle and sheep have long grazed Pleasanton Ridge, and the District continues to graze both cattle and sheep at moderate levels (EBRPD 1990). As of 1990, there was on-going damage at Pleasanton Ridge from unsanctioned off-road vehicle use (EBRPD 1990).

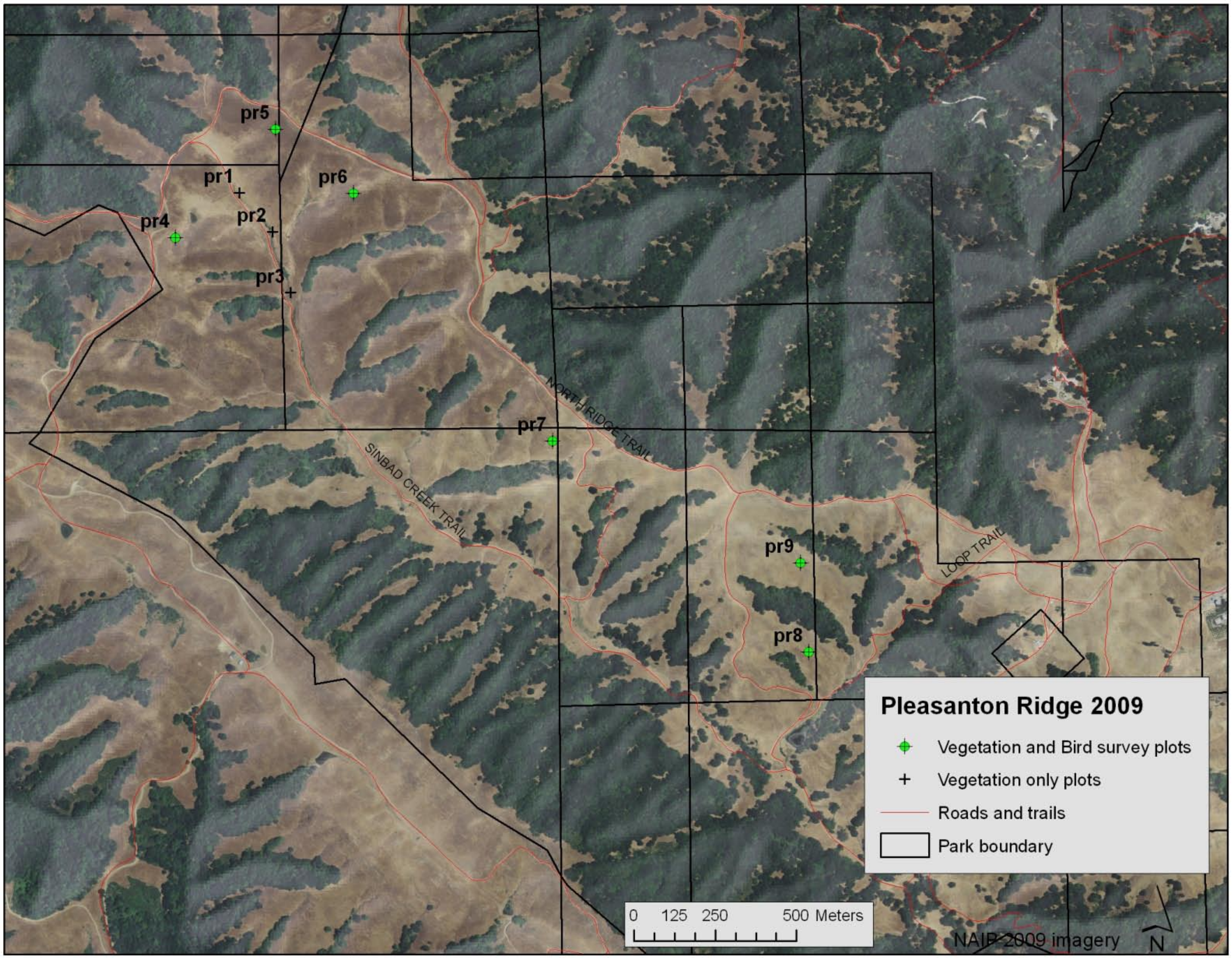

Figure 5.4: Pleasanton Ridge plot locations, PR1-9

Full site description and vegetation

We sampled nine plots at Pleasanton Ridge over the course of the Project. Six Valley grassland plots (PR4-9) were sampled from 2003-2011, and three riparian plots (PR1-3) were sampled in 2003 and 2004[5]. All Pleasanton Ridge plots were grazed: plots PR1-6 by cattle and plots PR7-9 by sheep, with the exception of 2009, when plots PR4-6 were left ungrazed[6].

The six Valley grassland plots were dominated by non-native grasses and forbs (Table 5.4-1), with native cover reaching 5% in only one year (Table 5.4-2). Purple needlegrass was moderately abundant on some of the plots, but its cover values fluctuated over the course of the study (Table 5.4-3). Native species richness varied from 2 to 14 (Table 5.4-2).

Table 5.4-1: **Pleasanton Ridge Valley grassland plots PR4-9**: top 10 species by percent average annual absolute cover, 2003-2011; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Avena barbata	exotic	Moderate	17
Bromus hordeaceus	exotic	Limited	15
Lolium multiflorum	exotic	Moderate	12
Erodium botrys	exotic		9
litter			7
soil			6
Brachypodium distachyon	exotic	Moderate	6
Bromus diandrus	exotic	Moderate	5
Vulpia bromoides			4
Trifolium hirtum	exotic	Moderate	3

Table 5.4-2: **Pleasanton Ridge Valley grassland plots PR4-9**: percent <u>total</u> annual native absolute cover and <u>total</u> annual native species richness, 2003-2011 (6 plots)

Year	Total native absolute cover (%)	Total native species richness
2003	3.7	7
2004	3.9	10
2005	4.0	11
2006	2.9	11
2007	1.8	9
2008	2.0	7
2009	5.4	14

[5] As previously noted, starting in 2005, the project focused on upland Valley grassland.

[6] Grazing status of Pleasanton Ridge riparian plots PR1-3 was not recorded after 2004.

2010	3.4	11
2011	3.0	2

Purple needlegrass occurred in both cattle-grazed and sheep-grazed plots at Pleasanton Ridge, although it tended to be more abundant in the cattle-grazed plots; our data do not permit us to determine whether this difference is related to grazing animal or plot environmental differences. In the drought years of 2007 and 2008, purple needlegrass was not hit on transect, although it did occur within the plots; cover recovered in the subsequent, wetter years (Table 5.4-3). As noted for other parks with purple needlegrass, we hypothesize that annual cover fluctuations are driven primarily by rainfall patterns. Please see the Vasco Caves section for more detailed discussion of purple needlegrass dynamics.

Table 5.4-3: **Pleasanton Ridge Valley grassland plots PR4-9**: purple needlegrass (*Nassella pulchra* or NAPU) percent average annual absolute cover, 2003-2011

Year	**Average NAPU absolute cover (%)**
2003	2.2
2004	1.7
2005	1.8
2006	0.4
2007	0
2008	0
2009	1.0
2010	0.5
2011	1.6

Table 5.4-4 lists all native species either hit on transect or observed within plot at the six Pleasanton Ridge Valley grassland plots from 2003-2011, with average annual cover for the species hit on transect.

Table 5.4-4: **Pleasanton Ridge Valley grassland plots PR4-9**: native species found 2003-2011, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Native Species	**Average absolute cover (%)**
Nassella pulchra	1.019
Bromus carinatus	0.787
Lagophylla ramosissima	0.437
Madia gracilis	0.218
Ranunculus californicus	0.179
Trifolium gracilentum	0.126
Leymus triticoides	0.106
Juncus bufonius	0.099

Sisyrinchium bellum	0.066
Calystegia subacaulis	0.040
Trifolium barbigerum	0.040
Elymus glaucus	0.026
Linanthus acicularis	0.020
Trifolium bifidum	0.020
Trifolium oliganthum	0.020
Aphanes occidentalis	0.013
Elymus multisetus	0.013
Epilobium sp.	0.013
Eschscholzia californica	0.013
Madia sp.	0.013
Trifolium sp.	0.013
Achillea millefolium	0.007
Daucus pusillus	0.007
Linanthus sp.	0.007
Micropus californicus var. *subvestitus*	0.007
Plagiobothrys sp.	0.007
Selaginella bigelovii	0.007
Trifolium microdon	0.007
Trifolium wormskioldii	0.007
Triphysaria pusilla	0.007
Acaena pinnatifida var. *californica*	observed
Achyrachaena mollis	observed
Amsinckia menziesii	observed
Calandrinia sp.	observed
Castilleja attenuata	observed
Clarkia affinis	observed
Clarkia purpurea	observed
Crassula connata	observed
Dichelostemma capitatum	observed
Eremocarpus setigerus	observed
Hordeum brachyantherum	observed
Juncus sp.	observed
Lepidium nitidum	observed
Lotus wrangelianus	observed
Lupinus bicolor	observed
Plantago erecta	observed
Thysanocarpus sp.	observed
Trifolium ciliolatum	observed
Trifolium microcephalum	observed
Trifolium willdenovii	observed
Triteleia laxa	observed
Vulpia microstachys	observed

Tables 5.4-5 and 5.4-6 provide summary data for the three Pleasanton Ridge riparian plots (PR1-3) we sampled in 2003 and 2004, after which the study's focus was narrowed to upland Valley grassland. The dominant species in the riparian area were the common non-native grasses and forbs (Table 5.4-5), while the native component included many riparian-associated species (Table 5.4-6).

Table 5.4-5: **Pleasanton Ridge riparian plots PR1-3**: top 10 species by percent average annual absolute cover, 2003-2004; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Lolium multiflorum	exotic	Moderate	18
Bromus hordeaceus	exotic	Limited	14
Bromus diandrus	exotic	Moderate	9
litter			8
soil			7
Vulpia bromoides	exotic		6
Carduus pycnocephalus	exotic	Moderate	5
Geranium dissectum	exotic	Moderate	5
Hordeum murinum	exotic	Moderate	5
Avena barbata	exotic	Moderate	3

Table 5.4-6: **Pleasanton Ridge riparian plots PR1-3**: native species found 2003-2004, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Native Species	Average absolute cover (%)
Leymus triticoides	2.1
Juncus sp.	0.7
Hordeum brachyantherum	0.4
Sisyrinchium bellum	0.2
Rorippa nasturtium-aquaticum	0.2
Eleocharis acicularis	0.1
Epilobium sp.	0.1
Calystegia subacaulis	0.1
Carex sp.	0.1
Cyperus eragrostis	0.1
Juncus effusis	0.1
Vicia americana	0.1
Agoseris sp.	observed
Mimulus guttatus	observed
Monardella villosa	observed
Ribes sp.	observed
Toxicodendron diversilobum	observed

Wyethia sp.	observed

Appendix Table B.4 lists all species, both native and non-native, either hit on transect or observed within plot at the nine Pleasanton Ridge plots from 2003-2011. At least 60 native species were observed, including 6 perennial grasses, 1 annual grass, 30 annual forbs, 15 perennial forbs, 5 non-grass graminoids, 2 shrubs, and 1 spikemoss. We also observed at least 64 non-native species, with an additional 3 species of unknown origin (Appendix Table B.4).

5.5 Sunol Regional Wilderness-Ohlone Regional Wilderness

Park summary and options

We sampled between nine and twelve plots, depending on the year, from 2005-2011 at Sunol-Ohlone (Figure 5.5-1). All plots were Valley grassland. Six plots were grazed by cattle (SU1-6); between three and six plots were ungrazed (SU7-12), depending on the year. Several of the plots, in High Valley and Valpe Ridge, had high levels of native cover and species richness, in particular of native forbs. Livestock exclosures were built in High Valley and Valpe Ridge late in the project (2009) to create more ungrazed vegetation survey plots.

In the seven years that we sampled at Sunol-Ohlone, we observed at least 75 native species, including 6 perennial grasses, 1 annual grass, 41 annual forbs, 23 perennial forbs, 2 non-grass graminoids, and 2 trees; and we observed at least 61 non-native species, with an additional 2 species of unknown origin.

Invasive plants management

Three major pest plant species were found on plot at Sunol-Ohlone: fennel (*Foeniculum vulgare*), yellow starthistle (*Centaurea solstitialis*) and medusahead (*Taeniatherum caput-medusae*). Fennel was observed only once, on plot SU7 in 2011. Yellow starthistle was not found on transect but was observed in plot SU9 from 2008-2010. Medusahead has been observed in High Valley plots SU4, SU6, and SU10 and found on transect in SU5 (2011 cover: 14%). The District may wish to target these species for control and, if feasible, elimination.

In addition, there is black mustard (*Brassica nigra*) at Sunol-Ohlone, although at fairly low abundance; we have observed black mustard on plots SU5 and SU7 and found it on transect in SU8 and SU9 at cover ≤6%; resuming livestock grazing may provide some mustard control in those areas that are currently ungrazed. Purple false-brome (*Brachypodium distachyon*) may be increasing in the park (see 2009 Annual report). As of 2011, purple false-brome had been observed in 10 of the 12 Sunol-Ohlone plots, was abundant in 4 of those plots, of which it was the dominant species in the High Valley plots SU4 (40% cover), SU6 (31% cover), and SU10 (57% cover).

Grassland restoration considerations

Both at the park and plot scales, Sunol-Ohlone had the highest levels of native species cover and richness observed during the course of the Project. Native forbs in particular were abundant and diverse, while native grasses formed a smaller part of the native component than in other parks in the study. Because of the abundance of native forb germplasm in Valpe Ridge and High Valley[7], these areas may be appropriate sites for restoration and enhancement activities. Because little is known about restoration of many native California forbs, a quasi-experimental, adaptive management approach to restoration may be especially useful in this park.

Some areas of Sunol-Ohlone may have been farmed; given the thin, rocky soil and high native abundance on Valpe Ridge, it seems less likely that this area of the parks was farmed.

[7] The plots near park headquarters, while almost completely non-native themselves, were adjacent to areas in which we observed abundant native cover. For example, numerous purple needlegrass (*Nassella pulchra*) and narrowleaf mule ear (*Wyethia angustifolia*) plants grew along sections of the trail leading to plots SU8 and SU9 (see Figure 5.5-2).

High Valley was the site of a homestead and so may have seen cultivation. Site-specific evaluation of cultivation within the park may help prioritize areas for restoration.

A model of nitrogen deposition for the Bay Area (Tonnesen et al. 2007) indicates that the Sunol-Ohlone area receives fairly low levels of nitrogen (~5 lbs/acre). Whether low to moderate deposition levels affect grassland species composition is unknown, but Weiss (1999) suggests that there may be chronic, long-term impacts. Cattle grazing may help mitigate such impacts.

Grazing management

Sunol-Ohlone had year-long cattle grazing management throughout the years of the Project. From 2005-2008, six plots located on Valpe Ridge (SU1-3) and in High Valley (SU 4-6), were cattle-grazed; three plots (SU7-9), located near Park headquarters and near Little Yosemite, were ungrazed. However, these ungrazed plots (SU7-9) are at lower elevations and had a very limited native component compared with the grazed plots (SU1-6). To establish more closely paired grazed/ungrazed plots, we added three new ungrazed plots in 2009: two on Valpe Ridge (SU11-12) and one in High Valley (SU10).

Plots in both Valpe Ridge and High Valley, especially the former, had high levels of native forb cover and species richness (grazed columns in Tables 5.5-1 and 5.5-2); the lower elevation ungrazed plots had very low native abundance (ungrazed columns for 2005-2008 in Tables 5.5-1 and 5.5-2); note that, unlike other parks in this study, most of the native cover was contributed by forbs rather than purple needlegrass, which had a limited presence in the Sunol-Ohlone plots. Once the new high elevation ungrazed plots were added to the study, ungrazed native cover and richness values increased somewhat but were still several times lower than grazed values (cf. grazed and ungrazed columns for 2009-2011 in Tables 5.5-1 and 5.5-2).

Sunol-Ohlone's seven-year average grazed native cover was considerably higher (14.9%) than the seven-year average ungrazed cover (1.9%); the difference was highly statistically significant (2-tailed t-test, p-value<0.001). Similarly, average grazed native species richness over the seven year period was higher (8.7) than the seven-year average ungrazed native species richness (1.6); this difference was also highly statistically significant (2-tailed t-test, p-value<0.001).

Seemingly reversing the relationship found at Morgan Territory, the coefficient of variation (CV), a normalized measure of variation, for grazed native cover at Sunol-Ohlone was about one-third that of ungrazed native cover (Table 5.5-1). Similarly, the CV for grazed native species richness was less than one-third of ungrazed native species richness (Table 5.5-2). However, this trend appears to be an artifact of the limited comparability of Sunol-Ohlone's ungrazed and grazed plots during the initial four years of sampling (see below for further details).

Table 5.5-1: Sunol-Ohlone: percent average absolute native cover for ungrazed and grazed plots, 2005-2011

Year	Average native absolute cover (%)		Number of ungrazed plots	Number of grazed plots
	Ungrazed	Grazed		
2005	0.5	22.5	3	6
2006	0.2	14.5	3	6
2007	0.1	10.7	3	6

2008	1.4	11.3	3	6
2009	4.6	20.7	6	6
2010	3.5	14.5	6	6
2011	2.9	9.9	6	6
Average	1.9	14.9		
CV	0.95	0.33		

Table 5.5-2: Sunol-Ohlone: average native species richness for ungrazed and grazed plots, 2005-2011

Year	**Average native species richness**		**Number of ungrazed plots**	**Number of grazed plots**
	Ungrazed	**Grazed**		
2005	0.7	9.7	3	6
2006	0.7	10.2	3	6
2007	0.3	7.7	3	6
2008	1.0	7.5	3	6
2009	3.2	11.2	6	6
2010	2.3	8.3	6	6
2011	2.7	6.2	6	6
Average	1.6	8.7		
CV	0.74	0.20		

Comparing only the closely paired grazed/ungrazed plots, those on Valpe Ridge and in High Valley, the relationship between ungrazed plots and grazed plots remains the same, but the difference is not as extreme: grazed plots have about twice as much native cover and generally twice as much native species richness (Tables 5.5-3 and 5.5-4). The three-year average grazed native cover for this subset of plots was higher (15%) than the average ungrazed cover (7%), but this difference was not statistically significant (2-tailed t-test, p-value=0.12). Similarly, the three-year average grazed native species richness for this subset was higher (8.6) than the average ungrazed native species richness (5), but, again, this difference was not statistically significant (2-tailed t-test, p-value=0.12).

The coefficient of variation (CV) for the closely paired subset's grazed native cover (0.36) was greater than the CV for its ungrazed plots (0.20). Similarly, the CV for grazed native species richness (0.29) is more than double that of the ungrazed native species richness (0.14). This suggests that the all-plot/year CV comparison described above was indeed an artifact of the limited comparability of Sunol-Ohlone's ungrazed and grazed plots during the initial four years of sampling. Both Morgan Territory and Sunol-Ohlone appear to show that grazed areas experienced greater annual fluctuations in native species than did ungrazed areas.

Table 5.5-3: Sunol-Ohlone plots SU1-6, 10-12: percent absolute native cover, with annual averages, for High Valley (HV) and Valpe Ridge (VR) ungrazed and grazed comparison plots, 2009-2011

Ungrazed plots

Location	Plot	2009 % abs. cover	2010 % abs. cover	2011 % abs. cover
HV	SU10	3.2	1.1	3.2
VR	SU11	14.6	15.7	9.3
VR	SU12	7.5	3.6	4.6
Annual average:		**8.5**	**6.8**	**5.7**
Grazed plots				
Location	**Plot**	**2009 % abs. cover**	**2010 % abs. cover**	**2011 % abs. cover**
VR	SU1	9.3	9.3	5.0
VR	SU2	30.0	23.9	20.4
VR	SU3	31.1	23.6	9.6
HV	SU4	13.9	10.4	7.1
HV	SU5	19.3	6.4	0
HV	SU6	20.7	13.6	17.1
Annual average:		**20.7**	**14.5**	**9.9**

Table 5.5-4: Sunol-Ohlone plots SU1-6, 10-12: native species richness, with annual averages, for High Valley (HV) and Valpe Ridge (VR) ungrazed and grazed comparison plots, 2009-2011

Ungrazed plots				
Location	**Plot**	**2009 species richness**	**2010 species richness**	**2011 species richness**
HV	SU10	4	3	2
VR	SU11	7	5	8
VR	SU12	6	5	5
Annual average:		**5.7**	**4.3**	**5.0**
Grazed plots				
Location	**Plot**	**2009 species richness**	**2010 species richness**	**2011 species richness**
VR	SU1	6	5	4
VR	SU2	15	9	10
VR	SU3	12	12	9
HV	SU4	14	10	6
HV	SU5	9	4	0
HV	SU6	11	10	8
Annual average:		**11.2**	**8.3**	**6.2**

Monitoring

The District may wish to conduct RDM mapping at Sunol-Ohlone for protection of natural resources. Effectiveness monitoring could focus on the native species rich areas of Valpe Ridge and High Valley and on control of invasive species, in particular medusahead and purple false-brome. One or two permanent line-point transects could be established in the Valpe Ridge and High Valley forb sites to monitor changes in cover. Alternatively, relevé plots (with or without associated line-point transects) would provide information on native species diversity and would likely capture rare species better than line-point transects alone. If the District wants to collect further data on grazing effects on the native forbs at Sunol-Ohlone, continued sampling of the Project's paired ungrazed/grazed plots would allow for multi-year analyses, although the District may not wish to collect data at the research level used in this study. Although not part of this study, the purple needlegrass and narrowleaf mule ear areas (Figure 5.5-2) referred to in footnote 9 may be worth monitoring, if livestock grazing is re-introduced there.

For the invasive species, medusahead and purple false-brome, areas of infestation could be mapped. Then, permanent GPS photo points could be established and photographed every year. If invasive cover has changed significantly, the extent of the population could be re-mapped at the same time. Both the permanent photo points and the population extent mapping could be done at the same time as RDM mapping, if desired. Another option would be to establish frequency plots to monitor medusahead and/or purple false-brome.

Land-use history

Livestock have grazed at Sunol-Ohlone since the rancho era of the early 1800s (EBRPD 2003). Many families built home sites and had homesteads in what is now Sunol-Ohlone (e.g., in High Valley). In addition, some of the area may have been cultivated for dry-land farming of grain (EBRPD 2003). By the 1900s, much of the area comprised ranches, on which livestock grazing and hunting were primary land-use activities.

The District began acquiring land in the area in 1958 and then added to that through San Francisco Public Utilities Commission leases and other acquisitions. The District continued grazing at Sunol-Ohlone to achieve resource management objectives and fire prevention (EBRPD 2003).

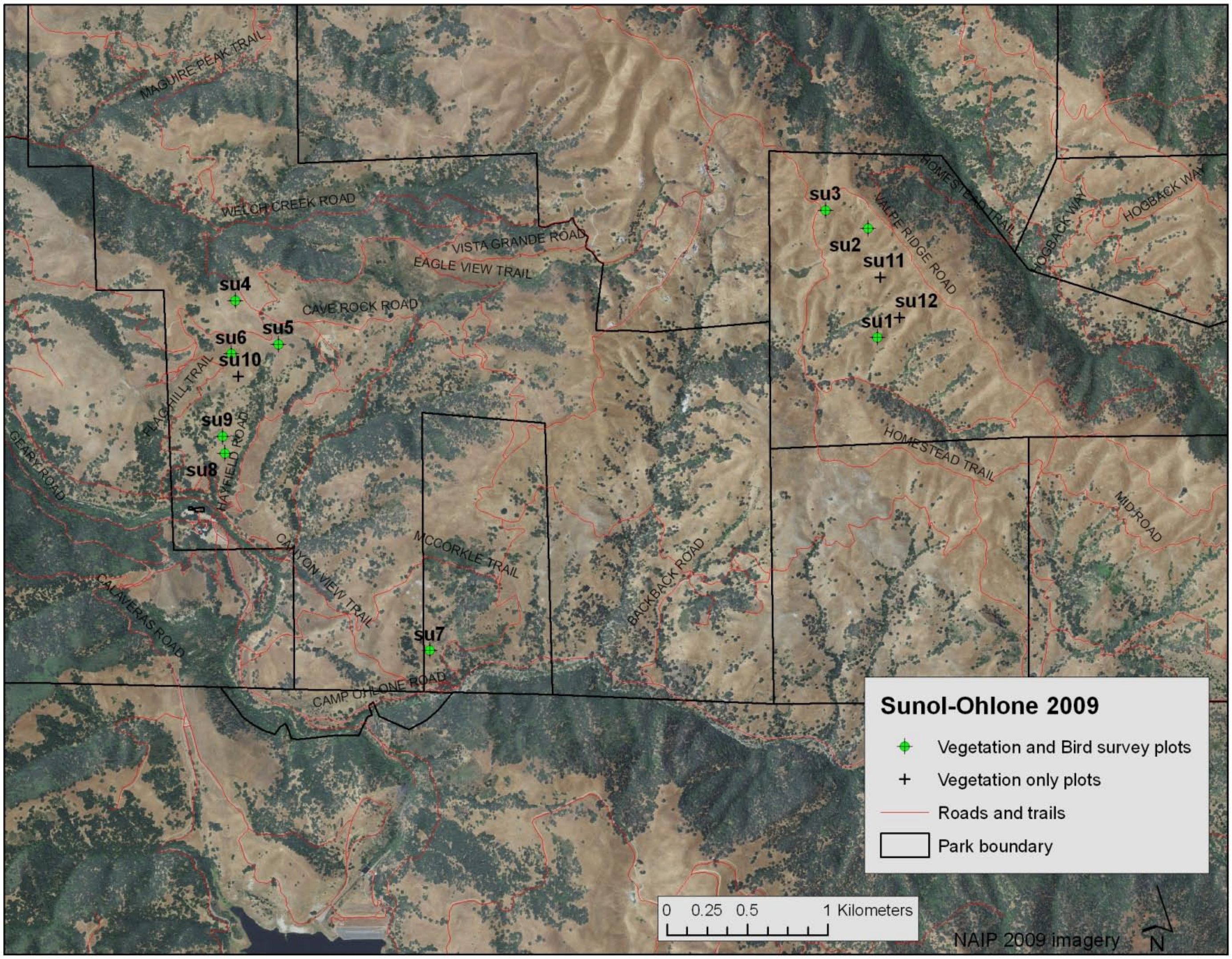

Figure 5.5-1: Sunol-Ohlone plot locations, SU1-12

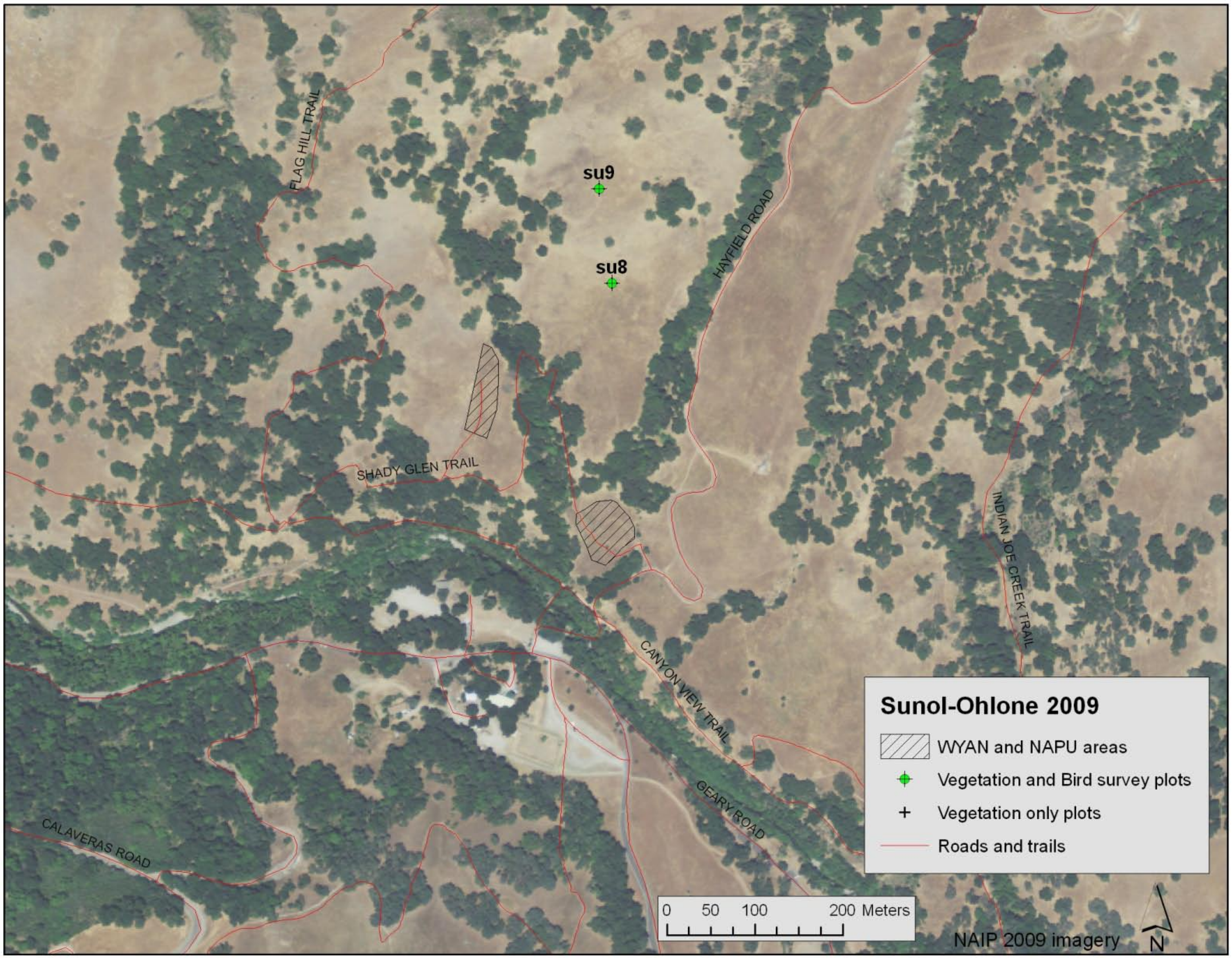

Figure 5.5-2: Sunol-Ohlone location of native areas near plots SU8 and SU9; WYAN= narrowleaf mule ear (*Wyethia angustifolia*), NAPU=purple needlegrass (*Nassella pulchra*)

Full site description and vegetation

We sampled nine plots from 2005-2008 and twelve plots from 2009-2011 at Sunol-Ohlone. From 2005-2008, six plots (SU1-6), located on Valpe Ridge and in High Valley, were cattle-grazed; three plots (SU7-9), located near the Park headquarters or Little Yosemite, were ungrazed. In 2009, three new ungrazed plots were added: two on Valpe Ridge and one in High Valley (see 2008 annual report for further details). All twelve plots were Valley grassland.

Common, non-native grasses and forbs dominated the Sunol-Ohlone plots (Table 5.5-5); native plants were nonetheless abundant in many of the plots (Table 5.5-6). Forbs were notably more abundant at Sunol-Ohlone than at any other of the study parks, with three forb species at higher cover than purple needlegrass, elsewhere the most common native species (Table 5.5-7).

Table 5.5-5: **Sunol-Ohlone plots SU1-12**: top 10 species by percent average annual absolute cover, 2005-2011; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Bromus hordeaceus	exotic	Limited	11
Avena fatua	exotic	Moderate	10
Bromus diandrus	exotic	Moderate	9
Erodium botrys	exotic		8
Lolium multiflorum	exotic	Moderate	8
Brachypodium distachyon	exotic	Moderate	8
litter			7
Avena barbata	exotic	Moderate	7
soil			3
Vulpia bromoides	exotic		3

Table 5.5-6: **Sunol-Ohlone plots SU1-12**: percent total annual native absolute cover and total annual native species richness, 2005-2011; wavy horizontal lines indicate there were fewer plots prior to 2009

Year	Total native absolute cover (%)	Total native species richness	Number of plots
2005	15.2	31	9
2006	9.7	28	9
2007	7.1	30	9
2008	8.0	27	9
2009	12.7	40	12
2010	9.0	32	12
2011	6.4	23	12

Table 5.5-7 lists all native species either hit on transect or observed within plot at the twelve Sunol-Ohlone plots from 2005-2011, with average annual cover for the species hit on transect.

Table 5.5-7: **Sunol-Ohlone plots SU1-12**: native species found 2005-2011, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Native species	Average absolute cover (%)
Viola pedunculata	2.059
Trifolium willdenovii	1.205
Sidalcea malviflora	0.972
Nassella pulchra	0.570
Holocarpha heermannii	0.556
Lupinus bicolor	0.541

Lupinus formosus	0.441
Lotus wrangelianus	0.313
Sisyrinchium bellum	0.273
Trifolium gracilentum	0.223
Ranunculus californicus	0.218
Lupinus nanus	0.203
Lupinus sp.	0.193
Elymus multisetus	0.184
Eschscholzia californica	0.179
Lagophylla ramosissima	0.134
Micropus californicus	0.134
Calystegia subacaulis	0.104
Vulpia microstachys	0.104
Achillea millefolium	0.094
Amsinckia menziesii var. *intermedia*	0.089
Chlorogalum pomeridianum	0.089
Trifolium bifidum	0.074
Sanicula bipinnatifida	0.060
Clarkia sp.	0.055
Plagiobothrys sp.	0.050
Achyrachaena mollis	0.040
Clarkia purpurea	0.040
Hesperevax sparsiflora	0.040
Linanthus bicolor	0.040
Melica californica	0.035
Sanicula bipinnata	0.035
Triteleia laxa	0.035
Trifolium microcephalum	0.030
Dichelostemma capitatum	0.025
Vicia americana	0.025
Epilobium brachycarpum	0.020
Lepidium nitidum	0.020
Madia sp.	0.015
Sanicula sp.	0.015
Amsinckia menziesii	0.010
Calochortus sp.	0.010
Castilleja attenuata	0.010
Eremocarpus setigerus	0.010
Madia gracilis	0.010
Plagiobothrys nothofulvus	0.010
Poa secunda ssp. *secunda*	0.010
Aphanes occidentalis	0.005
Astragalus gambelianus	0.005
Calochortus luteus	0.005

Juncus bufonius	0.005
Linanthus parviflorus	0.005
Linanthus sp.	0.005
Lomatium utriculatum	0.005
Lupinus succulentus	0.005
Marah fabaceus	0.005
Microseris douglasii	0.005
Plagiobothrys canescens	0.005
Plantago erecta	0.005
Stebbinsoseris heterocarpa	0.005
Trifolium ciliolatum	0.005
Trifolium microdon	0.005
Vulpia microstachys var. *ciliata*	0.005
Wyethia angustifolia	0.005
Agoseris sp.	Observed
Allium serra	Observed
Astragalus sp.	Observed
Brodiaea elegans	Observed
Bromus carinatus	Observed
Castilleja exserta	Observed
Chenopodium californicum	Observed
Clarkia affinis	Observed
Claytonia perfoliata	Observed
Delphinium variegatum	Observed
Elymus glaucus	Observed
Epilobium sp.	Observed
Galium aparine	Observed
Gilia tricolor	Observed
Grindelia sp.	Observed
Heterotheca sessiliflora	Observed
Quercus douglasii	Observed
Quercus lobata	Observed
Trichostema lanceolatum	Observed
Trifolium depauperatum	Observed

Appendix Table B.5 lists all species, both native and non-native, either hit on transect or observed within plot at the twelve Sunol-Ohlone plots from 2005-2011. At least 75 native species were observed, including 6 perennial grasses, 1 annual grass, 41 annual forbs, 23 perennial forbs, 2 non-grass graminoids, and 2 trees. We also observed at least 61 non-native species, with an additional 2 species of unknown origin (Appendix Table B.5).

5.6 Sycamore Valley Regional Open Space Preserve

Park summary and options

We sampled six plots at Sycamore Valley Regional Open Space Preserve from 2002 through 2007 (Figure 5.6). All six plots were Valley grassland and had very low levels of native species. Three of the plots were cattle-grazed (SV4-6), and the other three were ungrazed (SV1-3).

In the six years that we sampled at Sycamore Valley, we observed 22 native species, including 1 grass and 21 forbs; and we observed at least 48 non-native species.

Invasive plants management

One major pest plant species was found on plot at Sycamore Valley: yellow starthistle (*Centaurea solstitialis*). The District may wish to target this species for control and, if feasible, elimination.

In addition, there are significant populations of Harding grass (*Phalaris aquatica*) in the Short Ridge Unit and of black mustard (*Brassica nigra*) in the Home Owners Association Open Space. Both species occur at fairly high cover and can almost completely exclude other species, native or exotic, and so may be candidates for control measures.

Grassland restoration considerations

The Sycamore Valley area was cultivated for several crops in the late 1800s to the mid 1900s. Researchers have found that native perennial grasses and native annual forbs are often absent from areas with a history of cultivation. This may explain in part the low abundance of native species at Sycamore Valley. Grassland restoration may be more challenging and expensive as a consequence of this land-use history. In addition, the low levels of grassland native species mean natives are probably very seed-limited on site, increasing the difficulty of restoration.

In the 1950s, the rancher who owned Sycamore Valley before the District seeded 90 acres to “Sunol-grass”, a Harding grass cultivar (EBRPD 2005). Despite its use as a forage species, Harding grass can be toxic to livestock, causing a neurological condition known as phalaris staggers (DiTomaso and Healy 2007). Although Harding grass has difficulty establishing, once established, it often forms dense stands, displacing other species (DiTomaso and Healy 2007).

A model of nitrogen deposition for the Bay Area (Tonnesen et al. 2007) indicates that the Sycamore Valley area receives fairly low levels of nitrogen (~5 lbs/acre). Whether low to moderate deposition levels affect grassland species composition is unknown, but Weiss (1999) suggests that there may be chronic, long-term impacts. Cattle grazing may help mitigate such impacts.

Grazing management

The Project area managed by the District in Sycamore Valley had cattle grazing throughout the years of the Project. Adjacent ungrazed areas were managed by home owner’s associations. The park had paired cattle-grazed/ungrazed plots, surveyed from 2002-2007 (Tables 5.6-1 and 5.6-2). This park had very low levels of native species in both grazed and ungrazed plots, suggesting that grazing makes little difference to the presence or cover of native species in this park. The history of cultivation and the lack of natives limit the potential for using grazing management to achieve native plant species goals at Sycamore Valley. Livestock grazing can still provide services such as fuel management and wildlife habitat enhancement. Additionally, grazing can help keep black mustard in check, which may be why the mustard occurs primarily in the ungrazed areas. Depending on specifics of the grazing management at Sycamore Valley, grazing may also help control yellow starthistle.

Table 5.6-1: **Sycamore Valley**: percent average absolute native cover for ungrazed and grazed plots, 2002-2007

Year	**Ungrazed** native average absolute cover	**Grazed** native average absolute cover
2002	0.7	1.3
2003	0.5	1.1
2004	0.4	0.2
2005	1.4	1.3
2006	0.2	0.1
2007	0.4	0.5

Table 5.6-2: **Sycamore Valley**: average native species richness for ungrazed and grazed plots, 2002-2007

Year	**Ungrazed** average native species richness	**Grazed** average native species richness
2002	0.3	1.0
2003	0.3	1.0
2004	0.3	0.7
2005	1.0	1.0
2006	0.3	0.3
2007	0.7	1.0

Monitoring

The District may wish to conduct RDM mapping at Sycamore Valley for protection of natural resources. Effectiveness monitoring at Sycamore Valley could focus on invasive species, especially yellow starthistle, black mustard, and Harding grass. The areas of infestation could be mapped. Then permanent GPS photo points could be established and photographed every year. If the extent of the population has changed significantly, it could be re-mapped at the same time. Both the permanent photo points and the population extent mapping could be completed at the same time as RDM mapping, if desired. Another option would be to establish frequency plots to monitor the invasives.

Land-use history

With construction by the Spanish of Mission San Jose in the late 1700s, the San Ramon and Sycamore Valley areas became livestock grazing land for the mission. After the Mexican government gained control of California in 1835, the mission lands were split up and turned into large ranchos. Around 1850, settlers built homes and farms in the Sycamore Valley, eventually establishing the area as a productive agricultural region, raising livestock and a variety of crops (EBRPD 2005).

In 1862, the Wood family purchased the area around Sycamore Valley, eventually farming and ranching most of the land that is now Sycamore Valley Open Space Regional Preserve. The Wood family routinely managed their land by rotating crops and livestock over a three-year period. Crops were grown on ridge tops and lower slopes of hill and valley areas. Ninety acres of steeper mid-slopes were planted with a subspecies of Harding grass in the 1950s, probably to control erosion (EBRPD 2005).

By the turn of the last century, the Wood ranch was fragmented into multiple land use types. The flatter valley areas were developed into residential neighborhoods and the hilly ridge lands were acquired for private and public open spaces. To create Sycamore Valley Regional Preserve, the District acquired 255 acres of former farmland and rangeland as open space from the Town of Danville in 1998, along with 106 acres from the Wood Ranch subdivision, forming the Short Ridge Unit. When acquired by the District, none of these lands had been farmed or grazed since the early 1990s, although the town and development company disked with a tractor to create fire breaks. The District reintroduced cattle grazing to the Short Ridge Unit upon acquisition (EBRPD 2005).

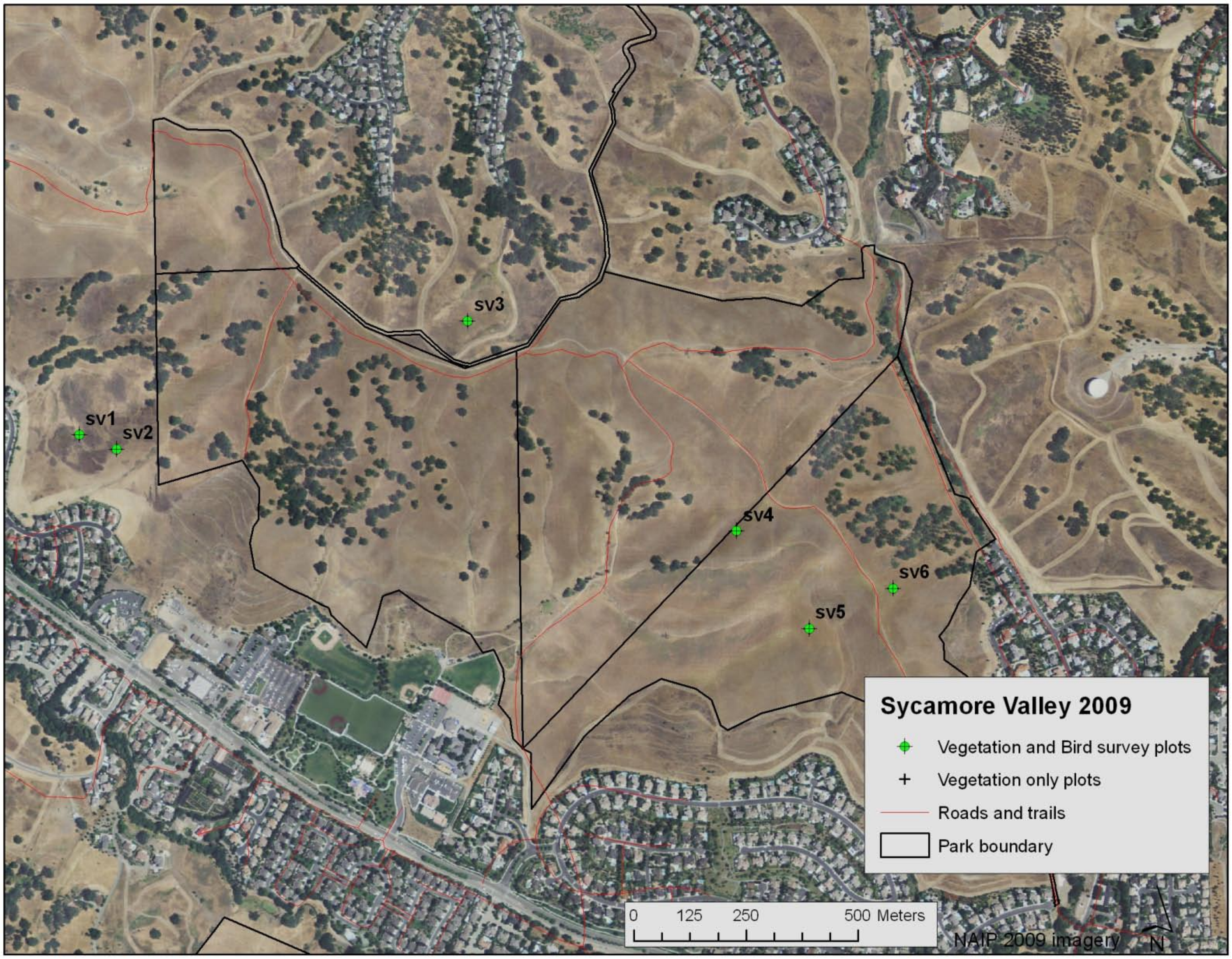

Figure 5.6: Sycamore Valley plot locations, SV1-6

<u>Full site description and vegetation</u>

We sampled six plots at Sycamore Valley from 2002 through 2007: three in the Short Ridge Unit (SV4-6), one in the Magee Ranch Home Owners Association Open Space (SV3), and 2 (SV1-2) in another Home Owners Association open space property. Three plots were grazed by cattle (SV4-6), and the other three plots were ungrazed (SV1-3). All plots were Valley grassland.

Like Brushy Peak, Sycamore Valley plots were dominated by non-native grasses and forbs (Table 5.6-3) and consistently had among the lowest levels of native plant cover: <u>total</u> annual native cover never exceeded 1.4% (absolute cover; 23 native hits out of 1680 total annual hits; Table 5.6-4). The total annual number (species richness) of native species found on transect was also low, varying from 2 to 5 (Table 5.6-4). SV3, an ungrazed plot, had a small population of harvest brodiaea (*Brodiaea elegans*) that reliably flowered every year.

Table 5.6-3: **Sycamore Valley plots SV1-6**: top 10 species by percent average annual absolute cover, 2002-2007*; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Lolium multiflorum	exotic	Moderate	21
Bromus hordeaceus	exotic	Limited	17
Bromus diandrus	exotic	Moderate	10
litter			8
Avena fatua	exotic	Moderate	7
Vicia villosa	exotic		4
Phalaris aquatica	exotic	Moderate	4
Carduus pycnocephalus	exotic	Moderate	3
Picris echioides	exotic	Limited	3
Geranium dissectum	exotic	Moderate	3

* *Brassica nigra* (black mustard) cover was underestimated in 2002 and 2003; true cover for black mustard could be as high as 6% and so this invasive species should probably be included in this table.

Table 5.6-4: **Sycamore Valley**: percent total annual native absolute cover and total annual native species richness, 2002-2007 (6 plots)

Year	Total absolute cover (%)	Total species richness
2002	1.0	3
2003	0.8	3
2004	0.3	3
2005	1.4	5
2006	0.2	2
2007	0.4	5

Table 5.6-5 lists all native species either hit on transect or observed within plot at the six Sycamore Valley plots from 2002-2007, with average annual cover for the species hit on transect.

Table 5.6-5: **Sycamore Valley plots SV1-6**: native species found 2002-2007, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Species	Average absolute cover (%)
Amsinckia menziesii var. *intermedia*	0.2
Lupinus bicolor	0.1
Malvella leprosa	0.1
Calystegia subacaulis	0.1
Epilobium sp.	0.1
Lupinus sp.	0.04
Eschscholzia californica	0.02

Trifolium bifidum	0.02
Bromus carinatus	0.01
Clarkia purpurea	0.01
Clarkia sp.	0.01
Epilobium brachycarpum	0.01
Trifolium gracilentum	0.01
Achillea millefolium	observed
Brodiaea elegans	observed
Castilleja exserta	observed
Chlorogalum pomeridianum	observed
Clarkia affinis	observed
Grindelia sp.	observed
Madia sp.	observed
Marah fabaceus	observed
Sisyrinchium bellum	observed
Triphysaria eriantha	observed
Triteleia laxa	observed

Appendix Table B.6 lists all species, both native and non-native, either hit on transect or observed within plot at the six Sycamore Valley plots from 2002-2007. At least 22 native species were observed, including 1 perennial grass, 10 annual forbs, 9 perennial forbs, and 2 forbs of unknown life history. We also observed at least 48 non-native species (Appendix Table B.6).

5.7 Vasco Caves Regional Preserve

Park summary and options

We sampled between six and seventeen plots at Vasco Caves from 2002 to 2011 (Figure 5.7). All seventeen plots were Valley grassland; eight of the plots (VC1-3, 8, 10, 15-17) were deliberately located within the park's notable purple needlegrass stands; the other plots either lacked significant purple needlegrass cover or were not part of the stratified plot design (the four Souza plots adjacent to windmills VC11-14). The grazing status of Vasco Caves plots varied over the study period, but during the final four years of the Project, 11 plots were grazed by sheep, and 6 plots were ungrazed.

Over the ten years that we sampled at Vasco Caves, we observed at least 73 native species, including 8 perennial grasses, 45 annual forbs, 19 perennial forbs, and 1 non-grass graminoid; and we observed at least 55 non-native species, with an additional 2 species of unknown origin.

Invasive plants management

With the exception of black mustard, the invasive species infesting the other study parks were extremely uncommon on our Vasco Caves plots over the course of the study. One major pest plant species was found on plot at Vasco Caves: yellow starthistle (*Centaurea solstitialis*); however, it was only found on transect in plot VC5 in 2002 (0.4% cover) and was not observed thereafter.

Black mustard (*Brassica nigra*) is fairly wide-spread at Vasco Caves: we have observed black mustard at least once on all plots at Vasco Caves. It has never exceeded 7% cover on any plot, however. Current grazing management probably provides some measure of control for the black mustard. Purple false-brome (*Brachypodium distachyon*) has been observed on plot at VC5 in 2006 and on plot VC13 in 2010 and found on transect at VC11 in 2010 (0.4% cover).

Grassland restoration considerations

Over the course of the study, Vasco Caves had moderate levels of native cover, primarily contributed by a significant population of purple needlegrass. Native species richness was also at moderate levels, especially at one plot VC8. Vasco Caves had a greater diversity of native perennial grasses than any other park in the study. This indicates that there is an in-situ source of germplasm for many native species in addition to the significant population of purple needlegrass, suggesting restoration and enhancement potential.

Annual ryegrass (*Lolium multiflorum*) was strongly dominant at Vasco Caves. This non-native grass is known to form dense stands that may crowd out native species. Annual ryegrass may increase purple needlegrass mortality (Fehmi et al. 2004) and have other undesirable ecosystem effects. Cattle grazing may mitigate some of the impacts of annual ryegrass.

A model of nitrogen deposition for the Bay Area (Tonnesen et al. 2007) indicates that the Vasco Caves area receives moderate levels of nitrogen (~7 lbs/acre). Whether moderate deposition levels affect grassland species composition is unknown, but Weiss (1999) suggests that there may be chronic, long-term impacts. Cattle grazing may help mitigate such impacts, but the effects of sheep grazing may differ from that of cattle grazing; the two livestock species have different dietary preferences, which could affect the outcome of a conservation grazing program.

Grazing management

Vasco Caves had seasonal fast-rotation sheep grazing throughout the years of the Project. The park did not have ungrazed control areas until 2005. The primary focus of the grazed/ungrazed plot design was grazing effects on purple needlegrass, with a mostly balanced design initiated in 2008. Native cover tended to be higher on grazed plots in wetter years and higher on ungrazed plots in drier years (Table 5.7-1). Native species richness was higher in grazed plots in all years but 2005 (Table 5.7-2).

Table 5.7-**1**: **Vasco Caves (non-Souza) plots VC1-10, 15-17**: percent average absolute native cover for ungrazed and grazed plots, 2002-2011; N/A=not applicable*

Year	**Average native absolute cover (%)**		**Number of ungrazed plots**	**Number of grazed plots**
	Ungrazed	**Grazed**		
2002	N/A	12.4	0	6
2003	N/A	6.7	0	10
2004	N/A	5.8	0	10
2005	4.3	5.1	4	6
2006	3.4	4.3	4	6
2007	5.3	2.2	4	6
2008	9.5	8.9	6	7
2009	6.0	4.8	6	7
2010	8.6	6.9	6	7
2011	3.2	3.7	6	7

*Coefficient of variation is not included for this park because of the multiple changes in the number of plots.

Table 5.7-**2**: **Vasco Caves (non-Souza) plots VC1-10, 15-17**: average native species richness for ungrazed and grazed plots, 2002-2011; N/A=not applicable*

Year	**Average native species richness**		**Number of ungrazed plots**	**Number of grazed plots**
	Ungrazed	**Grazed**		
2002	N/A	2.3	0	6
2003	N/A	3.0	0	10
2004	N/A	3.0	0	10
2005	3.3	3.2	4	6
2006	1.0	3.8	4	6
2007	1.5	2.0	4	6
2008	2.3	3.9	6	7
2009	1.7	3.3	6	7
2010	2.0	3.1	6	7
2011	1.5	2.6	6	7

*Coefficient of variation is not included for this park because of the multiple changes in the number of plots.

The impact of livestock grazing on the purple needlegrass population at Vasco Caves was an important research focus of the Project. Purple needlegrass was the most abundant native species over all our study plots. Over the course of the Project, purple needlegrass was found on plot in five out of the seven Valley grassland parks (see 2009 annual report), but its main presence was at Chabot Ridge and Vasco Caves, parks which had grazed and ungrazed comparison plots[8]. Unfortunately, in both locations, circumstances made evaluating differences between grazed and ungrazed plots difficult. In 2007, ungrazed plots at Chabot Ridge started being grazed, and they had been subject to mowing and nearby oak planting for several years; there may also be confounding differences in soil factors between the grazed and ungrazed plots at Chabot Ridge. At Vasco Caves, there was only one ungrazed purple needlegrass plot from 2005-2007, precluding any statistical analysis. Furthermore, the grazed plot with the highest purple needlegrass cover burnt in the June 2006 wildfire, probably reducing cover, at least in the first year after the fire. These confounding factors make it difficult to draw strong conclusions about the effect of grazing on purple needlegrass prior to 2008.

To address the lack of paired grazed/ungrazed plots in areas of high purple needlegrass cover, three new plots were added to Vasco Caves in 2008. Plots were randomly located within areas of high purple needlegrass cover; two of the plots were in areas fenced out of sheep-grazing in 2008, the other continued to be sheep-grazed (Table 5.7-4).

Over the years of the Project, purple needlegrass has fluctuated widely from year to year, regardless of plot grazing status or park (see 2009 annual report): for several years, there was a steady decline; more recently, cover stabilized or even increased, but then fell again. These trends generally occurred in all parks and on grazed and ungrazed plots leading us to surmise that trends were related primarily to regional environmental factors, especially rainfall patterns, with livestock grazing exerting little influence. The two most recent years of data (2010-2011) at Vasco Caves support this hypothesis: trends in cover of purple needlegrass were similar for both grazed and ungrazed plots (Table 5.7-3). See Table 5.7-9 for purple needlegrass cover in all years at Vasco Caves.

Table 5.7-**3**: Purple needlegrass (*Nassella pulchra* or NAPU) cover on ungrazed and sheep-grazed plots, Vasco Caves, 2008-2011

plot ID	**grazing status**	**NAPU absolute cover (%)**			
		2008	**2009**	**2010**	**2011**
VC10	ungrazed since 2005	20.7	18.2	19.6	6.1
VC15	ungrazed since 2008	17.9	4.3	15.0	5.7
VC16	ungrazed since 2008	12.5	8.2	10.4	2.9
	Annual average:	**17.0**	**10.2**	**15.0**	**4.9**
	Annual average's percent of 2008 average:	**100.0**	**60.1**	**88.1**	**28.7**
VC2	sheep-grazed	22.1	8.2	12.9	7.9
VC3	sheep-grazed	6.1	2.9	4.3	2.1
VC8	sheep-grazed	2.9	2.1	4.3	4.3
VC9	sheep-grazed	0.4	0.4	0.4	0.7
VC17	sheep-grazed	9.3	7.9	11.4	4.6
	Annual average:	**8.1**	**4.3**	**6.6**	**3.9**

[8] Pleasanton Ridge also has notable purple needlegrass cover but has no ungrazed comparison plots.

Annual average's percent of 2008 average:	**100.0**	**52.6**	**81.6**	**48.2**

Livestock grazing provides services such as wildlife habitat enhancement and fuel management. Additionally, grazing can help keep black mustard in check, which may be why the mustard occurs primarily in the ungrazed plots at Vasco Caves.

Monitoring

The District may wish to conduct RDM mapping at Vasco Caves for protection of natural resources. Effectiveness monitoring could focus on the purple needlegrass stands. One or two permanent line-point transects could be established in the purple needlegrass stands to monitor changes in cover. Another option would be to track trends in purple needlegrass with frequency plots. One plot, VC8, had high native species richness; a relevé plot sited in plot VC8 would provide information on native species diversity. If the District wants to collect further data on effects of sheep grazing on purple needlegrass at Vasco Caves, continued sampling of the Project's paired ungrazed/grazed plots would allow for multi-year analyses, although the District may not wish to collect data at the research level used in this study.

Land-use history

Fairly detailed land use history is available for parts of Vasco Caves because Dina Robertson (2004), a graduate student with the Project, investigated the area's land use history for her thesis. Starting in the late 1700s, the area was part of the Spanish Mission San Jose grazing lands, which were grazed by an estimated 350,000 head of cattle, as well as other livestock species (Robertson 2004). Grazing by cattle and sheep continued in the area throughout the Mexican rancho period and after the land passed into U.S. ownership (Robertson 2004). The District acquired the main portion of the park and changed the management from cattle to sheep grazing in 2000 to achieve (EBRPD 2000). The northern portion of the park (Souza I property acquired later), switched to sheep grazing in 2005 from cow-calf cattle grazing management for the same resource conservation objectives.

The cultivation history of Vasco Caves is uncertain prior to the 1940s; especially during the last half of the 19th century, extensive areas in the region were dry-land farmed for grain (Robertson 2004; EBRPD 2000). Robertson (2004) concludes, however, that during the period 1940-2000, much of Vasco Caves was free of cultivation. The presence of extensive purple needlegrass cover supports this conclusion, as the native bunchgrass is generally absent in cultivated areas (Stromberg and Griffin 1996; Hamilton et al. 2002).

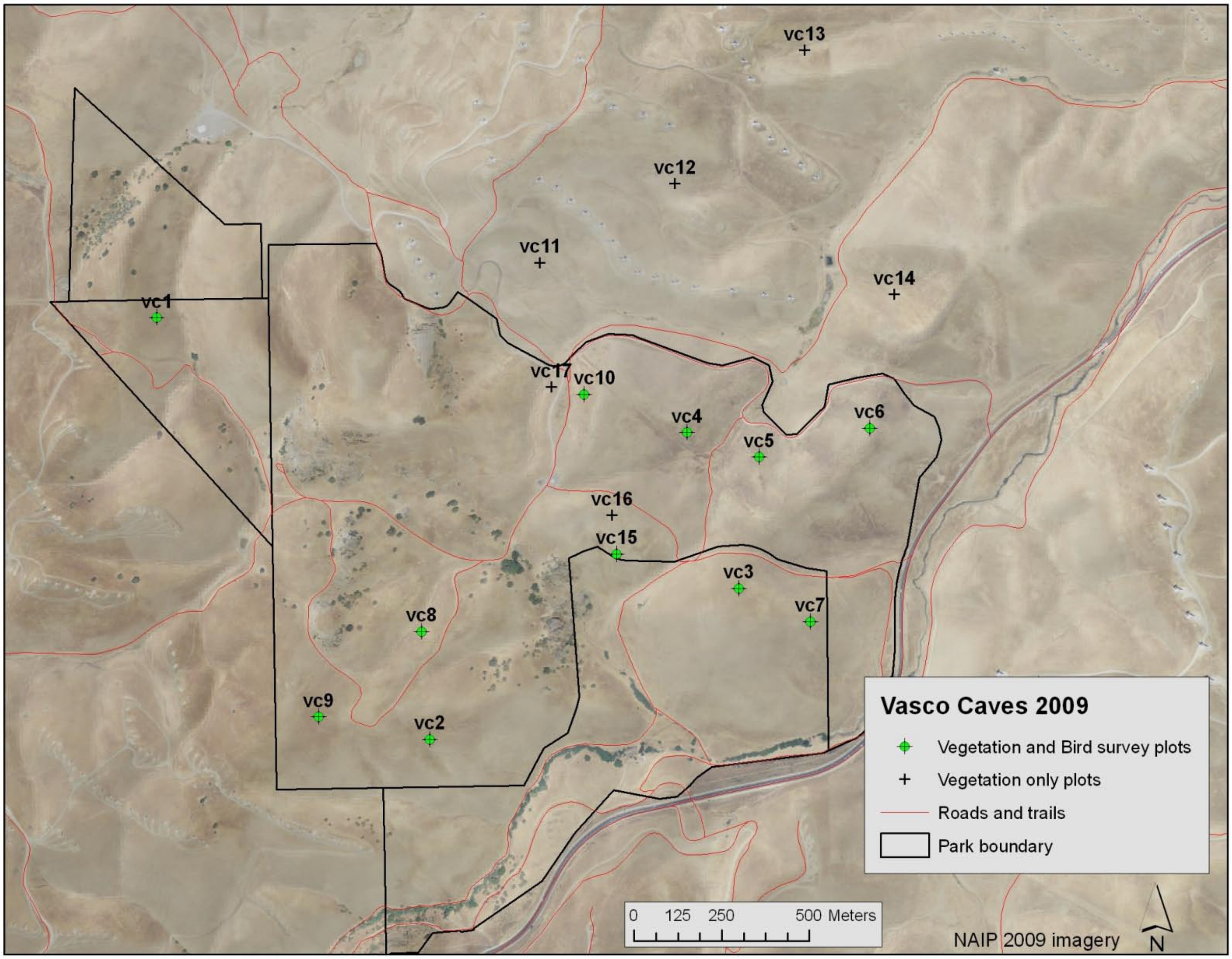

Figure 5.7: Vasco Caves plot locations, VC1-17

Full site description and vegetation

We sampled between six and seventeen plots at Vasco Caves from 2002 to 2011: six plots in 2002 (Vasco Caves central VC1-6), ten plots in 2003 and 2004 (Vasco Caves central VC1-10). Four plots (VC11-14) were added in the new Souza I property adjacent to the north and thus fourteen plots (VC1-14) were surveyed from 2005-2007. Three more plots (VC15-17) were added (in purple needlegrass areas, see above for details) creating a total of seventeen plots (VC1-17) from 2008-2011. The grazing status and changing numbers of the Vasco Caves plots is somewhat complicated and so is described in Table 5.7-4. All seventeen plots were Valley grassland; eight of the plots (VC1-3, 8, 10, 15-17) were deliberately located within purple needlegrass stands (classed as "native" plots); the other plots either lacked significant purple needlegrass cover (classed as "exotic" plots) or were not part of the stratified plot design (Souza property "windmill" plots (VC11-14); Table 5.7-4).

A wildfire on June 19, 2006, added a further complication. The fire burned three Vasco Caves plots: VC2, VC8, and VC9; in addition, VC9 was disturbed by emergency vehicles post-fire (tire tracks and likely compaction). Plant cover and species richness were potentially affected by the fire for at least 2-3 years.

Table 5.7-**4**: Grazing status and classification of Vasco Caves plots, 2002-2011; shaded cells=plots not yet established; *plots burned in June 2006 wildfire

Plot	**Plot classification**	**Grazing status**				
		2002	**2003-2004**	**2005**	**2006-2007**	**2008-2011**
VC1	native	sheep	sheep	sheep	sheep	sheep
VC2	native	sheep	sheep	sheep	sheep*	sheep
VC3	native	sheep	sheep	sheep	sheep	sheep
VC4	exotic	sheep	sheep	ungrazed	ungrazed	ungrazed
VC5	exotic	sheep	sheep	ungrazed	ungrazed	ungrazed
VC6	exotic	sheep	sheep	ungrazed	ungrazed	ungrazed
VC7	exotic		sheep	sheep	sheep	sheep
VC8	native		sheep	sheep	sheep*	sheep
VC9	exotic		sheep	sheep	sheep*	sheep
VC10	native		sheep	ungrazed	ungrazed	ungrazed
VC11	not included in plot classification (Souza plots)			cattle	sheep	sheep
VC12				cattle	sheep	sheep
VC13				cattle	sheep	sheep
VC14				cattle	sheep	sheep
VC15	native					ungrazed
VC16	native					ungrazed
VC17	native					sheep

Vasco Caves plots were dominated by the usual suite of non-native grasses and forbs (Tables 5.7-5 and 5.7-6), with the exception of purple needlegrass in the non-Souza plots, which just squeaked into the top 10 species (Table 5.7-5). Annual ryegrass (*Lolium multiflorum*) was strongly dominant at Vasco Caves: making up 80-90% of the cover in some plots in some years. During the ten years of this study, annual ryegrass contributed over a quarter of the cover in the non-Souza plots (Table 5.7-5) and almost half of the cover in the Souza plots (Table 5.7-6).

Annual ryegrass is known to thrive in warm, mesic, and nitrogen-rich environments (Gulmon 1979); in such conditions, it can form dense stands that may crowd out native species. Annual ryegrass has been found to increase mortality of purple needlegrass (Fehmi et al. 2004) and has been implicated in the local extinction of endangered Bay checkerspot butterfly populations in south San Jose serpentine grasslands via its effect on native forbs that serve as larval host plants (Weiss 1999). Cattle grazing has been shown to mitigate some of the impacts of annual ryegrass (see Section 2.3 above, 2006 Annual report, and Weiss 1999).

Table 5.7-**5**: **Vasco Caves (non-Souza) plots VC1-10, 15-17**: top 10 species by percent average annual absolute cover, 2002-2011; see Appendix B for further information on Cal-IPC ratings

Species	**Origin**	**Cal-IPC**	**Average absolute**

		rating	cover (%)
Lolium multiflorum	exotic	Moderate	26
Bromus hordeaceus	exotic	Limited	10
Bromus madritensis ssp. *madritensis*	exotic		9
litter			9
Bromus diandrus	exotic	Moderate	6
Avena fatua	exotic	Moderate	5
Avena barbata	exotic	Moderate	5
Erodium botrys	exotic		5
Nassella pulchra	native		4
soil			4

Table 5.7-**6**: **Vasco Caves Souza plots VC11-14**: top 10 species by percent average annual absolute cover, 2005-2011; see Appendix B for further information on Cal-IPC ratings

Species	Origin	Cal-IPC rating	Average absolute cover (%)
Lolium multiflorum	exotic	Moderate	47
Bromus madritensis ssp. *madritensis*	exotic		19
Bromus hordeaceus	exotic	Limited	14
litter			5
Bromus diandrus	exotic	Moderate	3
Hordeum marinum ssp. *gussoneanum*	exotic	Moderate	2
soil			1
Hordeum murinum	exotic	Moderate	1
Brassica nigra	exotic	Moderate	1
Medicago polymorpha	exotic	Limited	1

As noted above, purple needlegrass contributed most of the native cover at Vasco Caves (Tables 5.7-7 and 5.7-9). Native species richness was at moderate levels (Table 5.7-7). One plot in particular, VC8, contained more native species than other Vasco Caves plots; in 6 of 9 years, it had the highest species richness of all Vasco Caves plots, and in 3 of those 6 years, double the species richness of the next richest plot.

Table 5.7-7: All Vasco Caves plots VC1-17: percent total annual native absolute cover and total annual native species richness, 2002-2011; wavy lines indicate which years plots were added and denote changes in number of plots

Year	Total absolute cover (%)	Total species richness	Number of plots
2002	12.4	10	6
2003	6.7	18	10
2004	5.8	18	10
2005	4.5	26	14

2006	3.5	20	14
2007	2.5	8	14
2008	7.7	19	17
2009	4.4	19	17
2010	6.3	19	17
2011	3.0	14	17

Table 5.7-8 provides cover values for purple needlegrass on all plots in which the native bunchgrass occurred over the course of the study. As noted above, purple needlegrass cover is highly variable from year to year in all plots, suggesting that annual weather patterns play a strong controlling role.

Table 5.7-**8**: Purple needlegrass (NAPU) percent absolute cover at Vasco Caves plots with purple needlegrass, 2002-2011; UG =plots ungrazed; shaded cells=plots not yet established; *plot burned in June 2006 wildfire

Plot	**NAPU absolute cover (%)**									
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
VC2	45.4	21.8	18.9	15.0	11.1	5.0*	22.1	8.2	12.9	7.9
VC3	5.0	2.5	3.6	1.4	2.1	1.8	6.1	2.9	4.3	2.1
VC8		3.2	6.8	2.9	0.7	1.8*	2.9	2.1	4.3	4.3
VC9		0	0.7	0	0.4	0.7*	0.4	0.4	0.4	0.7
VC10 (UG 2005-2011)		11.4	6.8	12.1	10.4	18.9	20.7	18.2	19.6	6.1
VC13				0	0	0	0	0	0	0.4
VC15 (UG)							17.9	4.3	15.0	5.7
VC16 (UG)							12.5	8.2	10.4	2.9
VC17							9.3	7.9	11.4	4.6

Table 5.7-9 lists all native species either hit on transect or observed within plot at the seventeen Vasco Caves plots from 2002-2011, with average annual cover for the species hit on transect.

Table 5.7-9: All Vasco Caves plots VC1-17: native species found 2002-2011, with percent average annual absolute cover for species hit on transect, observed species were found within the area of the plot

Species	**Average absolute cover (%)**
Nassella pulchra	4.335
Amsinckia menziesii var. *intermedia*	0.686

Marah fabaceus	0.604
Melica californica	0.488
Achillea millefolium	0.441
Leymus triticoides	0.282
Achyrachaena mollis	0.157
Lupinus microcarpus var. *microcarpus*	0.157
Ranunculus californicus	0.116
Trifolium oliganthum	0.083
Chlorogalum pomeridianum	0.056
Triteleia laxa	0.053
Lagophylla ramosissima	0.051
Triphysaria pusilla	0.046
Trifolium willdenovii	0.046
Hesperevax sparsiflora	0.043
Lotus wrangelianus	0.043
Lupinus bicolor	0.040
Amsinckia menziesii	0.038
Grindelia camporum	0.030
Sanicula bipinnata	0.030
Eremocarpus setigerus	0.026
Trifolium gracilentum	0.023
Epilobium brachycarpum	0.020
Lupinus microcarpus ssp. *densiflorus*	0.020
Crassula connata	0.019
Aphanes occidentalis	0.017
Castilleja exserta	0.017
Microseris douglasii	0.017
Calandrinia ciliata	0.016
Dichelostemma capitatum	0.013
Galium aparine	0.013
Astragalus asymmetricus	0.010
Linanthus bicolor	0.010
Lupinus affinis	0.010
Lupinus microcarpus	0.007
Poa secunda	0.007
Astragalus sp.	0.003
Elymus glaucus	0.003
Grindelia sp.	0.003
Lepidium nitidum	0.003
Lupinus sp.	0.003
Microseris douglasii ssp. *tenella*	0.003
Plagiobothrys canescens	0.003
Plagiobothrys nothofulvus	0.003
Sanicula bipinnatifida	0.003

Trifolium bifidum	0.003
Agoseris sp.	observed
Allium serra	observed
Asclepias fascicularis	observed
Athysanus pusillus	observed
Brodiaea elegans	observed
Calystegia subacaulis	observed
Castilleja attenuata	observed
Clarkia affinis	observed
Clarkia purpurea	observed
Claytonia parviflora	observed
Claytonia perfoliata	observed
Collinsia sparsiflora	observed
Delphinium sp.	observed
Distichlis spicata	observed
Dodecatheon clevelandii	observed
Elymus multisetus	observed
Epilobium canum	observed
Eschscholzia californica	observed
Euphorbia spathulata	observed
Juncus mexicanus	observed
Lupinus nanus	observed
Lupinus succulentus	observed
Madia sp.	observed
Melica torreyana	observed
Plantago erecta	observed
Trifolium ciliolatum	observed
Trifolium depauperatum	observed
Trifolium depauperatum var. *amplectens*	observed
Trifolium microcephalum	observed
Trifolium microdon	observed
Triphysaria eriantha	observed
Vicia americana	observed

Appendix Table B.7 lists all species, both native and non-native, either hit on transect or observed within plot at the seventeen Vasco Caves plots from 2002-2011. At least 73 native species were observed, including 8 perennial grasses, 45 annual forbs, 19 perennial forbs, and 1 non-grass graminoid. We also observed at least 55 non-native species, with an additional 2 species of unknown origin (Appendix Table B.7).

6.0 References

Note: all links current as of June 29, 2012.

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7.0 Management and monitoring recommendations grassland bird introduction

7.1 Grassland bird monitoring recommendation overview

Conservation and management of habitat for grassland birds within the East Bay Regional Park District system is important and should continue to be a priority both for land stewardship and acquisition. The District is already playing an essential role in Alameda and Contra Costa counties by acquiring, preserving and managing large areas of grassland for biodiversity and recreation. The Grassland Monitoring Project report will help inform management and monitoring plans that maintain and enhance the current native diversity of grassland vegetation and bird communities.

<u>Importance and value of grassland bird monitoring</u>

Why the focus on the District's grassland bird species for monitoring and management? Grassland bird populations are in serious decline in both California as well as North America according to overviews from North American Bird Conservation Initiative (2009; http://www.state of the birds.org) and the North American Breeding Bird Survey (Sauer and Link 2011). There is very little published information about California's grassland bird species habitat requirements or population demographics. The Project's long-term ecological study adds essential information to grassland bird conservation in California as well as contributing the background necessary to create a science-based monitoring protocol for the District's grassland bird community (see section 8.0).

Regional datasets of grassland bird species distributions match the Project findings. Alameda and Contra Costa County Breeding Bird Atlas, a volunteer-based county-wide species survey, show the same grassland bird species breeding in the same larger areas as the District parklands (see sections 8.2 and Appendix E).

<u>Grassland Monitoring Project avian sampling overview</u>

The Grassland Monitoring Project avian sampling followed the vegetation sampling plot design, with the exception of continuing the same basic subset of plots throughout the length of the Project (2002-2011). The seven District parks included Brushy Peak, Lake Chabot (Fairmont Ridge), Morgan Territory, Pleasanton Ridge, Sunol-Ohlone, Sycamore Valley, and Vasco Caves (see Figures 5.1-5.7 for park maps and Appendix A for plot summary and details). The first two years of the Project (2002-2003) are considered pilot years for the avian dataset and are only included in the descriptive aspects of the summary analysis. Chabot-Fairmont Ridge was the only park not sampled for the duration of the avian sampling survey, 2004-2011.

The Project chose to focus on four grassland bird species of conservation and management concern that are common throughout the District's grasslands. These species represent a grassland bird guild for their association with and dependence on grassland habitat within the Project area and are focal species in the California Partners in Flight grassland bird conservation plan (CPIF 2000): Grasshopper Sparrow (*Ammodramus savannarum*), Horned Lark (*Eremophila alpestris*), Savannah Sparrow (*Passerculus sandwichensis*), and Western Meadowlark (*Sturnella neglecta*). Species with direct associations to a particular vegetation or habitat type, such as grassland-obligate species, are likely to be good monitoring indicators of grassland ecosystem health (Carignan and Villard 2002).

The Project uses different avian datasets for qualitative descriptions within the study and quantitative statistical descriptions of the avian point count surveys. The qualitative or observational summaries use the full dataset which includes all observations from the Project for all years and types of surveys. The quantitative descriptions of the data use the restricted dataset which includes: avian survey plot subset (see Appendix A and Figures 5.1-5.7), on plot point count survey detections less than 100 meters from the centroid, and years 2004-2011. The analyses that use the restricted dataset are referenced as such. See section 10.0 for further explanation.

7.2 Goals of monitoring

Suggested emphases for grassland bird monitoring:
1) Goal: Determine long-term presence and diversity of grassland birds on District land
2) Goal: Use grassland bird species responses as an indicator of management change (e.g., livestock grazing, native plant restoration, prescribed fire, infrastructure development)
3) Goal: Determine long-term population trends for focal grassland bird species in the District's Valley grasslands

7.3 Bird monitoring methods overview

The California Partners in Flight grassland bird conservation plan (CPIF 2000) recommends the following monitoring methods for the conservation of California grassland birds depending on the land manager's goals and resources. Long-term monitoring is necessary for detecting natural or human-induced changes in bird populations. The Grassland Monitoring Project achieved eight years (2004-2011) of intensive point count surveys and vegetation measurements. The Project provides an estimate of management effects on grassland bird breeding success as well as habitat associations within East Bay Valley grassland. Table 7.1 below lists basic bird monitoring regimes ranked from least to most intensive and matched with possible monitoring goals. See Section 8.6 for detailed descriptions of survey methods.

Table 7.1: Monitoring regimes from least to most intensive

Goal	Method	Survey length
Rapid assessment of grassland area with presence/absence of habitat indicator species	Point count or area search	One year, one survey per site
Determine breeding status, habitat association, restoration evaluation or evaluation of changes in management practices	Point count or area search	Three surveys per year for minimum 3 years; surveying should continue for at least 10 years.
Determination of population health or source/sink status	Point count or area search survey combined with demographic monitoring, e.g. spot-mapping or nest monitoring	Multiple surveys per season; minimum of 3 years, 4 years preferable

8.0 Grassland bird overview

8.1 Population decline of grassland birds in California and North America

Grassland birds as a group are in serious decline in North America generally and California specifically. Species included in this group are birds that nest and forage primarily within grassland vegetation types and are considered grassland-obligate birds. The United States State of the Birds Report confirmed that grassland birds in North America are significantly and consistently declining at a rate more rapid than that of other bird groups (U.S. NABCI Committee 2009, http://www.state of the birds.org). In the most recent analysis of the North American Breeding Bird Survey (BBS), Sauer and Link (2011) report that from 1968-2008, grassland-obligate bird species survey-wide experienced a total population change of negative 37% (CI -55.8, -10.4). Included in this BBS declining trend across North America are common grassland species found on District grasslands: Grasshopper Sparrow (*Ammodramus savannarum*), Horned Lark (*Eremophila alpestris*), Savannah Sparrow (*Passerculus sandwichensis*), and Western Meadowlark (*Sturnella neglecta*).

In addition to a continent-wide decline, Western Meadowlarks and Horned Larks show a significant decline when the Breeding Bird Survey dataset is restricted both to the California region and a more recent time period, 1980-2007. Western Meadowlarks have a significant declining trend of negative 2.18 (CI -2.19, 0.002) and Horned Larks have an even more serious decline of negative 4.62 (CI -4.69, 0.00). Grasshopper Sparrows and Savannah Sparrows do not show a significant trend within the California region dataset (Sauer 2008). This lack of a significant trend may be an artifact of the small number of observations for these two species on survey routes in the California region. The BBS dataset is the only available breeding bird dataset for grassland-obligate species that estimates population trend within California. This dataset, however, has infrequent surveys throughout the state, only three routes within Alameda and Contra Costa counties, and not enough individual detections to calculate significant trends for these grassland bird species.

Multiple reasons for the North-American decline in grassland birds have been proposed including the regrowth of eastern forests, fragmentation and degradation of midwestern prairies and the deterioration of western rangelands by a combination of exotic plant invasion, drought, lack of fire, heavy livestock grazing and road building (Brennan and Kuvlesky 2005; Knopf 1994; Peterjohn and Sauer 1999). California's grassland bird decline is less well documented and understood. Three published student works (Collier 1994; Gennet 2007; Goerrissen 2005), as well as one soon to be published manuscript, Gennet et al. (in prep.), look at California-specific habitat characteristics, but not population demographics, in inland and coastal grassland bird populations.

8.2 Local grassland bird guild distribution in Alameda and Contra Costa counties (Breeding Bird Atlas data)

Breeding Bird Atlas (BBA) data for the grassland bird guild species, from Alameda and Contra Costa counties, gives a regional distribution of these species (see Appendix E for species maps) as well as breeding status information. BBA information is compiled using volunteer surveys, with each county divided into 5 km blocks. BBA protocols for the determination of possible, probable and confirmed breeding status are fairly standard and follow North American Ornithological Atlas Committee guidelines (NORAC 2008). For Contra Costa County, BBA information was collected from 1998-2002 and for Alameda County from 1993-1997.

Overall, the Grassland Monitoring Project dataset expands the number of BBA blocks with grassland bird breeding presence. The atlas information corroborates many of our findings for each species distribution throughout the two counties. The Grasshopper Sparrow is a confirmed breeder in the western part of Contra Costa County in the BBA data but not in the eastern portion, where the Project data also find the species to be less common. This pattern is repeated for Alameda County, with confirmed breeding of the Grasshopper Sparrow only in the western portion of the coast range. Horned Larks are distributed widely over both BBA counties with Project data reflecting the same pattern. Savannah Sparrows are uncommon breeders in the interior areas of Contra Costa and Alameda counties, with confirmed breeding in blocks close to the bay and delta system. This is reflected by the scarcity of Savannah Sparrows in the Project dataset which covers mostly interior areas in both counties. In contrast, Western Meadowlarks are ubiquitous confirmed and probable breeders throughout both counties and in both datasets.

Lake Chabot-Fairmont Ridge had very few observations of the grassland bird guild, with only Western Meadowlark detections. BBA data for the blocks surrounding this portion of the park shows no presence of the guild. The proximity of a densely-populated urban area and likely heavier recreational use may be reasons for the absence of breeding grassland bird species.

8.3 Relative abundance of grassland bird guild for Grassland Monitoring Project 2004-2011

All the parks surveyed had the presence of the three most abundant grassland bird guild species, Grasshopper Sparrow, Horned Lark and Western Meadowlark except Lake Chabot-Fairmont Ridge which only supported the occasional migrating Western Meadowlark.

Brushy Peak and Vasco Caves supported the highest overall relative abundances (number of birds detected per plot averaged by park and all years) of all four grassland species, which is the Western Meadowlark (BP 2.38 (±1.25) and VC 2.84 (±0.79)) (Table 8.1). In other words, Western Meadowlarks were most likely to be found and were also the most numerous of the grassland bird guild at Brushy Peak and Vasco Caves over all years of the study. Horned Larks had the highest overall relative abundance on plot at Pleasanton Ridge (2.46 (±0.67). Sycamore Valley was the park that supported the highest overall relative abundance of Grasshopper Sparrows and Vasco Caves had the highest overall relative abundance for the Savannah Sparrow. Overall relative abundances of avian grassland guild species were not calculated for Lake Chabot-Fairmont Ridge due to lack of sufficient observations or detections.

Table 8.1: District parks avian grassland guild overall relative abundance*; restricted dataset (≤100m); bold are mean values >2.0

Years Surveyed	Park	Plots	Grasshopper Sparrow Mean (SD)	Horned Lark Mean (SD)	Savannah Sparrow Mean (SD)	Western Meadowlark Mean (SD)
2004-2011 (not 2009)	Brushy Peak	6	0.14 (±0.20)	0.57 (±0.62)	0.33 (±0.53)	**2.38** (±1.25)
2004 **2005-2011**	Morgan Territory	6 10	0.28 (±0.19)	0.90 (±0.33)	0.03 (±0.07)	0.23 (±0.39)
2004-2011	Pleasanton Ridge	6	0.88 (±0.54)	**2.46** (±0.67)	0.42 (±0.27)	0.65 (±0.85)
2005-2011	Sunol-Ohlone	9	0.35 (±0.25)	1.05 (±0.48)	0.00	0.86 (±0.39)
2004-2011	Sycamore Valley	6	1.00 (±0.45)	0.04 (±0.13)	0.08 (±0.09)	1.50 (±0.89)
2004-2011 **2008-2011**	Vasco Caves	10 11	0.10 (±0.16)	1.24 (±0.57)	0.75 (±1.10)	**2.84** (±0.79)

**Relative abundance* is calculated for each species as the total detections per plot averaged annually for the park. The *overall relative abundance* is averaged over all years surveyed for the park, SD is standard deviation; relative abundance measures use the restricted dataset (observations on plot ≤100m).

The individual avian grassland guild species annual relative abundances, or annual mean plot detection per park using the restricted dataset (≤ 100m), varied with a range from 0.0 to 4.09 showing temporal or year to year variation (Figures 8.1-8.4). Brushy Peak had an avian grassland guild species annual relative abundance range of 0.0 to 4.0, Morgan Territory ranged from 0.0 to 1.30, Pleasanton Ridge ranged from 0.0 to 3.67, Sunol-Ohlone ranged from 0.0 to 1.78, Sycamore Valley ranged from 0.0 to 2.83, and Vasco Caves ranged from 0.0 to 4.09.

This variation may be driven by the variation in weather although detection data do not reflect any clear trends related to weather for the eight years included in the survey, 2004-2011.

Grasshopper Sparrow's annual relative abundance range for all parks is 0.0 to 1.67 (Figure 8.1). Their only real presence is in Pleasanton Ridge (0.0-1.67) and Sycamore Valley (0.0-1.17) with the other parks relative abundances remaining close to zero. Savannah Sparrows annual relative abundance range for all parks is 0.0 to 3.10 (Figure 8.3) This species appears to be the most ephemeral guild species, showing up in some years only at Vasco Caves (0.0 to 3.10) and Pleasanton Ridge (0.0-0.83).

Western Meadowlarks annual relative abundance range for all parks is 0.0 to 4.09 (Figure 8.4) This species shows up consistently at Vasco Caves (1.80-4.09) and Brushy Peak (0.17-4.00), both parks located in the same east county area. Relative abundances of Western Meadowlarks do not show any clear effect of the drought years 2007-2008; there is a slightly lower presence at Vasco Caves and Sycamore Valley during these years but Brushy Peak does not show the same dip in relative abundance.

Horned Larks annual relative abundance range for all parks is 0.0 to 3.67. This species is consistently present in all of the parks, with the exception of Sycamore Valley (0.0-0.33), over the years of the study. Horned Larks show a relative abundance above zero every year in Morgan Territory (0.4-1.30), Pleasanton Ridge (1.67-3.67), Sunol-Ohlone (0.44-1.78) and Vasco Caves

(0.45-2.30). Pleasanton Ridge shows the highest annual presence of this species with a relative abundance of 3.67. See Appendix F for annual relative abundance tables for year to year means for each species by park.

Figure 8.1: Grasshopper Sparrow (*Ammodramus savannarum*) annual relative abundance for each park, 2004-2011; Brushy Peak not surveyed in 2009, Sunol-Ohlone not surveyed in 2004; Lake Chabot-Fairmont Ridge not included; restricted dataset

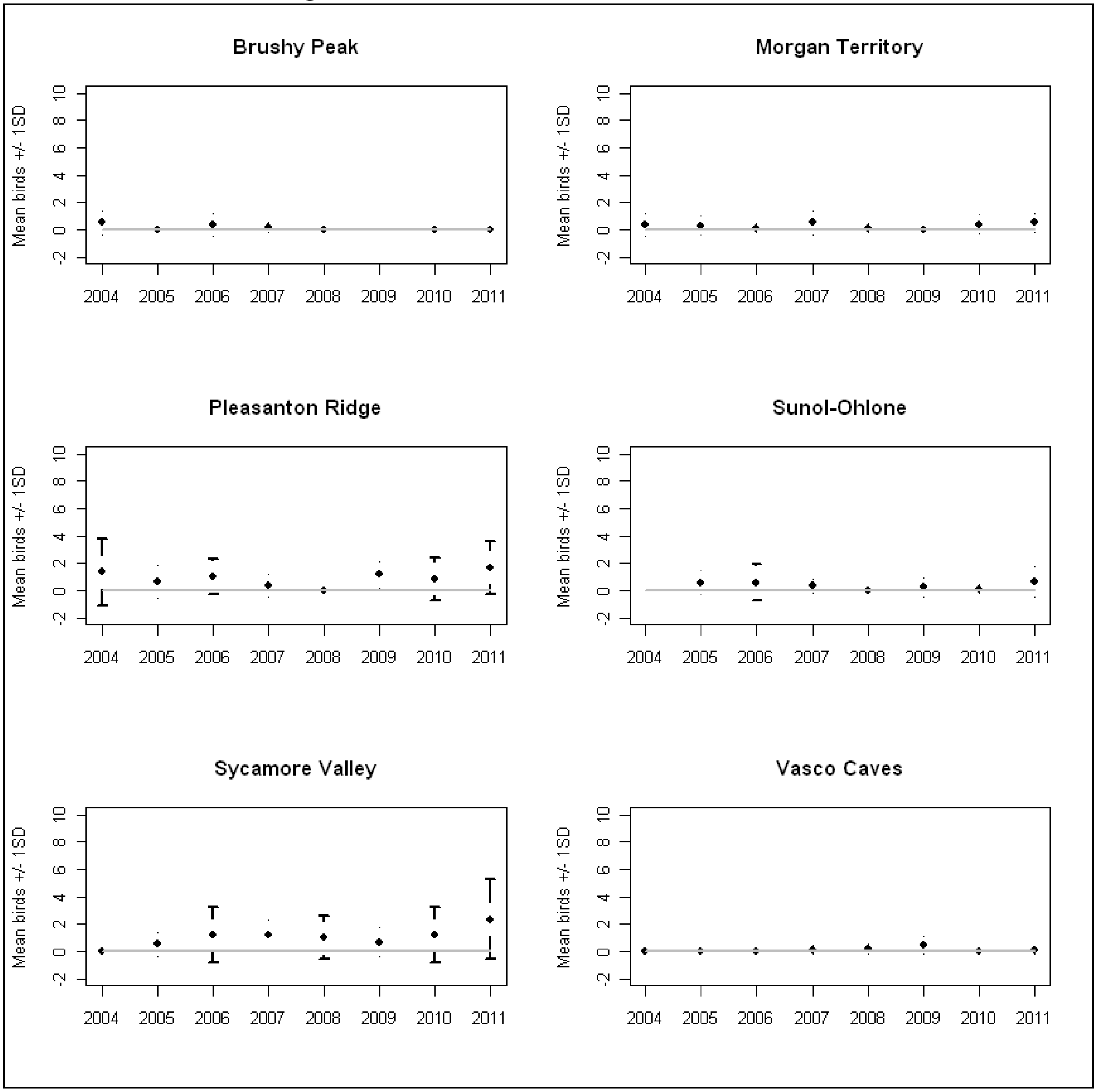


Figure 8.2: Horned Lark (*Eremophila alpestris*) annual relative abundance for each park, 2004-2011; Brushy Peak not surveyed in 2009, Sunol-Ohlone not surveyed in 2004; Lake Chabot-Fairmont Ridge not included; restricted dataset

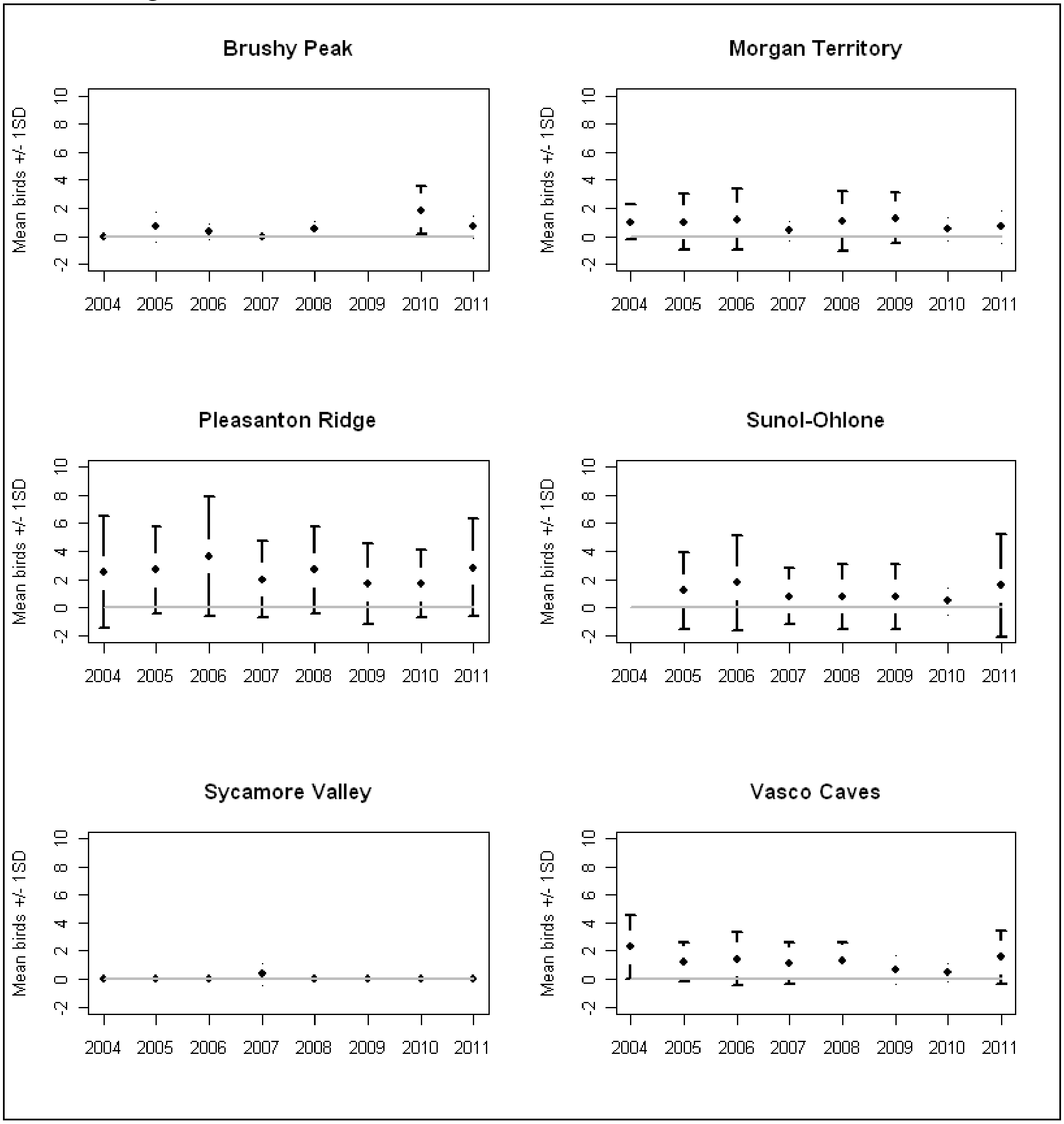


Figure 8.3: Savannah Sparrow (*Passerculus sandwichensis*) annual relative abundance for each park, 2004-2011; Brushy Peak not surveyed in 2009, Sunol-Ohlone not surveyed in 2004; Lake Chabot-Fairmont Ridge not included; restricted dataset

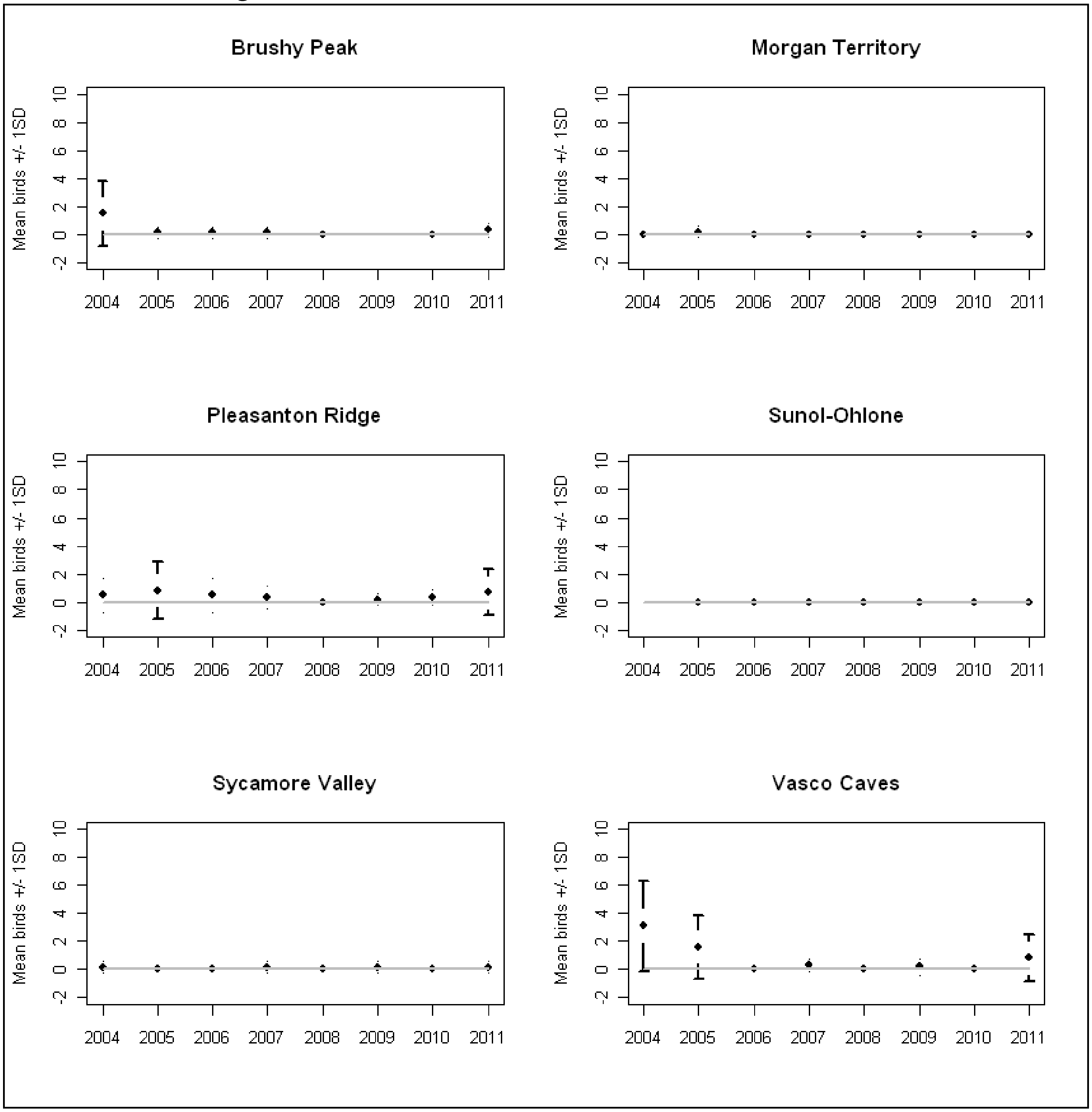
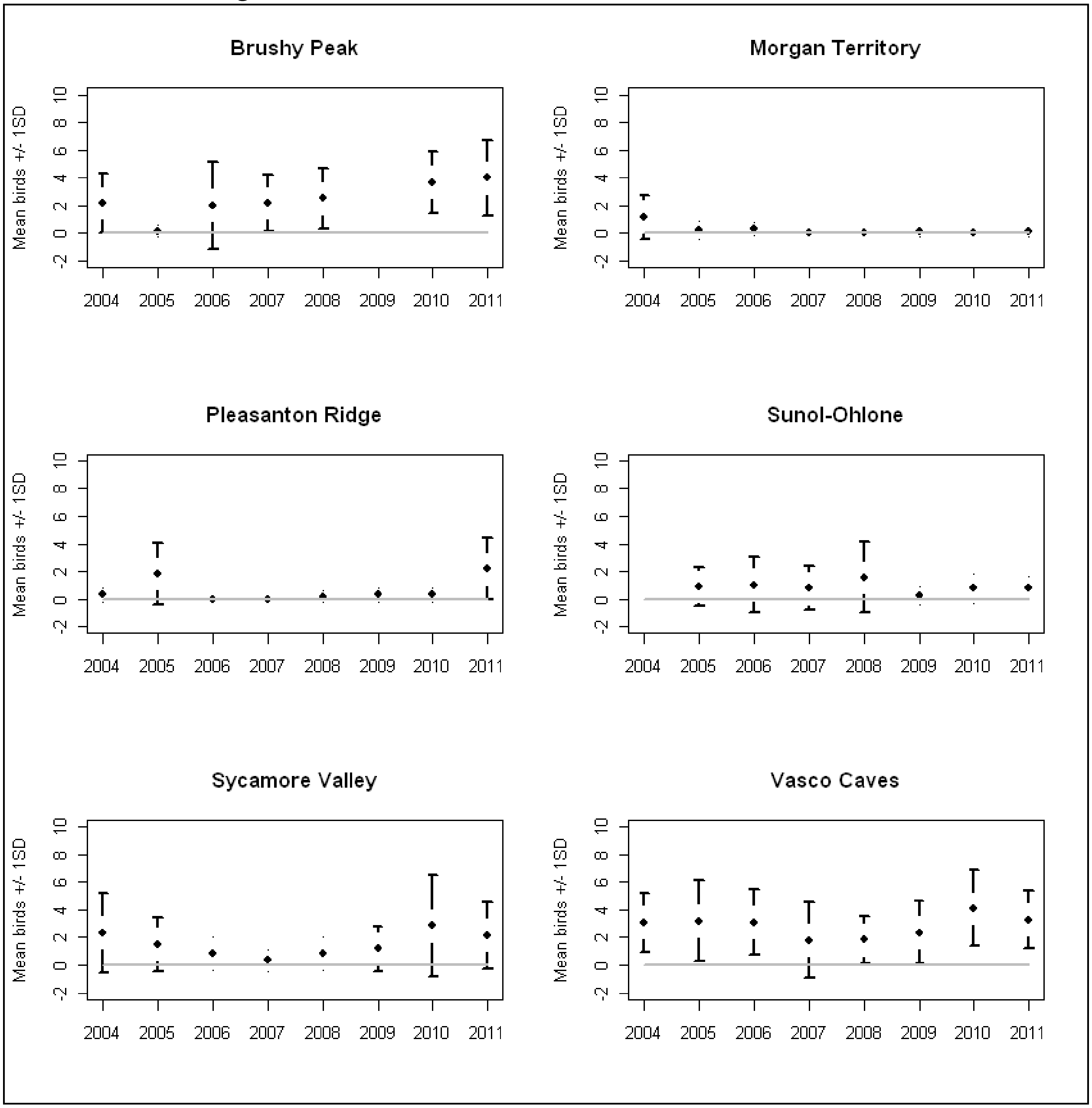


Figure 8.4: Western Meadowlark (*Sturnella neglecta*) annual relative abundance for each park, 2004-2011; Brushy Peak not surveyed in 2009, Sunol-Ohlone not surveyed in 2004; Lake Chabot-Fairmont Ridge not included; restricted dataset



8.4 Regional issues for grassland birds in California

Current issues facing grassland birds in California include 1) the widespread conversion of native habitat to exotic annual grassland in many grassland types and 2) the grassland habitat loss, degradation, and fragmentation caused by intensive agriculture and urban and suburban development (CPIF 2000; Shuford et al. 2008). Climate change, however, is not predicted to be a major factor affecting the future populations of grassland birds in California. In a recent assessment of at-risk birds for California, Gardali et al. (2012) found that grassland and oak woodland birds were the least vulnerable taxa to climate change. This opinion is largely based on the prediction that grassland vegetation will expand within California and not contract like other habitat types (Lenihan et al. 2008). Quality or native-ness of the grassland is not included in these predictions.

1) Negative effect of exotic plant invasion on grassland habitat

The conversion from native grassland to exotic annual grassland dominance happened before the mid-1800s in California (Schiffman 2007a). See section 2.0 for a more detailed explanation of the current Valley grassland plant community in the East Bay and restoration prospects. A large scale restoration attempt of these areas back to a “pristine” native grassland state is not possible, although current management for a native-like grassland and controlling or eradicating certain noxious invasive plants will benefit grassland bird species and other native wildlife.

Gennet et al. (in prep.), as part of the Grassland Monitoring Project, found strong positive associations of grassland bird species with native plant cover in the East Bay. Another study which included Californian native and exotic dominated grasslands (Goerrissen 2005), found that Grasshopper Sparrows were associated with native bunchgrass cover. Goerrison’s explanation for this behavior is that an area dominated by native bunchgrasses creates a preferable structure to the grassland layer, which allows for a variation in height and density of grasses. Vegetation structure may be a primary factor for grassland birds when they choose areas for nesting and foraging (Rotenberry and Wiens 1980).

A study in southeastern Arizona grasslands suggests prey abundance may be another reason birds avoid exotic plant dominated areas (Litt and Steidl 2010). Litt and Steidl found increasing levels of exotic plant invasion have a strong negative effect on insect richness and overall abundance. Grassland bird species are known to primarily eat insects during the breeding season (Wiens and Rotenberry 1979) which may also explain their higher presence in native grassland areas in California. Kennedy et al. (2009) also found that bunchgrass prairie plant communities with low to moderate levels of exotic plants are still suitable habitat for grassland-obligate bird species in northeastern Oregon. However, when this Oregon study compared insect abundance (terrestrial arthropods) with percent non-native plant cover there was no noticeable negative effect. The Grassland Monitoring Project also had a similar preliminary finding of no noticeable increase in grassland insect abundance in the District’s more native grassland areas (see 2008 Annual Report for insect survey summary).

2) Effects of grassland habitat fragmentation

California is becoming increasingly urbanized as many agricultural areas are transforming into larger metropolitan areas with a mix of open space and development. Alameda and Contra Costa counties specifically are a matrix of open grasslands and oak woodlands with suburban communities to the east moving into dense urban development in the western portion along San Francisco Bay. The District plays an important role in the Bay Area by acquiring and preserving large tracts of grassland habitat and thus lessening the impacts of urban growth and sprawl on native wildlife. Large contiguous areas of grassland are known to be important for many grassland-obligate species, like Grasshopper Sparrows, which research from other regions has shown prefer large grassland patches for breeding (e.g., Davis 2004; Jobin and Falardeau 2010; Johnson and Igl 2001). Ribic et al. (2009), in an overview of multiple studies throughout the Midwest and Canada, found all four of the common grassland species in our study to increase in density or occurrence with larger patches of grassland.

Grassland bird species have also shown sensitivity to edge effects which can be more prevalent in highly fragmented habitat. Some of the parks where our study is located, Pleasanton Ridge, Lake Chabot, and Sycamore Valley, have dense suburban and urban communities adjacent to their grassland habitat. Multiple studies have shown the avoidance of wooded edges by grassland birds (e. g., Patten et al. 2006; Renfrew and Ribic 2003; Ribic et al. 2009), but there is also evidence that grassland birds prefer nesting at least 200 meters from the edge of suburban development (Bock et al. 1999). District parks potentially have high levels of recreation, especially in locations adjacent to suburban or urban communities or with popular hiking or mountain biking trails. Smaller grassland areas would logically have a higher level of disturbance to breeding birds by both hikers and dog walkers (Banks and Bryant 2007).

3) Windmill disturbance

The Souza property adjacent to Vasco Caves has current disturbance to grassland birds from the operation of windmills and future issues with the replacement and relocation of windmills during the repowering effort (Smallwood and Karas 2009). There are a few studies detailing the negative effect of windmills on raptors and passerines, both in the Midwest (Leddy et al. 1999) as well as locally in the Altamont Pass area (Smallwood et al. 2010; Smallwood and Karas 2009). Leddy et al. (1999) suggest that windmills should be located in areas that are already known to be poor habitat for grassland birds, i.e., areas where grassland-obligate bird species are absent or at low density. For district grasslands, this could mean areas where there is little native plant abundance, i.e. Brushy Peak instead of Vasco Caves although this merits further investigation.

4) Livestock grazing

The response of grassland birds to livestock grazing is species specific, variable and likely dependent on site characteristics as well as the type of grazing system. In a review of studies done in western North America (although none in California), Saab et al. (1995) found Western Meadowlarks and Grasshopper Sparrows show mixed negative, positive, and neutral responses to livestock grazed habitat depending on the reported grazing intensity, type of grazing system, or type of grassland. Savannah Sparrows show only negative responses to livestock grazing in the review by Saab et al. (1995), although fewer studies included this species. Horned Larks show an overall preference for livestock grazed areas across many different grassland types (Saab et al. 1995). Recent studies have shown no difference in abundance of Western Meadowlarks in cattle grazed or ungrazed areas in the inter-mountain region of British Columbia, an area which shows a steep decline of this species (Harrison et al. 2010).

The first year of a more local study in coastal prairie grassland at Jenner Headlands and Sonoma Coast State Park, found that the grazed grassland (Jenner) showed a different grassland bird community from the ungrazed grassland (Sonoma Coast), although the site differences may confound the grazing treatment (DiGaudio 2010). Sonoma Coast is a flat marine terrace with twice as much shrub cover than Jenner which has more varied topography and well drained soils. Several grassland species were absent or rare in the ungrazed Sonoma Coast including Grasshopper Sparrow, Lark Sparrow, and Horned Lark. Savannah Sparrow is at the same approximate relative abundance, 2.53 and 2.55 (±0.39 and 0.53) in both locations. It is interesting to note that the relative abundance of Grasshopper Sparrow at Jenner, 1.53 (SE ±0.39), is within the range of annual relative abundance for this species in District grasslands during the ten years of the Project (0.0 to 1.67). Savannah Sparrow show the same pattern with relative abundances from both locations fitting within the range of this species during the Project (0.0 to 3.10). See section 8.3 for further detail on the Project avian grassland guild relative abundance numbers.

Within the District grasslands, Horned Larks show this preference for livestock grazed areas most strongly in areas of low native plant abundance (Gennet et al. in prep.). Horned Larks may be responding to an increased structural heterogeneity in livestock grazed Valley grassland, which in the East Bay is mostly a dense and homogeneous plant community dominated by annual grasses. Grazing by livestock at moderate stocking rates (Bartolome et al. 2006) alters the physical characteristics of the even grass layer through defoliation and trampling (Jackson and Bartolome 2007). This effect may partially mitigate the structural changes resulting from the historic shift from perennial- to annual-dominated vegetation in Valley grassland.

Targeted livestock grazing and fire are frequently used as conservation tools to increase the heterogeneity of grasslands in the Great Plains region. Much recent emphasis has been placed on moving away from livestock grazing practices that utilize the grassland uniformly, e.g. short-duration, fast rotation grazing, instead of practices like yearlong grazing that typically create patches of different vegetation heights as well as bare ground areas (Coppedge 2008; Derner et al. 2009; Fuhlendorf and Engle 2001; Fuhlendorf et al. 2006).

8.5 Suggested monitoring goals

Depending on the goals of District management, different levels of monitoring intensity are recommended for grassland birds.

Suggested emphases would be:

1) Goal: Determine the long-term presence and diversity of grassland birds on District land

Repeat current permanent breeding season (April-June 15) grassland point count surveys on a rotation of 5-7 years; to detect if grassland guild bird species are still present in grassland areas where they are currently located. Using volunteers, conduct area searches in accessible areas in December-January for wintering species. (all parks)

2) Goal: Use grassland bird species response as an indicator of grassland management (e.g., livestock grazing, native plant restoration, prescribed fire, infrastructure development)

Create intensive avian monitoring plan, with a balanced experimental design using point count surveys or area searches that cover extent of grassland (e.g., in a grid pattern), i.e., survey livestock grazed and ungrazed areas or areas where native plant enhancement or weed removal occurs with a similar area, or control area, where no management occurs. Include moderate intensity vegetation monitoring at each location (Vasco Caves, Sunol-Ohlone, other parks with consistent presence of grassland bird species) Annual surveys recommended.

3) Goal: Determine long-term population trends for focal grassland bird species in the District's Valley grasslands

Combine new plot locations with current plots in areas that have consistent grassland bird presence. Emphasis on permanent long-term annual surveys and not multiple parks to reduce cost. For instance, surveys could target Vasco Caves, Sunol-Ohlone, or other parks with higher abundance of grassland species.

8.6 Bird survey methods

Grassland point count survey

Point count surveys for the Grassland Monitoring Project follow standardized protocol (Ralph et al. 1995) which allows the data to be part of a larger effort. Variable circular plot point count surveys in grasslands should be located at least 250 meters apart, have a 10 minute duration, and a 100 meter radius distance. Bird species are counted through visual or sound observation and the distance of individuals from plot center is estimated for every 10 meters. Three surveys per breeding season, between March 31 and June 15, are necessary to maximize the number of detections in a low-density grassland bird community. Counts are conducted within 3 hours of sunrise to capture highest level of bird activity.

The reasons to continue to use this type of point count for avian monitoring surveys include: comparable to other grassland bird monitoring, ability to calculate species density estimates with specific distance measurements, longer (10 minute) point counts recommended when travel time between counts is greater than 15 minutes, and most importantly longer (10 minute) counts to increase the detection of birds with low availability or perceptibility (Johnson 2008; Ralph et al. 1995)

Line or belt transect survey

A line or belt transect survey is a similar method to the point count survey, however, the observer walks in a line (transect) counting all birds that are seen or heard out to a pre-determined width to either side of the line. An avian survey done in California grasslands using this method covered a 2 hectare area with 2-200 meter transects with a width of 100 meters (Goerrison 2005). Belt transect surveys can increase detection for secretive species because they are flushed during the survey.

A belt transect survey is not recommended in many parks (Morgan Territory, Sunol-Ohlone) because of the difficulty of covering steep terrain with randomly located long transects. Identification of sparrow species (Grasshopper vs. Savannah) would potentially be more difficult with this type of transect survey if individuals were flushed from their habitat by the observer walking in a line instead of standing for a period of observation at a central point.

Area search

An area search is a survey of contiguous habitat area (grassland patch) where one observer can cover the habitat in approximately 20 minutes while counting and identifying all birds seen or heard. Abundance and diversity of the bird community can be quantitatively measured. This technique is easier for volunteer birders because it allows an individual to track down and identify unfamiliar birds. Area searches are commonly also used for winter surveys, when identification by song is not possible.

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10.0 Grassland bird management and monitoring for individual parks

Each park section will include a description of 1) grassland bird monitoring recommendation, 2) landscape description with associated imagery, 3) avian demographics or an overview of grassland bird survey data which includes a table of species annual average detections and a list of all bird species observed with its breeding status for the park. For more details on each park see sections 5.1-5.7 above which include vegetation management and monitoring recommendations, a land-use history and a map of plot locations. See also Appendices for further detail.

<u>Analysis dataset description: full and restricted</u>

The grassland bird analyses use the full avian monitoring dataset for descriptive summaries and the restricted dataset for statistical comparisons and modeling. The full dataset is intended as a comprehensive inventory of bird species and includes all observations of birds during field visits to each park for bird, vegetation and wildlife surveys for all years of the Project (2002-2011). The restricted dataset includes only the observations of birds located within 100 meters of the plot center during the point count survey for the years 2004-2011 (2002-2003 are pilot years). The restricted dataset also uses a reduced number of Project plots, the avian survey plot subset (see Appendix A and Figures 5.1-5.7). Use of a restricted dataset is recommended by Ralph et al. (1995; 1993) and is commonly used across California and North America to allow robust statistical comparisons of bird observations between sites and habitats.

<u>Breeding bird status code explanation:</u>

Breeding bird status codes are based on the following observations:

•) No evidence of breeding: bird encountered but no territorial or breeding behavior noted.
1) Possible breeder: bird encountered singing or acting territorial only once during the breeding season (in suitable habitat).
2) Probable breeder: singing individual encountered on two or more days of point count surveys (within a season, at least one week apart); territorial behavior noted more than once at the same location; pair observed in courtship behavior.
3) Confirmed breeder: nest building observed; nesting material or fecal sac being carried by adult; active nest observed; dependent juveniles with adults.

10.1 Brushy Peak

Grassland bird monitoring recommendation

Suggested goal: Include in survey of parks to determine the long-term presence and diversity of grassland birds on District land.

Because of the low numbers of grassland birds and low level of native plant cover at Brushy Peak recommendations for monitoring in this park are at the basic level.

Repeat current permanent grassland point count survey, BP6, on a rotation of 5-7 years. BP6 is the only current plot with a consistent presence of grassland bird species. Add point count surveys in areas of the park to the north which are at least 250 meters from each other and at a larger buffer distance from a non-grassland vegetation type (see landscape features below). Survey areas to the north for the presence of grassland bird species or native plant cover (plots BP10-12 possible but too far from BP6 area to logistically cover in one 3 hour survey). See map for plot locations (Figure 5.1).

Conduct area searches in accessible areas in December-January for wintering species.

Current locations of bird monitoring plots (see park map in Figure 5.1) are within approximately 200 meters of the edge of a landfill, riparian or woody vegetation or human structures (ranch house and barn complex). These non-grassland land-cover types are known to be avoided by grassland bird species. Brushy Peak has very low levels of upland grassland native plant cover, which Project research has shown to be important to grassland bird species in the East Bay, and may be a contributing factor to the scarcity of these species.

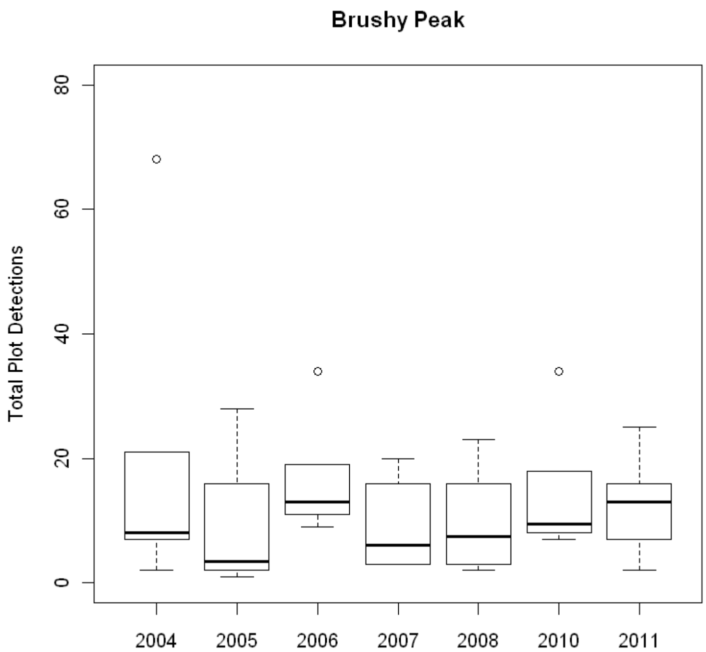
Landscape features:

Brushy Peak is part of a large grassland/oak woodland matrix with very little housing development to the north and is potentially fairly non-fragmented grassland bird habitat. However, Brushy Peak is located adjacent to several potential land-use areas that could affect grassland bird presence. There is windmill development to the north and east sides of the park with unknown disturbance effects. A landfill is directly west which attracts a large number of gulls (potential predators) in close proximity. Gulls were not detected on plot but as occasional individuals flying over the grassland. This park is also less than a mile from suburban housing development occupied in the last decade to the south (see Appendix H Brushy Peak landscape maps 1993-95 and 2009). Continued suburban development has potential to encroach on park.

Avian demographics:

Brushy Peak has a fluctuating overall number of plot total detections with pulses of wintering flocks, such as American Pipits (restricted dataset; Figure 10.1-1). The median total number of birds detected every year stays within 20 individuals and does not fluctuate widely following any predictable pattern such as climate. The median values show an up and down pattern but there is no clear response to weather patterns. Brushy Peak was not surveyed in 2009 but continued 2010-2011.

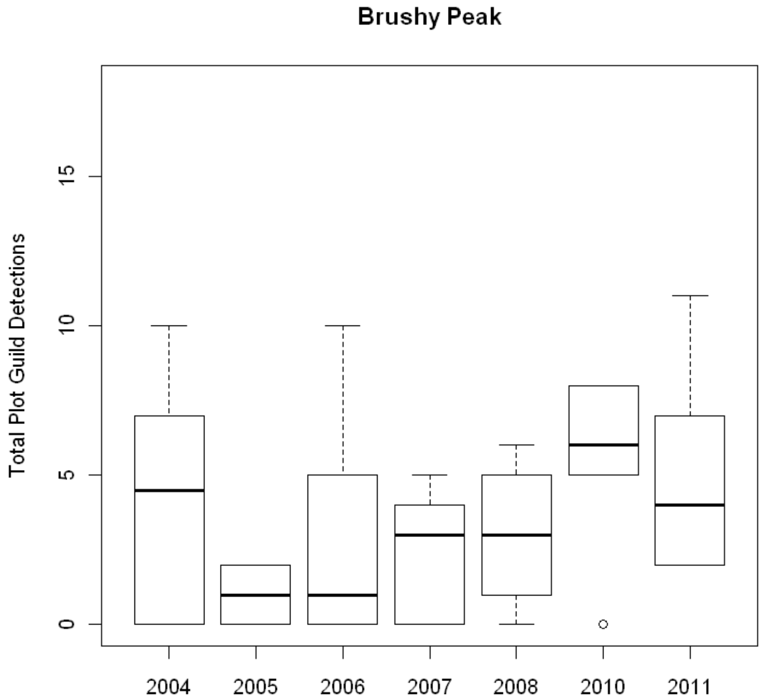
Figure 10.1-1: 2004-2008, 2010-2011 (2009 park not surveyed) Brushy Peak total annual avian detections; restricted dataset*



* Tukey boxplot shown, lines within box are the median of summed avian plot detections (all birds) per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

The grassland bird guild at Brushy Peak includes the four focal species, Grasshopper Sparrow, Horned Lark, Savannah Sparrow and Western Meadowlark (Figure 10.1-2). Total annual detections of the guild species are low at Brushy Peak with a lot of plot surveys having zero guild species. Median guild values rarely fluctuate above 5 even with annual variation. Landscape level effects mentioned previously as well as the lack of native plant cover in the area surveyed may be the cause of this low frequency grassland bird population.

Figure 10.1-2: 2004-2008, 2010-2011 (2009 park not surveyed) Brushy Peak total annual avian grassland guild detection*



* Tukey boxplot shown, lines within box are the median of summed plot detections per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

All four of the grassland bird focal species are present at Brushy Peak but not all species are present every year (Appendix F Table 1.1). Western Meadowlarks are the most frequent and abundant grassland bird species with an overall relative abundance of 2.38 (SD 1.25) and are probable breeders (Appendix F Table 1.2). Grasshopper Sparrow and Horned Lark are also probable breeders at Brushy Peak. Prairie Falcons have been seen at the park but never on plot during a point count survey.

10.2 Lake Chabot-Fairmont Ridge

Bird monitoring recommendation

Suggested goal: Include in survey of parks to determine the long-term presence and diversity of grassland birds on District land only if new point count locations are sited.

Grassland birds are almost entirely absent from the Project area during the breeding season possibly due to the smaller size of the grassland patch and the proximity to urban areas.

Current locations of point count plots are very close to the edge of eucalyptus woodland, coastal scrub, oak woodland, dense urban area, and a four-lane road (see Appendix H landscape photo 2009). Grassland area where current Project surveys are located is also a heavily recreated off-leash dog walking area.

The Fairmont Ridge area grassland has interesting native cover but a lot of anthropogenic disturbance which may cause the absence of breeding grassland bird species. An informal survey of Lake Chabot and Anthony Chabot grasslands might locate a grassland area with the presence of the grassland bird guild. Consult with local birding organizations for potential areas to survey.

Landscape features:

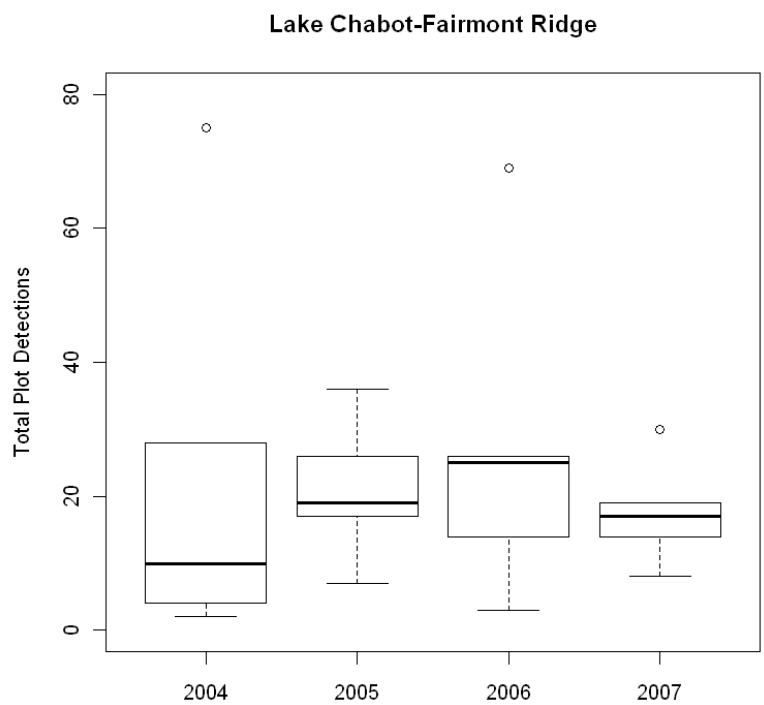
Adjacent to dense urban development, reservoir and four-lane road. Grassland area where counts are located is small and highly fragmented. There was no difference in development intensity of the surrounding areas for Lake Chabot so only the 2009 imagery map is included (see Appendix H).

Avian demographics:

See Figure 5.2 for park map. The vegetation plots in the ungrazed area of Lake Chabot-Fairmont Ridge were located within 100 meters of each other. For this reason vegetation plot CR2 was never included in the point count survey. Included in all bird analyses for this park are five plots CR1, CR3 – CR6.

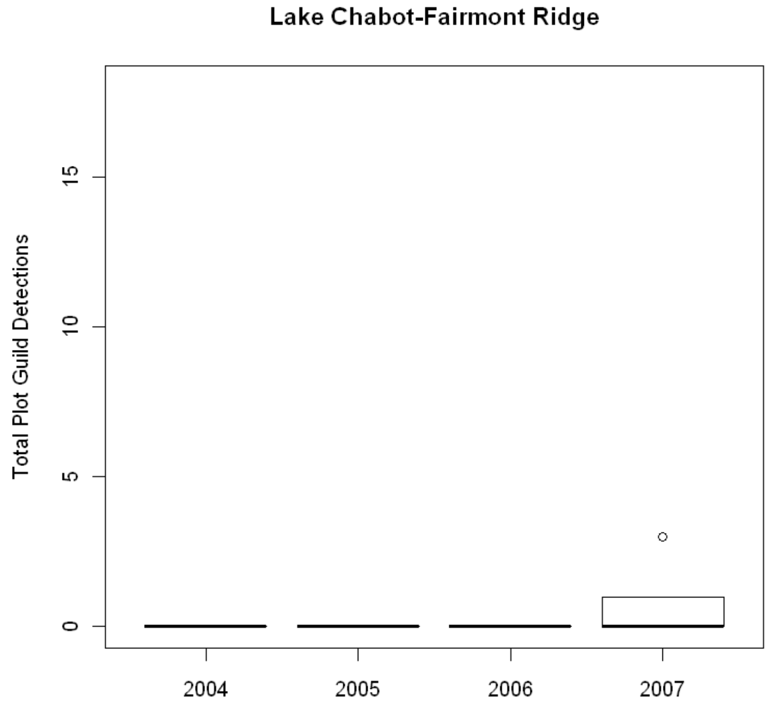
Outliers on the total bird detection figure are birds located in the Eucalyptus grove, such as flocks of Cedar Waxwings (Figure 10.2-1). Grassland birds are mostly absent from Lake Chabot-Fairmont Ridge and not utilizing the grassland for breeding or foraging (Figure 10.2-2), except for the occasional Western Meadowlark (2007) migrating through at the beginning of spring. The zero value median lines for 2004-2006 show no grassland bird species on any surveys for the park. Lake Chabot-Fairmont Ridge was discontinued from the survey in 2008 due to the lack of grassland birds and the confounding landscape scale factors.

Figure 10.2-1: 2004-2007 Lake Chabot-Fairmont Ridge, total annual avian detections; restricted dataset*



* Tukey boxplot shown, lines within box are the median of summed avian plot detections (all birds) per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

Figure 10.2-2: 2004-2007 Lake Chabot-Fairmont Ridge total annual avian grassland guild detection; median is zero for 2004-2006 where no grassland species detected on plot*



* Tukey boxplot shown, lines within box are the median of summed plot detections per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

10.3 Morgan Territory

Grassland bird monitoring recommendation

Suggested goal: Determine long-term presence and diversity of grassland birds on District land

Repeat current permanent breeding season (April-June 15) grassland point count surveys on a rotation of 5-7 years; to detect if grassland guild bird species are still present in grassland areas where they are currently located. Using volunteers, conduct area searches in accessible areas in (December-January) for wintering species.

Plots in the grazed areas of Morgan Territory and along Highland Ridge (MT 4-8) had slightly more presence of the grassland bird guild. See Figure 5.3 for park map. However, the proximity of dense oak woodlands to the grassland areas of this park may be the reason for the scarcity of grassland birds. Survey could be expanded to grassland areas with larger extent if grassland birds appear to be at higher levels.

Landscape features:

Morgan Territory is part of a large grassland/oak woodland mosaic with very low density housing development to the north along Morgan Territory Road and south along Finley Road (see Appendix H 2009 landscape imagery). This park is part of the preserved corridor of the Diablo range and is potentially fairly non-fragmented bird habitat. However, the low frequency of grassland birds in this park suggests that the grassland patches may be too small to support a stable population of these species.

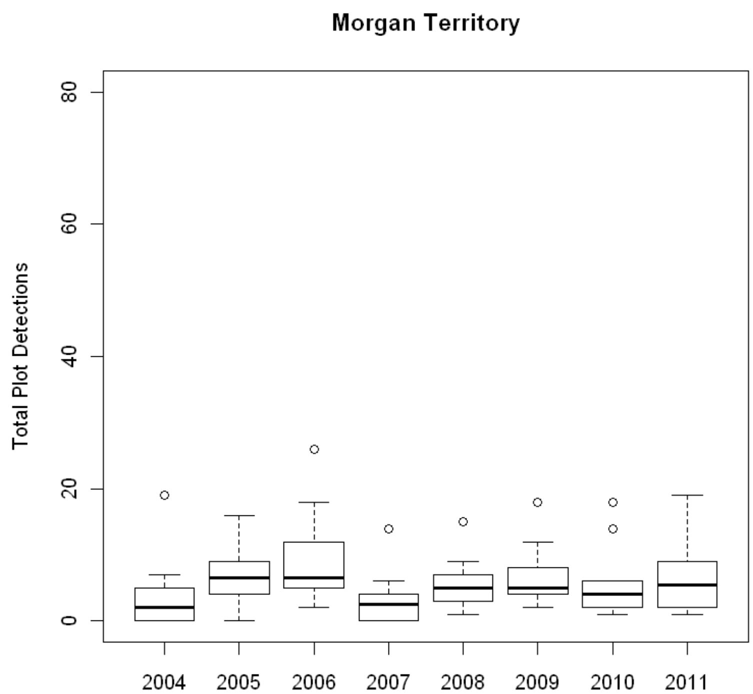
Avian Demographics:

Morgan Territory has fairly consistent total avian plot detections throughout 2004-2011 (Figure 10.3-1). The median total number of birds detected on plot every year hovers between 10 and almost zero.

Total annual detections of the grassland bird guild species are low at Morgan Territory. Median values for guild species do not fluctuate widely due to annual variation. The guild at this park consists mainly of three of the four focal species, Grasshopper Sparrow, Horned Lark, and Western Meadowlark, with only one year showing an occurrence of the Savannah Sparrow (Figure 10.3-2). Landscape level effects mentioned previously as well as the low level of native plant cover may be the cause of this less abundant grassland bird population.

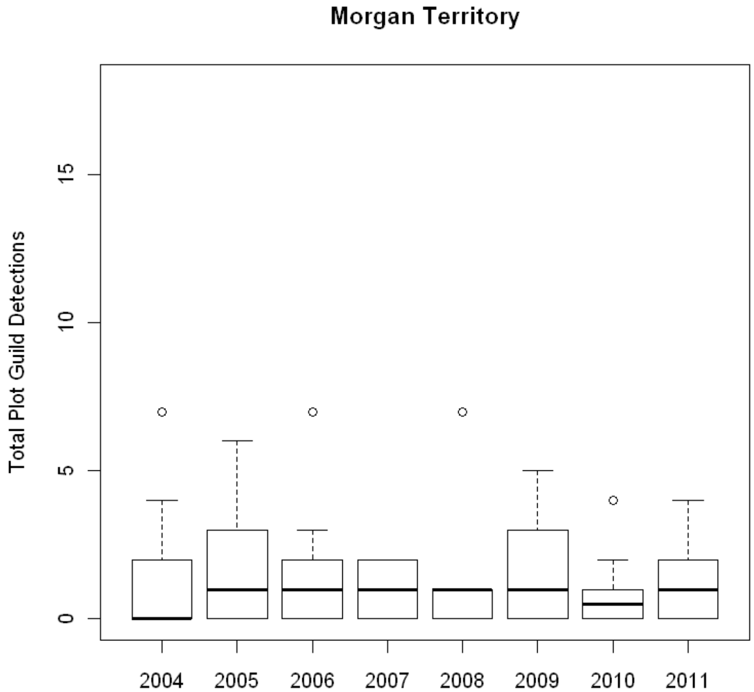
All four of the grassland bird focal species are present at Morgan Territory, but not all species are present every year (Appendix F Table 3.1). Horned Larks are the most frequent and abundant grassland bird species, with the highest overall relative abundance (0.90 SD ±0.33), and the only confirmed breeder (Appendix F Table 3.2).

Figure 10.3-1: 2004-2011 Morgan Territory total annual avian detections; restricted dataset; in 2005 survey was expanded from 6 to 10 plots*



* Tukey boxplot shown, lines within box are the median of summed avian plot detections (all birds) per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

Figure 10.3-2: 2004-2011 Morgan Territory total annual avian grassland guild detection; 2005 survey expanded from 6 to 10 plots*



* Tukey boxplot shown, lines within box are the median of summed plot detections per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

10.4 Pleasanton Ridge

Grassland bird monitoring recommendation

Suggested goal: All of the goals suggested from the monitoring overview would be appropriate for Pleasanton Ridge

1) Goal: Determine long-term presence and diversity of grassland birds on District land

Repeat current permanent breeding season (April-June 15) grassland point count surveys on a rotation of 5-7 years; to detect if grassland guild bird species are still present in grassland areas where they are currently located. Using volunteers, conduct area searches in accessible areas in December-January for wintering species.

2) Goal: Use grassland bird species response as an indicator of grassland management (e.g., livestock grazing, native plant restoration, prescribed fire, infrastructure development)

Create intensive avian monitoring plan, with a balanced experimental design using point count surveys or area searches that cover extent of grassland (e.g., in a grid pattern), i.e., survey livestock grazed and ungrazed areas or areas where native plant enhancement or weed removal occurs with a similar area where no management occurs. Include moderate intensity vegetation monitoring at each location. Annual surveys recommended.

3) Goal: Determine long-term population trends for focal grassland bird species in the District's Valley grasslands

Combine new plot locations with current plots in areas that have consistent grassland bird presence. Emphasis on permanent long-term annual surveys and not multiple parks to reduce cost. Larger grassland patch sizes may be important to focal species and should be prioritized for new plot locations.

Landscape features:

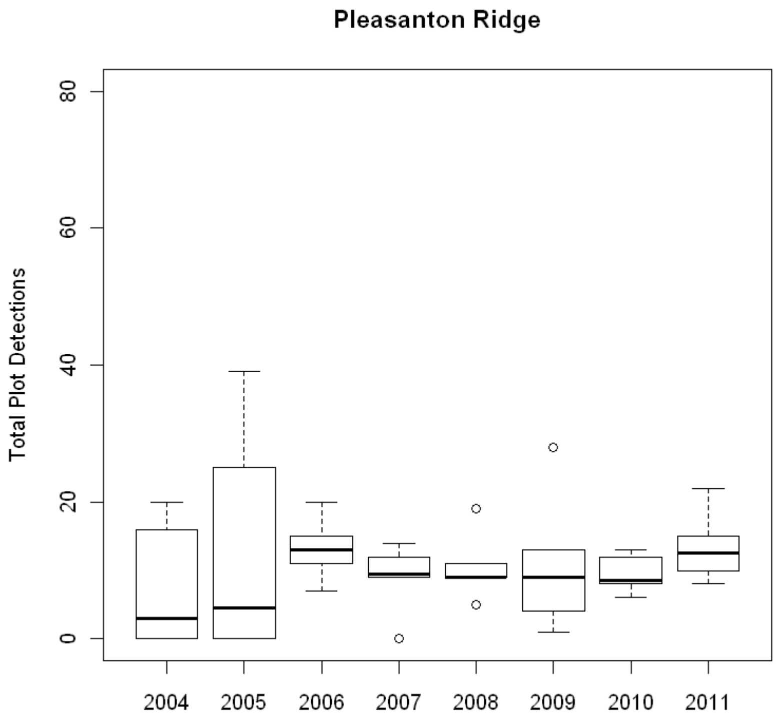
Pleasanton Ridge is a park that has high density housing developments on the east within approximately 2 kilometers (see housing encroachment between Appendix H 1993-97 and 2009 landscape imagery). Within the northern part of the park, most of the grassland patches are small with adjacent dense oak woodland. Plots PR4-6 are located within the largest grassland patch, of the area sampled by the Project, and had the only consistent presence of the grassland bird guild. See Figure 5.4 for park map. Further investigation in this park of the guild preference for larger grassland patch sizes could be interesting.

Avian Demographics:

Pleasanton Ridge has a fairly consistent range of total avian plot detections (Figure 10.4-1). The median values for total grassland bird guild detections on plot are also fairly consistent throughout the time period of the study (Figure 10.4-2). All four of the focal guild species are present at Pleasanton Ridge but not very frequent throughout the surveys. Plots 7-9 had very few occurrences of the guild possibly due to grassland bird species avoidance of the smaller grassland patches where these plots are located. The median values for the total plot guild detections are low although this park has a relatively larger plot range of quartile values or boxes in the graph than other parks in the study (Figure 10.4-2).

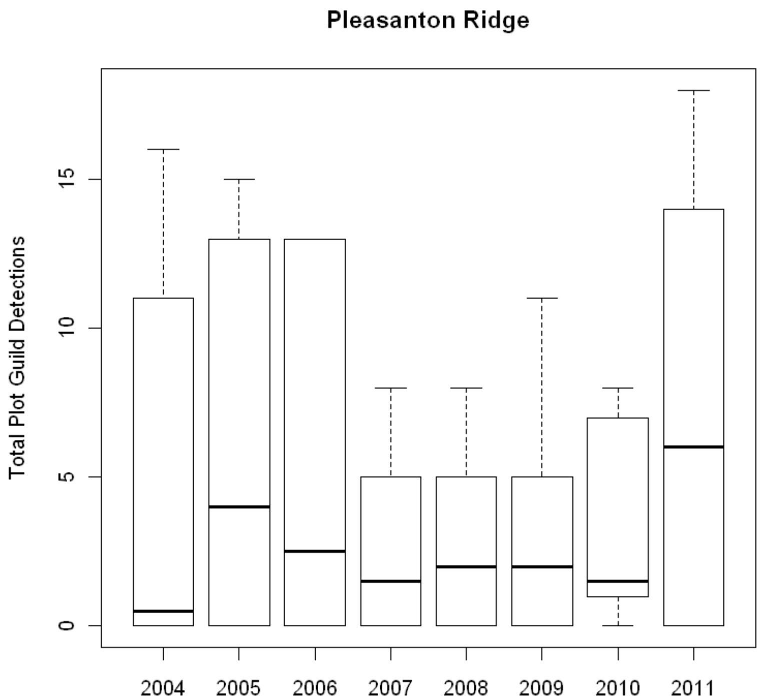
Horned larks are the most common of the guild species in this park. This species has the highest overall relative abundance (2.46 ±0.67 SD) and is a confirmed breeder in the park (Appendix F Table 4.2). Grasshopper Sparrows are the next most common of the guild species and are also confirmed breeders.

Figure 10.4-1: 2004-2011 Pleasanton Ridge total annual avian detections; restricted dataset*



* Tukey boxplot shown, lines within box are the median of summed avian plot detections (all birds) per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

Figure 10.4-2: 2004-2011 Pleasanton Ridge total annual avian grassland guild detection*



* Tukey boxplot shown, lines within box are the median of summed plot detections per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

10.5 Sunol-Ohlone

Grassland bird monitoring recommendation

Suggested goal: All of the goals suggested from the monitoring overview would be appropriate for Sunol-Ohlone. The current Sunol-Ohlone livestock grazed plots have a consistent presence of the grassland bird guild as well as a high level of native plant diversity. This area also merits further grassland bird monitoring because of its large grassland area and lack of surrounding development pressure. If the monitoring goal is to compare the effect of livestock grazing on grassland birds, the current ungrazed bird plots should not be used. An ungrazed area equivalent to Valpe Ridge or High Valley should be found that is more similar in grassland patch size, elevation and native plant abundance. The current livestock exclosures built in Valpe Ridge and High Valley are not suitable for bird surveys because the fencing is within 100 meters of the plot center.

1) Goal: Determine long-term presence and diversity of grassland birds on District land

Repeat current permanent breeding season (April-June 15) grassland point count surveys on a rotation of 5-7 years; to detect if grassland guild bird species are still present in grassland areas where they are currently located. Using volunteers, conduct area searches in accessible areas in December-January for wintering species.

2) Goal: Use grassland bird species response as an indicator of grassland management (e.g. livestock grazing, native plant restoration, prescribed fire, infrastructure development)

Create intensive avian monitoring plan, with a balanced experimental design using point count surveys or area searches that cover extent of grassland (e.g., in a grid pattern), i.e., survey livestock grazed and ungrazed areas or areas where native plant enhancement or weed removal occurs with a similar area where no management occurs. Include moderate intensity vegetation monitoring at each location

3) Goal: Determine long-term population trends for focal grassland bird species in the District's Valley grasslands

Combine new plot locations with current plots in areas that have consistent grassland bird presence. See Figure 5.5 park map. Emphasis on permanent long-term annual surveys and not multiple parks to reduce costs.

Landscape features:

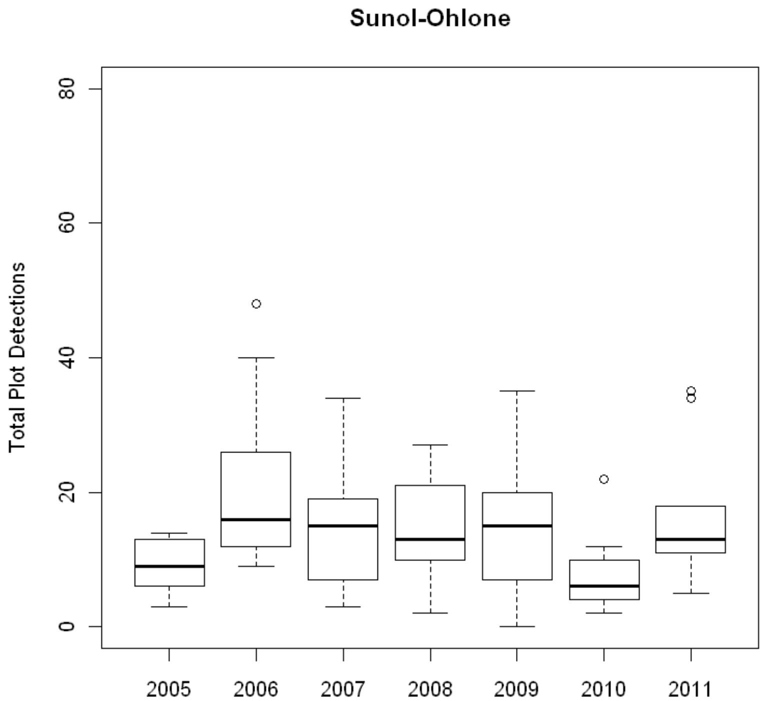
Sunol and Ohlone parks are part of a large mosaic of grassland/oak woodland open area in the relatively undeveloped southeastern part of Alameda County. There are a few adjacent low density housing developments at the top of Welch Creek Road. Both parks have large grassland patches which support a consistent presence of the grassland bird guild. There are no obvious land-use changes between the 1993-2009 time periods in the vicinity of Sunol-Ohlone. Only the 2009 imagery map is included (Appendix H).

Avian Demographics:

Sunol-Ohlone shows a consistent presence of all birds on plot with few total plot detections at or near zero (Figure10.5-1). Outlier values for 2006 represent an on-plot pulse of European Starlings and in 2011 Red-winged Blackbirds. Median values for grassland bird guild detections (Figure10.5-2) are heavily weighted to zero in most years of the study due to the guild not being present on the ungrazed plots and also infrequent on the grazed plots.

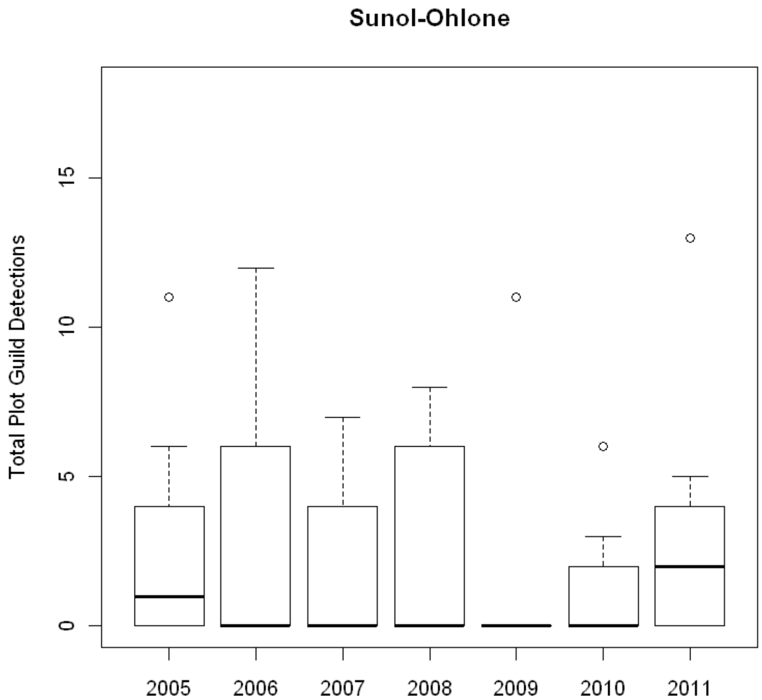
Horned Larks are the most common of the grassland bird guild in this park with an overall relative abundance of 1.05 (±0.48 SD) and a breeding status of probable breeder (Appendix F, Table F.5-2). Grasshopper Sparrows and Western Meadowlarks are also probable breeders at Sunol-Ohlone. Savannah Sparrows were not observed in this park during the course of the study.

Figure 10.5-1: 2004-2011 Sunol-Ohlone total annual avian detections; restricted dataset*†



* Tukey boxplot shown, lines within box are the median of summed avian plot detections (all birds) per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m) † in 2010 only 2 point count surveys for Sunol-Ohlone were completed

Figure 10.5-2: 2004-2011 Sunol-Ohlone total annual avian grassland guild detection*†



* Tukey boxplot shown, lines within box are the median of summed plot detections per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m) † in 2010 only 2 point count surveys for Sunol-Ohlone were completed

10.6 Sycamore Valley

Bird monitoring recommendation

Suggested goal: Determine long-term presence and diversity of grassland birds on District land; annual frequency

The consistent presence of grassland bird species, Grasshopper Sparrows in particular, over the length of the survey suggests a potential for an annual or short time interval to repeat point count surveys. It is potentially interesting to see how long grassland birds persist with the recent build out of adjacent suburban housing development (see Sycamore Valley land-use history in this report and the Appendix H landscape maps 1993-1995 and 2009) and the creation of the park with its associated increase in recreational activity in the grassland. If the monitoring goal is to compare the effect of livestock grazing on grassland birds, a new ungrazed area should be chosen. The current housing association area is too close to the edge of suburban housing to be a balanced ungrazed comparison for grassland bird species.

Grasshopper sparrows are most frequently present on plot SV5, a steep canyon area dominated by an exotic perennial bunchgrass, Harding grass (*Phalaris aquatica*). See Figure 5.6 for park map. Grasshopper Sparrows are known in California to be associated with purple needlegrass (*Nassella pulchra*), a native perennial bunchgrass (Gennet et al. in prep.; Goerrissen 2005). Grasshopper Sparrows might be responding to the structure of a perennial bunchgrass vegetation type. Further research could be interesting comparing reproductive demographics of this species in Harding grass dominated grassland versus native bunchgrass dominated grassland.

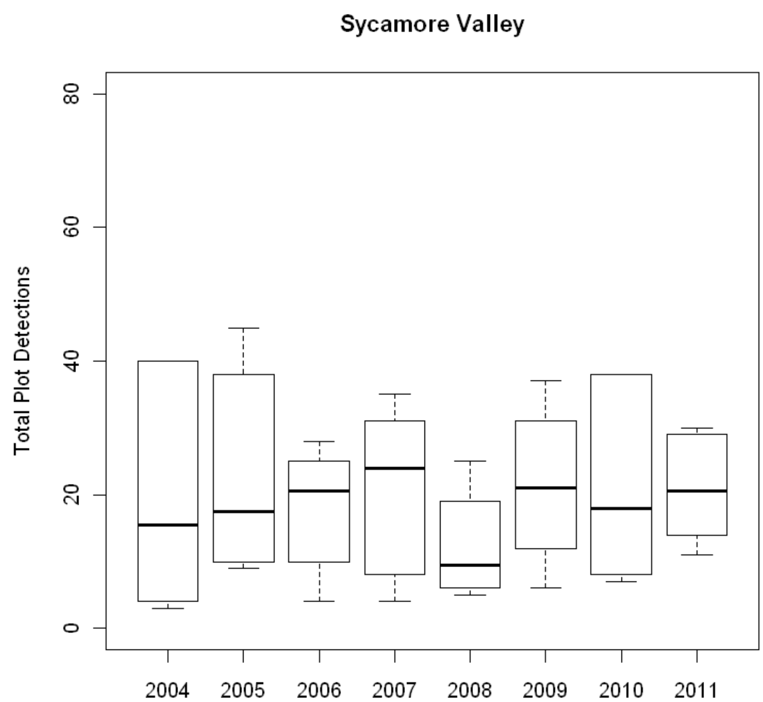
Landscape features:

Sycamore Valley is surrounded on all sides with recently built dense suburban housing development. The park is part of a corridor of contiguous open grassland towards Mt. Diablo State Park (see landscape photo 2009 in Appendix H).

Avian Demographics:

Similar to other parks in the study, Sycamore Valley has a fluctuating overall number of bird detections (Figure 10.6-1). The median total number of birds detected every year varies around 20 individuals.

Figure 10.6-1: 2004-2011 Sycamore Valley total annual avian detections; restricted dataset*

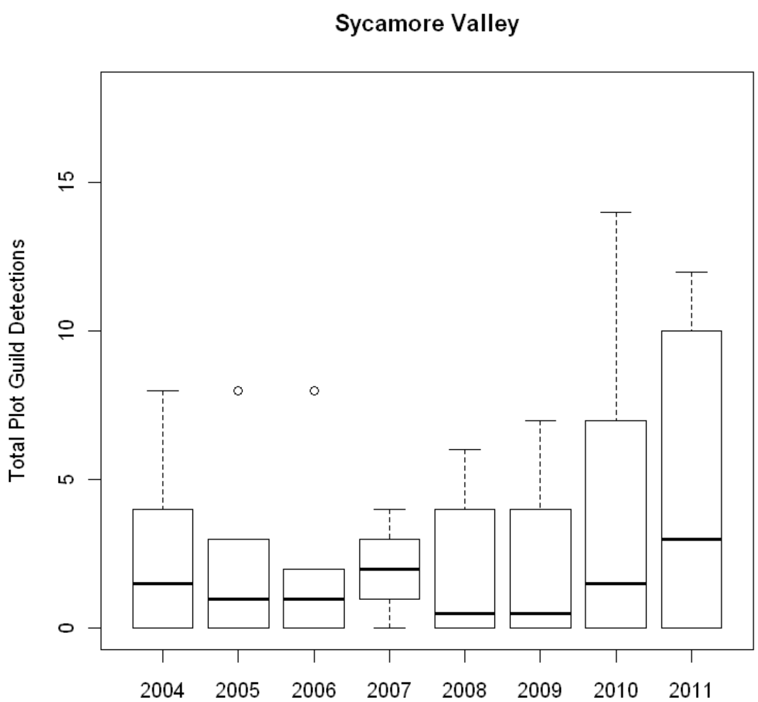


* Tukey boxplot shown, lines within box are the median of summed avian plot detections (all birds) per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

The grassland bird guild includes the four focal species, Grasshopper Sparrow, Horned Lark, Savannah Sparrow and Western Meadowlark (Figure 10.6-2). Total annual detections of the guild species are lower at Sycamore Valley and stay below 15 individuals. Median values do not fluctuate widely due to annual variation. Landscape level effects mentioned previously as well as the lack of native plant cover may be causing this lower abundance grassland bird population.

All four of the grassland bird focal species are present at Sycamore Valley, but not all species are present every year (Appendix F Table 6.1). Western Meadowlarks are the most frequent and abundant grassland species in this park with an overall relative abundance of 1.50 (SD 0.89) and a breeding status of probable (Appendix F Table F.6-2). Grasshopper Sparrows and Savannah Sparrows are also probable breeders at Sycamore Valley.

Figure 10.6-2: 2004-2011 Sycamore Valley total annual avian grassland guild detection*



* Tukey boxplot shown, lines within box are the median of summed plot detections per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

10.7 Vasco Caves

Grassland bird monitoring recommendation

Suggested goal: All of the goals suggested from the monitoring overview would be appropriate for Vasco Caves. This park has a high level of native plant cover and a moderately high level of native plant diversity as well as a consistent presence of the grassland bird guild and definitely merits further grassland bird monitoring.

1) Goal: Determine long-term presence and diversity of grassland birds on District land

Repeat current permanent breeding season (April-June 15) grassland point count surveys on a rotation of 5-7 years to detect if grassland guild bird species are still present in grassland areas where they are currently located. Using volunteers, conduct area searches in accessible areas in December-January for wintering species.

2) Goal: Use grassland bird species response as an indicator of grassland management (e.g., livestock grazing, native plant restoration, prescribed fire, infrastructure development)

Create intensive avian monitoring plan, with a balanced experimental design using point count surveys or area searches that cover extent of grassland (e.g., in a grid pattern), i.e., survey livestock grazed and ungrazed areas or areas where native plant enhancement or weed removal occurs with a similar area where no management occurs. Include moderate intensity vegetation monitoring at each location.

3) Goal: Determine long-term population trends for focal grassland bird species in the District's Valley grasslands

Combine new plot locations with current plots in areas that have consistent grassland bird presence. Emphasis on permanent long-term annual surveys and not multiple parks to reduce cost.

Landscape features:

Vasco Caves is part of a large grassland area with scattered trees and rocky outcroppings. It is in the same preserved corridor of the Diablo range east of Morgan Territory and northwest of Brushy Peak. There are multiple windmill farms surrounding and contained within the park boundary. There have been windmill farms in the larger Altamont pass area for at least 30 years.

There are some new windmill developments to the east of Vasco Caves, but no real differences are noted between 1993 and 2009. Only 2009 landscape imagery is included (Appendix H).

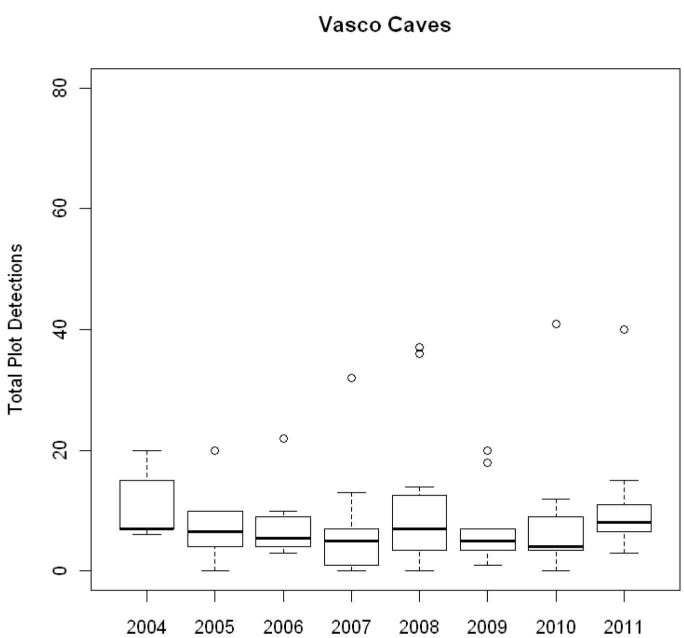
Avian Demographics:

Vasco Caves has a consistent total plot detection median value and quartile ranges (Figure 10.7-1). See Figure 5.7 for park map. There are only a few plots that have unusually high detection rates shown by the outlier values. Outlier values represent large numbers of Red-winged Blackbirds on plot VC4 for multiple years and in one year, 2009, a flock of American Crows on plot VC9.

The presence of the grassland bird guild species is more consistent throughout the plots surveyed at Vasco Caves then at any of the other parks. There are few plots with zero detections of a guild species, the median total plot guild detection lines are all above 3 and range as high as 7 detections (Figure 10.7-2). In other words, for 2004-2011 surveys in Vasco Caves the majority of the plots had a presence of guild species. The most common guild species in this park is the Western Meadowlark with an overall relative abundance of 2.84 ±0.79 SD, which is also the highest overall relative abundance across all parks and guild species in the study.

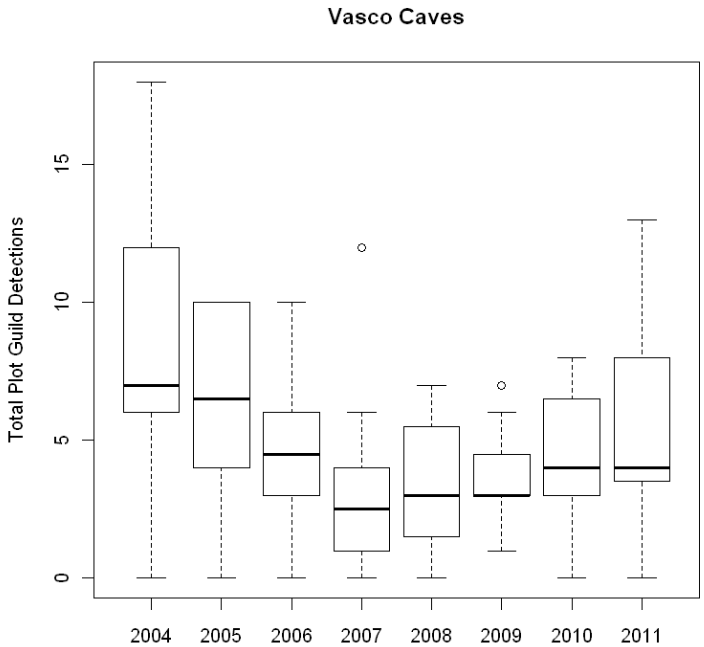
Western Meadowlarks, as well as Horned Larks, are confirmed breeders in this park.

Figure 10.7-1: 2004-2011 Vasco Caves total annual avian detections; restricted dataset*



* Tukey boxplot shown, lines within box are the median of summed avian plot detections (all birds) per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

Figure 10.7-2: 2004-2011 Vasco Caves total annual avian grassland guild detection*



* Tukey boxplot shown, lines within box are the median of summed plot detections per year per park; whiskers are the minimum and maximum plot values unless that value is 1.5 times the innerquartile range when it is represented with an outlier dot; data restricted to detections of individuals on plot (≤100m)

10.8 References

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Ralph, C. J., S. Droege, and J. R. Sauer. 1995. **Managing and monitoring birds using point counts: standards and applications**, USDA Forest Service Gen Tech. Rep. PSW-GTR-149: 161-169.

Ralph, C. J., G. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. **Handbook of field methods for monitoring landbirds** *in* U. S. Forest Service, ed., Pacific Southwest Research Station Gen Tech. Rep. PSW-GTR-144.

Appendix A: Grassland Monitoring Project research summary

Frequency of sampling

For the vegetation sampling, four of the parks, Morgan Territory, Pleasanton Ridge, Sunol-Ohlone, and Vasco Caves, were sampled until the final field year of the Project, 2011. Three other parks, Brushy Peak, Chabot-Fairmont Ridge, and Sycamore Valley, were sampled for vegetation for six years, from 2002-2007. These three parks have good baseline vegetation datasets but were not sampled after 2007 because Brushy Peak and Chabot-Fairmont Ridge contained no appropriate ungrazed comparison areas to pair with grazed plots and therefore were not able to provide information about the effect of management activities on vegetation. In addition, Sycamore Valley and Brushy Peak consistently had the lowest levels of native plant cover and species richness in the study and so provided limited information about the effect of management on native plant species.

For the avian sampling, the first two years (2002-2003) are considered pilot years and not included in the analysis. All of the parks included in the avian analysis section of this report (starting with section 7.0) were sampled for the duration of the avian sampling survey, 2004-2011, with the exception of Chabot-Fairmont Ridge. Chabot-Fairmont Ridge was discontinued in 2008 due to the absence of breeding grassland bird species.

Over the ten years (2002-2011) of the Grassland Monitoring Project two other parks were included, Diablo Foothills Regional Park and Point Pinole Regional Shoreline. Diablo Foothills Regional Park (3 riparian restoration plots surveyed in 2003 and 2004) and Point Pinole Regional Shoreline (6 coastal prairie plots surveyed from 2002-2004) were discontinued. It was decided that the Project should focus its resources on Valley grassland surveys. In 2005, the Project added Sunol-Ohlone and increased the number of plots in other parks (see Table A-1 below and 2005 annual report for further details). Annual reports from 2002-2004 include findings for Diablo Foothills and Point Pinole, but because data collection at these parks is limited, we do not discuss Diablo Foothills and Point Pinole in this report.

The avian point count survey plots are a subset of the vegetation survey plots because of the methodology requirements that avian surveys must be at least 100 meters from different vegetation, i.e. non-grassland vegetation type, that there be at least 200 meters distance between individual surveys, and that the livestock exclusion fencing was not part of the 100 meter radius of the survey (Sunol-Ohlone's Valpe Ridge ungrazed plots). See Figures 5.1-5.7 for park maps with plot locations.

Table A-1: 2002-2011 field survey total number of plots annual summary; includes all parks surveyed by UCB for Grassland Monitoring Project

Vegetation survey annual number of plots										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Pleasanton Ridge	0	9	9	6	6	6	6	6	6	6
Morgan Territory	0	6	6	10	16	16	16	16	16	16
Sunol-Ohlone	0	0	0	9	9	9	9	12	12	12
Vasco Caves	6	10	10	14	14	14	17	17	17	17
Brushy Peak	3	9	9	6	6	0	0	0	0	0
Chabot-Fairmont Ridge	6	6	6	6	6	0	0	0	0	0
Sycamore Valley	6	6	6	6	6	0	0	0	0	0

Diablo Foothills	0	3	3	0	0	0	0	0	0	0
Point Pinole	6	6	6	0	0	0	0	0	0	0
Total plots	*27*	*55*	*55*	*57*	*63*	*45*	*48*	*51*	*51*	*51*
Avian survey annual number of plots										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Brushy Peak	3	9	9	6	6	6	6	0	6	6
Pleasanton Ridge	0	9	9	6	6	6	6	6	6	6
Morgan Territory	0	6	6	10	10	10	10	10	10	10
Sycamore Valley	6	6	6	6	6	6	6	6	6	6
Vasco Caves	6	10	10	10	10	10	10	11	11	11
Sunol-Ohlone	0	0	0	9	9	9	9	9	9	9
Chabot-Fairmont Ridge	5	5	5	5	5	5	0	0	0	0
Diablo Foothills	0	3	3	0	0	0	0	0	0	0
Point Pinole	6	6	6	0	0	0	0	0	0	0
Total plots	*26*	*54*	*54*	*52*	*52*	*52*	*47*	*42*	*48*	*48*

Table A-2: 2002-2011 plot names field survey summary; shows which plots were included in avian survey subset and which plots remained only vegetation surveys

Vegetation survey										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Pleasanton Ridge	0	1-9	1-9	4-9	4-9	4-9	4-9	4-9	4-9	4-9
Morgan Territory	0	1-6	1-6	1-10	1-16	1-16	1-16	1-16	1-16	1-16
Sunol-Ohlone	0	0	0	1-9	1-9	1-9	1-9	1-12	1-12	1-12
Vasco Caves	1-6	1-10	1-10	1-14	1-14	1-14	1-17	1-17	1-17	1-17
Brushy Peak	1-3	1-9	1-9	4-9	4-9	0	0	0	0	0
Chabot-Fairmont Ridge	1-6	1-6	1-6	1-6	1-6	0	0	0	0	0
Sycamore Valley	1-6	1-6	1-6	1-6	1-6	0	0	0	0	0
Diablo Foothills	0	1-3	1-3	0	0	0	0	0	0	0
Point Pinole	1-6	1-6	1-6	0	0	0	0	0	0	0
Avian survey subset of plots										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Brushy Peak	1-3	1-9	1-9	4-9	4-9	4-9	4-9	0	4-9	4-9
Pleasanton Ridge	0	1-9	1-9	4-9	4-9	4-9	4-9	4-9	4-9	4-9
Morgan Territory	0	1-6	1-6	1-10	1-10	1-10	1-10	1-10	1-10	1-10
Sycamore Valley	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6
Vasco Caves	1-6	1-10	1-10	1-10	1-10	1-10	1-10	1-10 15	1-10 15	1-10 15
Sunol-Ohlone	0	0	0	1-9	1-9	1-9	1-9	1-9	1-9	1-9
Chabot-Fairmont Ridge	1, 3-6	1, 3-6	1, 3-6	1, 3-6	1, 3-6	1, 3-6	0	0	0	0
Diablo Foothills	0	1-3	1-3	0	0	0	0	0	0	0
Point Pinole	1-6	1-6	1-6	0	0	0	0	0	0	0

Plot location

Sample plots were randomly located within a stratified design. The strata depended upon the specific park but were generally based on pre-existing management areas. For example, plots at Morgan Territory were randomly chosen from areas already subjected to cattle grazing or no grazing. A majority of plots are located a minimum of 300 meters from shrub or forest habitat (greater than 30% canopy cover of shrubs or trees) so as to limit the study to grassland wildlife species. Due to the space limitations for management areas chosen, Point Pinole and Chabot-Fairmont Ridge plots have eucalyptus forest habitat within 100 meters.

Vegetation survey method

Line-point transect research design for the vegetation was as follows: each plot comprised four 17-m vegetation transects radiating in the 4 cardinal directions from a central, permanently marked centroid. From a vertical line dropped perpendicular to the transect line, first-hit plant species was recorded every 10 cm for the first 4.5 m and every 50 cm from 5 to 17 m, for a total of 70 points per transect and 280 points per plot. We also took 2 photos of each transect: 1 from the centroid out to the end of the transect and another from the end of the transect in to the centroid (8 photos per plot). This radial design allowed integration of standard wildlife monitoring protocols with the vegetation monitoring.

Avian survey method

Point count surveys for the Project follow standardized protocol (Ralph et al. 1995) which allows the data to be part of a larger effort. Variable circular plot point count surveys in grasslands were located at least 250 meters apart the majority of the time, have a 10 minute duration, and a 100 meter radius distance. Bird species are counted through visual or sound observation and the distance of individuals from plot center is estimated for every 10 meters. Three surveys per breeding season, between March 31 and June 15, are necessary to maximize the number of detections in a low-density grassland bird community. Counts are conducted within 3 hours of sunrise to capture highest level of bird activity.

Other wildlife survey methods

Sampling within vegetation and avian surveys

For all years of the Project, vegetation sampling included the documentation of all signs of non-avian vertebrates along the four transects. Attempts were made to identify to species and quantify the various scat, runways, trails, and holes within one meter on either side of each transect. Any sightings of vertebrates during vegetation sampling were noted within the 17 meter radius plots and in the park at large. The avian point count surveys included the documentation of non-avian vertebrates, with notation of location within the 100 meter radius plot and in the park.

Ground squirrel visual observations

From 2005-2011, California ground squirrel (*Otospermophilus beecheyi*) abundance was counted during the avian point count survey. A summary analysis for 2005-2006 is included in the 2006 annual report. No ground squirrels were detected on point count surveys in ungrazed areas within 100 meters of the plot center. Sunol-Ohlone has the highest abundance of squirrels, driven by the population in High Valley. Less than one-third of the Project’s total plots (27%) had squirrel detections using this survey method.

Small mammal sign habitat modeling analysis

A habitat modeling analysis of small mammal sign, using the data collected during the vegetation surveys, included the years 2004 and 2006 and used a new statistical technique, HyperNiche, to estimate the likelihood of occurrence of three species, California vole (*Microtus californicus*), Botta's pocket gopher (*Thomomys bottae*), and California ground squirrel (*Otospermophilus beecheyi*). Models were created using environmental variables such as: livestock grazing, soil texture and chemistry, vegetation characteristics, topographic attributes, and plot location within a particular park.

HyperNiche identified habitat models that predict species presence for California vole and Botta's pocket gopher. Low clay soils and the presence of sheep grazing predicted California vole presence in 2004. In 2006, soil characteristics, but not grazing treatment, were more important predictors. Plot location within a park was the only variable included in the best model for pocket gophers in 2004. In 2006, our best pocket gopher model included low clay and higher elevation.

It is possible that interannual variability in rainfall and other conditions may affect the importance of environmental variables in predicting species presence year to year. However, factors such as the very small number of vole observations on plot in 2006 and historic small mammal eradication efforts in the study region may reduce our ability to detect habitat associations. Future analysis, including more years of the dataset, may reveal additional information about small mammal habitat associations in different weather years. (2007 Annual Report and 2008 Gaber master's thesis)

Trailmaster Camera-trap wildlife survey

Trailmaster cameras were placed on the sampling plots at Vasco Caves from March – September of 2004 in an attempt to document wildlife abundance and diversity not recorded on other surveys. This was the first attempt at using this particular camera system in open grassland areas. At the time, the decision was made to not spend more resources on this survey method due to the difficulties of deployment of this type of camera in grasslands and the small amount of data collected (mostly sheep pictures). This technology is more commonly used in wooded areas and has improved since 2004 in multiple ways. For further details and some humor see the 2004 Annual Report.

<u>Insect diversity sampling</u>

Methods

We used pitfall traps and sweep netting to collect invertebrates for this analysis. All collection was conducted between April 14 and May 29 in 2008.

Invertebrates were emptied into a sorting tray and sorted using a 7x – 30x variable light microscope. Invertebrates were sorted by order and subdivided into recognizable taxonomic units (RTUs, taxon based on morphological similarity) that were easily distinguishable and commonly found, while less commonly seen morphotypes were placed into a miscellaneous category for each order. The sorted invertebrates were counted, placed into 20ml bottles, and covered with 95% ethyl alcohol. The bottles were labeled with the plot number, taxonomic unit category and method of collection.

Results

Sweep netting captured more diptera, hemiptera, homoptera specimens, with other orders comprising fewer than 100 specimens each. Pitfall collections captured more arachnids, hymenoptera, nymphs, coleoptera, and thysanura, with other orders comprising fewer than 100 specimens each.

Initial reviews of the data show differences in diversity levels across parks based on livestock grazing. A generalized linear model comparing invertebrate abundance from ungrazed to grazed plots shows several negative effects and one positive effect that grazing has on order-level abundance of insects.

Sources of error include variation in both time and weather during insect collection. Temperature, humidity, wind, and time-of-day during collection could have effects on the abundance and diversity of insects present on the plots.

Additionally, the trend of the diversity indices follow the order of collection of insects from the park, which suggests that diversity levels could be tied to the date of collection, i.e. more diversity is present in mid April than in late May. Finally, because there are a different number of plots collected within each park (VC=17, MT=16, SU=9, and PR=6), the diversity index figures are likely to be higher for parks with a greater number of plots to draw upon. The Shannon Diversity Index ranks Vasco Caves as the most diverse park followed by Morgan Territory, Pleasanton Ridge, and Sunol.

Applying the Shannon Diversity Index to each park based on grazing status revealed that grazed plots (by sheep or cattle) have a higher diversity index reading than ungrazed plots. Vasco Caves had the largest difference in diversity between sheep grazed and ungrazed plots.

Recommendations for future study include randomizing plot collection both across parks and within parks so that insects are not collected sequentially from one park or from plots within each park. Also randomization with regards to time of collection within specified hours could assist with reducing effects based on collection times. Work from a uniform number of plots within each study site and replicate all treatments within a study site. Future research is needed. Additionally, identifying an entomologist who is able to sort and identify insects to the family level or further would be beneficial for gaining more specific information from the study. (See 2008 annual report)

<u>Soil dataset overview</u>

Soil samples were collected in 2003 and also 2006, with the addition of more parks to the study. One 10 cm deep soil sample was taken adjacent to each of the four transects of a plot, and transect soil measurements were averaged for overall plot values. The UC Davis DANR Lab conducted the soil analysis. Soil analysis includes cation exchange capacity (CEC), exchangeable calcium, soil particle size (percent sand, silt, and clay), total nitrogen (NH4 and NO3), carbon, phosphorus (Bray P), and pH. Bulk density measurements were also collected. (see 2004 Annual Report, 2007 Gennet PhD dissertation, and 2008 Gaber master's thesis)

Gea-Izquierdo et al. (2007) summarizes an analysis assessing plant and soil relationships using non-normal probability distribution analysis. We investigated the effects of soil characteristics and livestock grazing on native plant occurrence at 40 sites during the period 2003-2005. Low absolute cover (<5.8%) of native species resulted in strongly skewed, zero inflated data sets. To overcome problems in the analysis created by non-normality and correlations within plots, we used generalized models (GLM's and GLMM's), either with a Poisson or a Negative binomial distribution, to analyze native species richness and *Nassella pulchra* cover. Native species richness was highest in soils with low available nitrogen (high C:N), whereas *N. pulchra* cover was strongly associated with low phosphorus in sandy soils. Under current conditions, phosphorus seems to be a most critical factor influencing abundance of

N. pulchra. We conclude that low-fertility soils may be providing refugia for native species in highly invaded California grasslands because the soils in which native species persist at low levels are below a threshold required for non-native annuals to completely dominate. The use of generalized models with non-normal probability distributions is uncommon in ecology whereas being quite common in other biological sciences. However, they are simple and well-suited to analysis of highly non-normal data sets, which strongly suggests valuable applications for ecological data analysis.

References

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Appendix B: Complete plant species lists for Brushy Peak, Lake Chabot-Fairmont Ridge, Morgan Territory, Pleasanton Ridge, Sunol-Ohlone, Sycamore Valley, and Vasco Caves

Tables B-1 through B-7 list all plant species hit on transect and observed during timed area searches of the plots for the seven parks addressed in this report. All plant scientific names follow the first edition of *The Jepson Manual* (Hickman 1993), although as of the date of this report, the second edition of the *Manual* is available.

The California Invasive Plant Council's (Cal-IPC) California Invasive Plant Inventory rating categories referred to in the tables are described below:

The following description is taken directly from the Cal-IPC website (http://www.cal-ipc.org/ip/inventory/index.php, accessed Fall 2010):

Each plant on the list received an overall rating of High, Moderate or Limited based on evaluation using the criteria system. The meaning of these overall ratings is described below. Some plants were categorized as **Evaluated But Not Listed** because either [Cal-IPC lacks] sufficient information to assign a rating or the available information indicates that the species does not have significant impacts at the present time.

- **High** – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
- **Moderate** – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
- **Limited** – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

References

Hickman, J.C., ed. 1993. **The Jepson manual**. Berkeley, CA: University of California Press.

Table B-1: List of all species hit and observed on Brushy Peak plots BP1-9; **bolded** species are native

Scientific name	Common name	Origin	Life history	Life form	Cal-IPC rating	Family
Achillea millefolium	**Common Yarrow**	**native**	**perennial**	**forb**		**Asteraceae**
Achyrachaena mollis	**Blow Wives**	**native**	**annual**	**forb**		**Asteraceae**
Amsinckia menziesii* var. *intermedia	**Orange-flowered Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Anagallis arvensis	Scarlet Pimpernel	exotic	annual	forb		Primulaceae
Asclepias fascicularis	**Narrow-leaf Milkweed**	**native**	**perennial**	**forb**		**Asclepiadaceae**
Avena barbata	Slender Wild Oats	exotic	annual	grass	Moderate	Poaceae
Avena fatua	Common Wild Oats	exotic	annual	grass	Moderate	Poaceae
Bellardia trixago	Mediterranean Lineseed	exotic	annual	forb	Limited	Scrophulariaceae
Brassica nigra	Black Mustard	exotic	annual	forb	Moderate	Brassicaceae
Brassicaceae family	Mustard Family	unknown	unknown	forb		Brassicaceae
Bromus diandrus	Ripgut Brome	exotic	annual	grass	Moderate	Poaceae
Bromus hordeaceus	Soft Chess	exotic	annual	grass	Limited	Poaceae
Bromus madritensis ssp. *madritensis*	Foxtail Brome	exotic	annual	grass		Poaceae
Bromus madritensis ssp. *rubens*	Red Brome	exotic	annual	grass	High	Poaceae
Bromus sterilis	Sterile Brome	exotic	annual	grass		Poaceae
Carduus pycnocephalus	Italian Thistle	exotic	annual	forb	Moderate	Asteraceae
***Carex* sp.**	**Sedge**	**native**	**perennial**	**graminoid**		**Cyperaceae**
Castilleja exserta	**Purple Owl's Clover**	**native**	**annual**	**forb**		**Scrophulariaceae**
Centaurea melitensis	Tocalote	exotic	annual	forb	Moderate	Asteraceae
Centaurea solstitialis	Yellow Star-thistle	exotic	annual	forb	High	Asteraceae
Cerastium glomeratum	Mouse-ear Chickweed	exotic	annual	forb		Caryophyllaceae
Convolvulus arvensis	Bindweed	exotic	perennial	forb		Convolvulaceae
Crassula connata	**Pygmyweed**	**native**	**annual**	**forb**		**Crassulaceae**
Cynara cardunculus	Artichoke Thistle	exotic	perennial	forb	Moderate	Asteraceae
Danthonia californica	**California Oatgrass**	**native**	**perennial**	**grass**		**Poaceae**
Distichlis spicata	**Inland Saltgrass**	**native**	**perennial**	**grass**		**Poaceae**

Eremocarpus setigerus	**Turkey Mullein**	**native**	**annual**	**forb**		**Euphorbiaceae**
Erodium botrys	Broad-leaf Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Erodium cicutarium	Redstem Filaree	exotic	annual	forb	Limited	Geraniaceae
Erodium moschatum	White-stemmed Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Eschscholzia californica	**California Poppy**	**native**	**annual**	**forb**		**Papaveraceae**
Foeniculum vulgare	Fennel	exotic	perennial	forb	High	Apiaceae
Frankenia salina	**Alkali Heath**	**native**	**perennial**	**forb**		**Frankeniaceae**
Galium parisiense	Wall Bedstraw	exotic	annual	forb		Rubiaceae
Galium sp.	Bedstraw	unknown	annual	forb		Rubiaceae
Geranium dissectum	Cutleaf Geranium	exotic	annual	forb	Moderate	Geraniaceae
Geranium molle	Dovefoot Geranium	exotic	annual	forb	Eval No List	Geraniaceae
Herniaria hirsuta	Herniaria	exotic	annual	forb		Caryophyllaceae
Hesperevax sparsiflora	**Erect Dwarf-cudweed**	**native**	**annual**	**forb**		**Asteraceae**
Hirschfeldia incana	Shortpod Mustard	exotic	perennial	forb	Moderate	Brassicaceae
Hordeum brachyantherum	**Meadow Barley**	**native**	**perennial**	**grass**		**Poaceae**
Hordeum marinum ssp. *gussoneanum*	Mediterranean Barley	exotic	annual	grass	Moderate	Poaceae
Hordeum murinum	Foxtail Barley	exotic	annual	grass	Moderate	Poaceae
Hypochaeris glabra	Smooth Cat's Ear	exotic	annual	forb	Limited	Asteraceae
Hypochaeris radicata	Rough Cat's Ear	exotic	perennial	forb	Moderate	Asteraceae
Juncus bufonius	**Toad Rush**	**native**	**annual**	**graminoid**		**Juncaceae**
***Juncus* sp.**	**Rush**	**native**	**unknown**	**graminoid**		**Juncaceae**
Lactuca serriola	Prickly Lettuce	exotic	annual	forb	Eval No List	Asteraceae
Leymus triticoides	**Creeping Wildrye**	**native**	**perennial**	**grass**		**Poaceae**
Lolium multiflorum	Italian Rye-grass	exotic	annual	grass	Moderate	Poaceae
Lupinus microcarpus* var. *densiflorus	**Chick Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus microcarpus* var. *microcarpus	**Chick Lupine**	**native**	**annual**	**forb**		**Fabaceae**
***Lupinus* sp.**	**Lupine**	**native**	**unknown**	**forb**		**Fabaceae**

Marah fabaceus	**Wild-cucumber**	**native**	**perennial**	**forb**		**Cucurbitaceae**
Medicago polymorpha	Bur Clover	exotic	annual	forb	Limited	Fabaceae
Melilotus indica	Annual Yellow Sweetclover	exotic	annual	forb		Fabaceae
Nassella pulchra	**Purple Needlegrass**	**native**	**perennial**	**grass**		**Poaceae**
Plantago lanceolata	Narrowleaf Plantain	exotic	perennial	forb	Limited	Plantaginaceae
Poa sp.	Bluegrass	unknown	unknown	grass		Poaceae
Puccinellia nuttalliana	**Nuttall's Alkaligrass**	**native**	**perennial**	**grass**		**Poaceae**
Rumex acetosella	Sheep Sorrel	exotic	perennial	forb	Moderate	Polygonaceae
Rumex sp.	Sorrel	exotic	perennial	forb		Polygonaceae
Sherardia arvensis	Field Madder	exotic	annual	forb		Rubiaceae
Silybum marianum	Milk Thistle	exotic	annual	forb	Limited	Asteraceae
Sonchus oleraceus	Common Sow Thistle	exotic	annual	forb		Asteraceae
Torilis nodosa	Hedge Parsley	exotic	annual	forb		Apiaceae
Torilis sp. or *Scandix* sp.		exotic	annual	forb		Apiaceae
Trifolium hirtum	Rose Clover	exotic	annual	forb	Moderate	Fabaceae
Triphysaria pusilla	**Dwarf Owl's Clover**	**native**	**annual**	**forb**		**Scrophulariaceae**
Veronica persica	Birdeye Speedwell	exotic	annual	forb		Scrophulariaceae
Vicia sativa	Spring Vetch	exotic	annual	forb		Fabaceae
Vicia sp.	Vetch	unknown	unknown	forb		Fabaceae
Vulpia bromoides	Brome Fescue	exotic	annual	grass	Eval No List	Poaceae
Vulpia myuros	Foxtail Fescue	exotic	annual	grass	Moderate	Poaceae

Table B-2: List of all species hit and observed on Lake Chabot-Fairmont Ridge plots CR1-6; **bolded** species are native

Scientific name	Common name	Origin	Life history	Life form	Cal-IPC rating	Family
Anagallis arvensis	Scarlet Pimpernel	exotic	annual	forb		Primulaceae
Asteraceae family	Composite Family	unknown	unknown	forb		Asteraceae
Avena barbata	Slender Wild Oats	exotic	annual	grass	Moderate	Poaceae
Avena fatua	Common Wild Oats	exotic	annual	grass	Moderate	Poaceae

Baccharis pilularis	**Coyote Brush**	**native**	**perennial**	**shrub**		**Asteraceae**
***Balsamorhiza macrolepis* var. *macrolepis*†**	**Big Scale Balsamroot**	**native**	**perennial**	**forb**		**Asteraceae**
Bellardia trixago	Mediterranean Lineseed	exotic	annual	forb	Limited	Scrophulariaceae
Brachypodium distachyon	Purple False-brome	exotic	annual	grass	Moderate	Poaceae
Brassica nigra	Black Mustard	exotic	annual	forb	Moderate	Brassicaceae
Brodiaea elegans	**Harvest brodiaea**	**native**	**perennial**	**forb**		**Liliaceae**
Bromus diandrus	Ripgut Brome	exotic	annual	grass	Moderate	Poaceae
Bromus hordeaceus	Soft Chess	exotic	annual	grass	Limited	Poaceae
Bromus madritensis ssp. *madritensis*	Foxtail Brome	exotic	annual	grass		Poaceae
Bromus madritensis ssp. *rubens*	Red Brome	exotic	annual	grass	High	Poaceae
Calochortus argillosus	**Clay mariposa lily**	**native**	**perennial**	**forb**		**Liliaceae**
Calochortus luteus	**Yellow Mariposa Lily**	**native**	**perennial**	**forb**		**Liliaceae**
Calystegia collina* ssp. *collina	**Hillside Morning-glory**	**native**	**perennial**	**forb**		**Convolvulaceae**
Calystegia subacaulis	**Stemless Morning-glory**	**native**	**perennial**	**forb**		**Convolvulaceae**
Carduus pycnocephalus	Italian Thistle	exotic	annual	forb	Moderate	Asteraceae
Centaurea melitensis	Tocalote	exotic	annual	forb	Moderate	Asteraceae
Centaurea solstitialis	Yellow Star-thistle	exotic	annual	forb	High	Asteraceae
Chlorogalum pomeridianum	**Soap Plant**	**native**	**perennial**	**forb**		**Liliaceae**
Cirsium vulgare	Bull Thistle	exotic	perennial	forb	Moderate	Asteraceae
Convolvulus arvensis	Bindweed	exotic	perennial	forb		Convolvulaceae
Cynara cardunculus	Artichoke Thistle	exotic	perennial	forb	Moderate	Asteraceae
Dichelostemma capitatum	**Bluedicks**	**native**	**perennial**	**forb**		**Liliaceae**
***Dichondra* sp.**	**Dichondra**	**native**	**perennial**	**forb**		**Convolvulaceae**
Elymus multisetus	**Big Squirreltail**	**native**	**perennial**	**grass**		**Poaceae**
Epilobium brachycarpum	**Panicled Willow-herb**	**native**	**annual**	**forb**		**Onagraceae**
Eragrostis curvula var. *curvula*	Weeping Lovegrass	exotic	perennial	grass		Poaceae
Eremocarpus setigerus	**Turkey Mullein**	**native**	**annual**	**forb**		**Euphorbiaceae**
Eriogonum nudum	**Nude Buckwheat**	**native**	**perennial**	**forb**		**Polygonaceae**
Erodium botrys	Broad-leaf Filaree	exotic	annual	forb	Eval No List	Geraniaceae

Erodium cicutarium	Redstem Filaree	exotic	annual	forb	Limited	Geraniaceae
Eschscholzia californica	**California Poppy**	**native**	**annual**	**forb**		**Papaveraceae**
Euphorbia sp.	Euphorbia sp.	exotic	annual	forb		Euphorbiaceae
Filago gallica	Narrow-leaved Filago	exotic	annual	forb		Asteraceae
Filago sp.		unknown	annual	forb		Asteraceae
Foeniculum vulgare	Fennel	exotic	perennial	forb	High	Apiaceae
***Fritillaria liliacea**†**	**Fragrant Fritillary**	**native**	**perennial**	**forb**		**Liliaceae**
Galium aparine	**Common Bedstraw**	**native**	**annual**	**forb**		**Rubiaceae**
Geranium dissectum	Cutleaf Geranium	exotic	annual	forb	Moderate	Geraniaceae
Grindelia hirsutula	**Hairy Gumweed**	**native**	**perennial**	**forb**		**Asteraceae**
Hirschfeldia incana	Shortpod Mustard	exotic	perennial	forb	Moderate	Brassicaceae
Hordeum brachyantherum	**Meadow Barley**	**native**	**perennial**	**grass**		**Poaceae**
Hordeum marinum ssp. *gussoneanum*	Mediterranean Barley	exotic	annual	grass	Moderate	Poaceae
Hordeum murinum	Foxtail Barley	exotic	annual	grass	Moderate	Poaceae
Hypochaeris glabra	Smooth Cat's Ear	exotic	annual	forb	Limited	Asteraceae
Hypochaeris radicata	Rough Cat's Ear	exotic	perennial	forb	Moderate	Asteraceae
Lactuca saligna	Narrow-leaved Wild Lettuce	exotic	annual	forb		Asteraceae
Lactuca serriola	Prickly Lettuce	exotic	annual	forb	Eval No List	Asteraceae
Lolium multiflorum	Italian Rye-grass	exotic	annual	grass	Moderate	Poaceae
***Lomatium* sp.**	**Lomatium**	**native**	**perennial**	**forb**		**Apiaceae**
Lomatium utriculatum	**Common Lomatium**	**native**	**perennial**	**forb**		**Apiaceae**
Medicago polymorpha	Bur Clover	exotic	annual	forb	Limited	Fabaceae
Nassella pulchra	**Purple Needlegrass**	**native**	**perennial**	**grass**		**Poaceae**
Orobanche fasciculata	**Clustered broom-rape**	**native**	**perennial**	**forb**		**Orobanchaceae**
Phalaris aquatica	Harding Grass	exotic	perennial	grass	Moderate	Poaceae
Picris echioides	Bristly Oxtongue	exotic	annual	forb	Limited	Asteraceae
Plantago lanceolata	Narrowleaf Plantain	exotic	perennial	forb	Limited	Plantaginaceae
Ranunculus californicus	**California Buttercup**		**perennial**	**forb**		**Ranunculaceae**

Raphanus sativus	Cultivated Radish	exotic	annual	forb	Limited	Brassicaceae
Rumex acetosella	Sheep Sorrel	exotic	perennial	forb	Moderate	Polygonaceae
Rumex pulcher	Fiddle Dock	exotic	perennial	forb		Polygonaceae
Sanicula bipinnata	**Poison Sanicle**	**native**	**annual**	**forb**		**Apiaceae**
Sanicula bipinnatifida	**Purple Sanicle**	**native**	**perennial**	**forb**		**Apiaceae**
Scandix pecten-veneris	Shepherd's Needle	exotic	annual	forb		Apiaceae
Senecio sp.	Groundsel	exotic	annual	forb		Asteraceae
Sherardia arvensis	Field Madder	exotic	annual	forb		Rubiaceae
Silybum marianum	Milk Thistle	exotic	annual	forb	Limited	Asteraceae
Sisyrinchium bellum	**Blue-eyed Grass**	**native**	**perennial**	**forb**		**Iridaceae**
Sonchus asper ssp. *asper*	Prickly Sow Thistle	exotic	annual	forb		Asteraceae
Sonchus oleraceus	Common Sow Thistle	exotic	annual	forb		Asteraceae
Stellaria media	Common Chickweed	exotic	annual	forb		Caryophyllaceae
Torilis arvensis	Hedge Parsley	exotic	annual	forb	Moderate	Apiaceae
Torilis nodosa	Hedge Parsley	exotic	annual	forb		Apiaceae
Trifolium angustifolium	Narrowleaf Crimson Clover	exotic	annual	forb		Fabaceae
Trifolium campestre	Hop Clover	exotic	annual	forb		Fabaceae
Trifolium dubium	Shamrock	exotic	annual	forb		Fabaceae
Trifolium glomeratum	Clustered Clover	exotic	annual	forb		Fabaceae
Trifolium gracilentum	**Pinpoint Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium hirtum	Rose Clover	exotic	annual	forb	Moderate	Fabaceae
Trifolium sp.	Clover	unknown	unknown	forb		Fabaceae
Triteleia laxa	**Ithuriel's Spear**	**native**	**perennial**	**forb**		**Liliaceae**
Urospermum picroides	Prickly Goldenfleece	exotic	unknown	forb		Asteraceae
Vicia sativa	Spring Vetch	exotic	annual	forb		Fabaceae
Vicia sp.	Vetch	unknown	unknown	forb		Fabaceae
Vulpia bromoides	Brome Fescue	exotic	annual	grass	Eval No List	Poaceae
Vulpia myuros	Foxtail Fescue	exotic	annual	grass	Moderate	Poaceae

Wyethia angustifolia	**Narrowleaf Mule Ears**	**native**	**perennial**	**forb**		**Asteraceae**

* *Fritillaria liliacea*: this observation did not occur during our standard field season but earlier in the spring (March 3, 2005).

† *Balsamorhiza macrolepis* var. *macrolepis* and *Fritillaria liliacea*: CNPS Inventory of Rare and Endangered Plants list 1B.2

Table B-3: List of all species hit and observed on Morgan Territory plots MT1-16; **bolded** species are native

Scientific name	Common name	Origin	Life history	Life form	Cal-IPC rating	Family
Achillea millefolium	**Common Yarrow**	**native**	**perennial**	**forb**		**Asteraceae**
Achyrachaena mollis	**Blow Wives**	**native**	**annual**	**forb**		**Asteraceae**
Agoseris grandiflora	**California Dandelion**	**native**	**perennial**	**forb**		**Asteraceae**
Allium serra	**Jeweled Onion**	**native**	**perennial**	**forb**		**Liliaceae**
Amsinckia menziesii	**Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Amsinckia menziesii var. intermedia	**Orange-flowered Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Anagallis arvensis	Scarlet Pimpernel	exotic	annual	forb		Primulaceae
Aphanes occidentalis	**Western Lady's Mantle**	**native**	**annual**	**forb**		**Rosaceae**
Athysanus pusillus	**Common Sandweed**	**native**	**annual**	**forb**		**Brassicaceae**
Avena barbata	Slender Wild Oats	exotic	annual	grass	Moderate	Poaceae
Avena fatua	Common Wild Oats	exotic	annual	grass	Moderate	Poaceae
Bellardia trixago	Mediterranean Lineseed	exotic	annual	forb	Limited	Scrophulariaceae
Brachypodium distachyon	Purple False-brome	exotic	annual	grass	Moderate	Poaceae
Brassica nigra	Black Mustard	exotic	annual	forb	Moderate	Brassicaceae
Briza minor	Little Quaking Grass	exotic	annual	grass		Poaceae
Brodiaea elegans	**Harvest brodiaea**	**native**	**perennial**	**forb**		**Liliaceae**
Bromus carinatus	**California Brome**	**native**	**perennial**	**grass**		**Poaceae**
Bromus diandrus	Ripgut Brome	exotic	annual	grass	Moderate	Poaceae
Bromus hordeaceus	Soft Chess	exotic	annual	grass	Limited	Poaceae
Bromus madritensis ssp. madritensis	Foxtail Brome	exotic	annual	grass		Poaceae
Bromus madritensis ssp. rubens	Red Brome	exotic	annual	grass	High	Poaceae
Bromus sterilis	Sterile Brome	exotic	annual	grass		Poaceae
Calandrinia sp.	**Red Maids**	**native**	**annual**	**forb**		**Portulacaceae**

Calochortus sp.	**Mariposa Lily, Star-Tulip**	**native**	**perennial**	**forb**		**Liliaceae**
Calochortus venustus	**Butterfly Mariposa Lily**	**native**	**perennial**	**forb**		**Liliaceae**
Calystegia purpurata	**Morning-glory**	**native**	**perennial**	**forb**		**Convolvulaceae**
Calystegia subacaulis	**Stemless Morning-glory**	**native**	**perennial**	**forb**		**Convolvulaceae**
Carduus pycnocephalus	Italian Thistle	exotic	annual	forb	Moderate	Asteraceae
Carex sp.	**Sedge**	**native**	**perennial**	**graminoid**		**Cyperaceae**
Centaurea melitensis	Maltese Star-thistle	exotic	annual	forb	Moderate	Asteraceae
Centaurea solstitialis	Yellow Star-thistle	exotic	annual	forb	High	Asteraceae
Cerastium glomeratum	Mouse-ear Chickweed	exotic	annual	forb		Caryophyllaceae
Chlorogalum pomeridianum	**Soap Plant**	**native**	**perennial**	**forb**		**Liliaceae**
Cirsium vulgare	Bull Thistle	exotic	perennial	forb	Moderate	Asteraceae
Clarkia affinis	**Chaparral Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Clarkia purpurea	**Purple Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Claytonia sp.	**Spring beauty**	**native**	**annual, perennial**	**forb**		**Portulacaceae**
Convolvulus arvensis	Bindweed	exotic	perennial	forb		Convolvulaceae
Crassula connata	**Pygmyweed**	**native**	**annual**	**forb**		**Crassulaceae**
Crepis vesicaria ssp. taraxacifolia	Weedy Hawksbeard	exotic	annual, perennial	forb		Asteraceae
Cynara cardunculus	Artichoke Thistle	exotic	perennial	forb	Moderate	Asteraceae
Cynosurus echinatus	Hedgehog dogtail	exotic	annual	grass	Moderate	Poaceae
Delphinium patens	**Spreading Larkspur**	**native**	**perennial**	**forb**		**Ranunculaceae**
Dichelostemma capitatum	**Bluedicks**	**native**	**perennial**	**forb**		**Liliaceae**
Elymus multisetus	**Big Squirreltail**	**native**	**perennial**	**grass**		**Poaceae**
Epilobium brachycarpum	**Panicled Willow-herb**	**native**	**annual**	**forb**		**Onagraceae**
Epilobium canum	**California Fuchsia**	**native**	**perennial**	**forb**		**Onagraceae**
Eremocarpus setigerus	**Turkey Mullein**	**native**	**annual**	**forb**		**Euphorbiaceae**
Eriogonum nudum var. auriculatum	**Nude Buckwheat**	**native**	**perennial**	**shrub**		**Polygonaceae**
Erodium botrys	Broad-leaf Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Erodium cicutarium	Redstem Filaree	exotic	annual	forb	Limited	Geraniaceae
Erodium moschatum	White-stemmed Filaree	exotic	annual	forb	Eval No	Geraniaceae

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Eschscholzia californica	**California Poppy**	**native**	**annual**	**forb**		**Papaveraceae**
Filago gallica	Narrow-leaved Filago	exotic	annual	forb		Asteraceae
Galium aparine	**Common Bedstraw**	**native**	**annual**	**forb**		**Rubiaceae**
Galium parisiense	Wall Bedstraw	exotic	annual	forb		Rubiaceae
Geranium dissectum	Cutleaf Geranium	exotic	annual	forb	Moderate	Geraniaceae
Geranium molle	Dovefoot Geranium	exotic	annual	forb	Eval No List	Geraniaceae
Gnaphalium californicum	**California Cudweed**	**native**	**annual, perennial**	**forb**		**Asteraceae**
Grindelia camporum	**Great Valley Gumweed**	**native**	**perennial**	**forb**		**Asteraceae**
Grindelia hirsutula	**Hairy Gumweed**	**native**	**perennial**	**forb**		**Asteraceae**
Hordeum marinum ssp. gussoneanum	Mediterranean Barley	exotic	annual	grass	Moderate	Poaceae
Hordeum murinum	Foxtail Barley	exotic	annual	grass	Moderate	Poaceae
Hypochaeris glabra	Smooth Cat's Ear	exotic	annual	forb	Limited	Asteraceae
Hypochaeris radicata	Rough Cat's Ear	exotic	perennial	forb	Moderate	Asteraceae
Lactuca serriola	Prickly Lettuce	exotic	annual	forb	Eval No List	Asteraceae
Lagophylla ramosissima	**Common Hareleaf**	**native**	**annual**	**forb**		**Asteraceae**
Lathyrus vestitus var. vestitus	**Common Pacific Pea**	**native**	**perennial**	**forb**		**Fabaceae**
Lepidium nitidum	**Shining Pepperweed**	**native**	**annual**	**forb**		**Brassicaceae**
Leymus triticoides	**Creeping Wildrye**	**native**	**perennial**	**grass**		**Poaceae**
Lolium multiflorum	Italian Rye-grass	exotic	annual	grass	Moderate	Poaceae
Lomatium sp.	**Lomatium**	**native**	**perennial**	**forb**		**Apiaceae**
Lotus wrangelianus	**Chilean Trefoil**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus bicolor	**Bicolored Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus nanus	**Sky Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus succulentus	**Succulent Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Madia elegans	**Common madia**	**native**	**annual**	**forb**		**Asteraceae**
Madia gracilis	**Slender Tarweed**	**native**	**annual**	**forb**		**Asteraceae**
Marah fabaceus	**Wild-cucumber**	**native**	**perennial**	**forb**		**Cucurbitaceae**
Medicago polymorpha	Bur Clover	exotic	annual	forb	Limited	Fabaceae

Melica californica	**California Melicgrass**	**native**	**perennial**	**grass**		**Poaceae**
Micropus californicus	**Slender Cottonweed or Q-tips**	**native**	**annual**	**forb**		**Asteraceae**
Nassella pulchra	**Purple Needlegrass**	**native**	**perennial**	**grass**		**Poaceae**
Phalaris paradoxa	Hood Canarygrass	exotic	annual	forb		Poaceae
Picris echioides	Bristly Oxtongue	exotic	annual	forb	Limited	Asteraceae
Plagiobothrys sp.	**Popcornflower**	**native**	**unknown**	**forb**		**Boraginaceae**
Plantago erecta	**Foothill Plantain**	**native**	**annual**	**forb**		**Plantaginaceae**
Poa secunda ssp. secunda	**Pine Bluegrass**	**native**	**perennial**	**grass**		**Poaceae**
Quercus agrifolia	**Coast Live Oak**	**native**	**perennial**	**tree**		**Fagaceae**
Ranunculus californicus	**California Buttercup**	**native**	**perennial**	**forb**		**Ranunculaceae**
Rumex crispus	Curly-leaved Dock	exotic	perennial	forb	Limited	Polygonaceae
Rumex pulcher	Fiddle Dock	exotic	perennial	forb		Polygonaceae
Sanicula bipinnata	**Poison Sanicle**	**native**	**annual**	**forb**		**Apiaceae**
Sanicula bipinnatifida	**Snakeroot**	**native**	**perennial**	**forb**		**Apiaceae**
Sanicula crassicaulis	**Pacific Sanicle**	**native**	**perennial**	**forb**		**Apiaceae**
Scandix pecten-veneris	Shepherd's Needle	exotic	annual	forb		Apiaceae
Sherardia arvensis	Field Madder	exotic	annual	forb		Rubiaceae
Silene gallica	Windmill Pink	exotic	annual	forb		Caryophyllaceae
Silybum marianum	Milk Thistle	exotic	annual	forb	Limited	Asteraceae
Sinapis arvensis	Charlock	exotic	annual	forb	Limited	Brassicaceae
Sisymbrium officinale	Hedge Mustard	exotic	annual	forb		Brassicaceae
Sisyrinchium bellum	**Blue-eyed Grass**	**native**	**perennial**	**forb**		**Iridaceae**
Solidago californica	**California Goldenrod**	**native**	**perennial**	**forb**		**Asteraceae**
Sonchus asper	Prickly Sow Thistle	exotic	annual	forb		Asteraceae
Sonchus oleraceus	Common Sow Thistle	exotic	annual	forb		Asteraceae
Stellaria media	Common Chickweed	exotic	annual	forb		Caryophyllaceae
Taeniatherum caput-medusae	Medusahead	exotic	annual	grass	High	Poaceae
Torilis arvensis	Hedge Parsley	exotic	annual	forb	Moderate	Apiaceae
Torilis nodosa	Hedge Parsley	exotic	annual	forb		Apiaceae
Tragopogon porrifolius	Purple Salsify	exotic	perennial	forb		Asteraceae
Trichostema lanceolatum	**Vinegarweed**	**native**	**annual**	**forb**		**Lamiaceae**
Trifolium bifidum	**Notchleaf Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium campestre	Hop Clover	exotic	annual	forb		Fabaceae

Trifolium ciliolatum	**Tree Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium dubium	Shamrock	exotic	annual	forb		Fabaceae
Trifolium gracilentum	**Pinpoint Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium hirtum	Rose Clover	exotic	annual	forb	Moderate	Fabaceae
Trifolium microcephalum	**Small-headed Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium microdon	**Valparaiso Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium willdenovii	**Tomcat Clover**	**native**	**annual**	**forb**		**Fabaceae**
Triteleia laxa	**Ithuriel's Spear**	**native**	**perennial**	**forb**		**Liliaceae**
Vicia americana	**American Vetch**	**native**	**perennial**	**forb**		**Fabaceae**
Vicia sativa	Spring Vetch	exotic	annual	forb		Fabaceae
Vicia villosa	Hairy Vetch	exotic	annual	forb	Eval No List	Fabaceae
Vulpia bromoides	Brome Fescue	exotic	annual	grass	Eval No List	Poaceae
Vulpia myuros	Foxtail Fescue	exotic	annual	grass	Moderate	Poaceae

Table B-4: List of all species hit and observed on Pleasanton Ridge plots PR1-9; **bolded** species are native

Scientific name	Common name	Origin	Life history	Life form	Cal-IPC rating	Family
Acaena pinnatifida var. californica	**California Sheepburr**	**native**	**perennial**	**forb**		**Rosaceae**
Achillea millefolium	**Common Yarrow**	**native**	**perennial**	**forb**		**Asteraceae**
Achyrachaena mollis	**Blow Wives**	**native**	**annual**	**forb**		**Asteraceae**
Agoseris sp.	**Dandelion**	**native**	**annual, perennial**	**forb**		**Asteraceae**
Aira caryophyllea	Silver Hairgrass	exotic	annual	grass	Eval No List	Poaceae
Amsinckia menziesii	**Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Anagallis arvensis	Scarlet Pimpernel	exotic	annual	forb		Primulaceae
Aphanes occidentalis	**Western Lady's Mantle**	**native**	**annual**	**forb**		**Rosaceae**
Avena barbata	Slender Wild Oats	exotic	annual	grass	Moderate	Poaceae
Avena fatua	Common Wild Oats	exotic	annual	grass	Moderate	Poaceae
Brachypodium distachyon	Purple False-brome	exotic	annual	grass	Moderate	Poaceae
Brassica sp.	Mustard	exotic	annual	forb		Brassicaceae

Briza minor	Little Quaking Grass	exotic	annual	grass		Poaceae
Bromus carinatus	**California Brome**	**native**	**perennial**	**grass**		**Poaceae**
Bromus diandrus	Ripgut Brome	exotic	annual	grass	Moderate	Poaceae
Bromus hordeaceus	Soft Chess	exotic	annual	grass	Limited	Poaceae
Bromus madritensis ssp. madritensis	Foxtail Brome	exotic	annual	grass		Poaceae
Bromus sterilis	Sterile Brome	exotic	annual	grass		Poaceae
Calandrinia sp.	**Red Maids**	**native**	**annual**	**forb**		**Portulacaceae**
Calystegia subacaulis	**Stemless Morning-glory**	**native**	**perennial**	**forb**		**Convolvulaceae**
Capsella bursa-pastoris	Shepherd's purse	exotic	annual	forb		Brassicaceae
Carduus pycnocephalus	Italian Thistle	exotic	annual	forb	Moderate	Asteraceae
Carduus tenuiflorus	Slender flowered thistle	exotic	annual	forb		Asteraceae
Carex sp.	**Sedge**	**native**	**perennial**	**graminoid**		**Cyperaceae**
Castilleja attenuata	**Valley tassels**	**native**	**annual**	**forb**		**Scrophulariaceae**
Centaurea solstitialis	Yellow Star-thistle	exotic	annual	forb	High	Asteraceae
Cerastium glomeratum	Mouse-ear Chickweed	exotic	annual	forb		Caryophyllaceae
Cirsium vulgare	Bull Thistle	exotic	perennial	forb	Moderate	Asteraceae
Clarkia affinis	**Chaparral Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Clarkia purpurea	**Purple Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Convolvulus arvensis	Bindweed	exotic	perennial	forb		Convolvulaceae
Crassula connata	**Pygmyweed**	**native**	**annual**	**forb**		**Crassulaceae**
Crepis vesicaria ssp. taraxacifolia	Weedy Hawksbeard	exotic	annual, perennial	forb		Asteraceae
Cynosurus echinatus	Hedgehog dogtail	exotic	annual	grass	Moderate	Poaceae
Cyperus eragrostis	**Tall Flatsedge**	**native**	**perennial**	**graminoid**		**Cyperaceae**
Daucus pusillus	**Wild Carrot**	**native**	**annual**	**forb**		**Apiaceae**
Dichelostemma capitatum	**Bluedicks**	**native**	**perennial**	**forb**		**Liliaceae**
Eleocharis acicularis	**Needle Spikerush**	**native**	**perennial**	**graminoid**		**Cyperaceae**
Elymus glaucus	**Blue Wildrye**	**native**	**perennial**	**grass**		**Poaceae**
Elymus multisetus	**Big Squirreltail**	**native**	**perennial**	**grass**		**Poaceae**
Epilobium sp.	**Epilobium**	**native**	**perennial**	**forb**		**Onagraceae**
Eremocarpus setigerus	**Turkey Mullein**	**native**	**annual**	**forb**		**Euphorbiaceae**
Erodium botrys	Broad-leaf Filaree	exotic	annual	forb	Eval No List	Geraniaceae

Erodium cicutarium	Redstem Filaree	exotic	annual	forb	Limited	Geraniaceae
Erodium moschatum	White-stemmed Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Eschscholzia californica	**California Poppy**	**native**	**annual**	**forb**		**Papaveraceae**
Filago gallica	Narrow-leaved Filago	exotic	annual	forb		Asteraceae
Galium murale	Yellow Wall Bedstraw	exotic	annual	forb		Rubiaceae
Galium sp.	Bedstraw	unknown	annual	forb		Rubiaceae
Geranium dissectum	Cutleaf Geranium	exotic	annual	forb	Moderate	Geraniaceae
Geranium molle	Dovefoot Geranium	exotic	annual	forb	Eval No List	Geraniaceae
Hordeum brachyantherum	**Meadow Barley**	**native**	**perennial**	**grass**		**Poaceae**
Hordeum marinum ssp. gussoneanum	Mediterranean Barley	exotic	annual	grass	Moderate	Poaceae
Hordeum murinum	Foxtail Barley	exotic	annual	grass	Moderate	Poaceae
Hypochaeris glabra	Smooth Cat's Ear	exotic	annual	forb	Limited	Asteraceae
Hypochaeris radicata	Rough Cat's Ear	exotic	perennial	forb	Moderate	Asteraceae
Juncus bufonius	**Toad Rush**	**native**	**annual**	**graminoid**		**Juncaceae**
Juncus effusis	**Bog Rush**	**native**	**perennial**	**graminoid**		**Juncaceae**
Lactuca serriola	Prickly Lettuce	exotic	annual	forb	Eval No List	Asteraceae
Lagophylla ramosissima	**Common Hareleaf**	**native**	**annual**	**forb**		**Asteraceae**
Lamiaceae family	Mint Family	unknown	unknown	forb		Lamiaceae
Lepidium nitidum	**Shining Pepperweed**	**native**	**annual**	**forb**		**Brassicaceae**
Leymus triticoides	**Creeping Wildrye**	**native**	**perennial**	**grass**		**Poaceae**
Linanthus acicularis	**Bristly Linanthus**	**native**	**annual**	**forb**		**Polemoniaceae**
Lolium multiflorum	Italian Rye-grass	exotic	annual	grass	Moderate	Poaceae
Lotus wrangelianus	**Chilean Trefoil**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus bicolor	**Bicolored Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Madia gracilis	**Slender Tarweed**	**native**	**annual**	**forb**		**Asteraceae**
Medicago polymorpha	Bur Clover	exotic	annual	forb	Limited	Fabaceae
Melilotus indica	Annual Yellow Sweetclover	exotic	annual	forb		Fabaceae
Mentha pulegium	Pennyroyal	exotic	perennial	forb	Moderate	Lamiaceae
Micropus californicus var. subvestitus	**Slender Cottonweed or**	**native**	**annual**	**forb**		**Asteraceae**

	Q-tips					
Mimulus guttatus	**Seep Monkey Flower**	**native**	**annual, perennial**	**forb**		**Scrophulariaceae**
Monardella villosa	**Coyote Mint**	**native**	**perennial**	**forb**		**Lamiaceae**
Nassella pulchra	**Purple Needlegrass**	**native**	**perennial**	**grass**		**Poaceae**
Oxalis sp.	Oxalis	unknown	unknown	forb		Fabaceae
Picris echioides	Bristly Oxtongue	exotic	annual	forb	Limited	Asteraceae
Plagiobothrys sp.	**Popcornflower**	**native**	**unknown**	**forb**		**Boraginaceae**
Plantago erecta	**Foothill Plantain**	**native**	**annual**	**forb**		**Plantaginaceae**
Poa annua	Annual Bluegrass	exotic	annual	grass		Poaceae
Polypogon monspeliensis	Rabbit's Foot	exotic	annual	grass	Limited	Poaceae
Ranunculus californicus	**California Buttercup**	**native**	**perennial**	**forb**		**Ranunculaceae**
Ranunculus muricatus	Spiny buttercup	exotic	annual, perennial	forb		Ranunculaceae
Raphanus sp.	Radish	exotic	unknown	forb		Brassicaceae
Ribes sp.	**Gooseberry**	**native**	**perennial**	**shrub**		**Grossulariaceae**
Rorippa nasturtium-aquaticum	**Watercress**	**native**	**perennial**	**forb**		**Brassicaceae**
Rumex acetosella	Sheep Sorrel	exotic	perennial	forb	Moderate	Polygonaceae
Rumex crispus	Curly-leaved Dock	exotic	perennial	forb	Limited	Polygonaceae
Rumex pulcher	Fiddle Dock	exotic	perennial	forb		Polygonaceae
Scandix pecten-veneris	Shepherd's Needle	exotic	annual	forb		Apiaceae
Selaginella bigelovii	**Spike-moss**	**native**				**Selaginellaceae**
Sherardia arvensis	Field Madder	exotic	annual	forb		Rubiaceae
Silybum marianum	Milk Thistle	exotic	annual	forb	Limited	Asteraceae
Sisymbrium officinale	Hedge Mustard	exotic	annual	forb		Brassicaceae
Sisyrinchium bellum	**Blue-eyed Grass**	**native**	**perennial**	**forb**		**Iridaceae**
Sonchus asper	Prickly Sow Thistle	exotic	annual	forb		Asteraceae
Sonchus oleraceus	Common Sow Thistle	exotic	annual	forb		Asteraceae
Taeniatherum caput-medusae	Medusahead	exotic	annual	grass	High	Poaceae
Thysanocarpus sp.	**Fringe Pod**	**native**	**annual**	**forb**		**Brassicaceae**
Torilis arvensis	Hedge Parsley	exotic	annual	forb	Moderate	Apiaceae
Torilis nodosa	Hedge Parsley	exotic	annual	forb		Apiaceae
Toxicodendron diversilobum	**Poison Oak**	**native**	**perennial**	**shrub**		**Anacardiaceae**

Trifolium angustifolium	Narrowleaf Crimson Clover	exotic	annual	forb		Fabaceae
Trifolium barbigerum	**Bearded Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium bifidum	**Notchleaf Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium campestre	Hop Clover	exotic	annual	forb		Fabaceae
Trifolium ciliolatum	**Tree Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium dubium	Shamrock	exotic	annual	forb		Fabaceae
Trifolium glomeratum	Clustered Clover	exotic	annual	forb		Fabaceae
Trifolium gracilentum	**Pinpoint Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium hirtum	Rose Clover	exotic	annual	forb	Moderate	Fabaceae
Trifolium microcephalum	**Small-headed Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium microdon	**Valparaiso Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium oliganthum	**Few-flowered Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium pratense	Red Clover	exotic	perennial	forb		Fabaceae
Trifolium striatum	Knotted Clover	exotic	annual	forb		Fabaceae
Trifolium subterraneum	Subterranean Clover	exotic	annual	forb		Fabaceae
Trifolium willdenovii	**Tomcat Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium wormskioldii	**Cow Clover**	**native**	**perennial**	**forb**		**Fabaceae**
Triphysaria pusilla	**Dwarf Owl's Clover**	**native**	**annual**	**forb**		**Scrophulariaceae**
Triteleia laxa	**Ithuriel's Spear**	**native**	**perennial**	**forb**		**Liliaceae**
Vicia americana	**American Vetch**	**native**	**perennial**	**forb**		**Fabaceae**
Vicia sativa	Spring Vetch	exotic	annual	forb		Fabaceae
Vulpia bromoides	Brome Fescue	exotic	annual	grass	Eval No List	Poaceae
Vulpia microstachys	**Small Fescue**	**native**	**annual**	**grass**		**Poaceae**
Vulpia myuros	Foxtail Fescue	exotic	annual	grass	Moderate	Poaceae
Wyethia sp.	**Mule Ears**	**native**	**perennial**	**forb**		**Asteraceae**

Table B-5: List of all species hit and observed on Sunol-Ohlone plots SU1-12; **bolded** species are native

Scientific name	Common name	Origin	Life history	Life form	Cal-IPC rating	Family
Achillea millefolium	**Common Yarrow**	**native**	**perennial**	**forb**		**Asteraceae**
Achyrachaena mollis	**Blow Wives**	**native**	**annual**	**forb**		**Asteraceae**

Agoseris sp.	**Dandelion**	**native**	**annual, perennial**	**forb**		**Asteraceae**
Aira caryophyllea	Silver Hairgrass	exotic	annual	grass	Eval No List	Poaceae
Allium serra	**Jeweled Onion**	**native**	**perennial**	**forb**		**Liliaceae**
Amsinckia menziesii	**Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Amsinckia menziesii var. intermedia	**Orange-flowered Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Anagallis arvensis	Scarlet Pimpernel	exotic	annual	forb		Primulaceae
Aphanes occidentalis	**Western Lady's Mantle**	**native**	**annual**	**forb**		**Rosaceae**
Astragalus gambelianus	**Gambel's dwarf milk vetch**	**native**	**annual**	**forb**		**Fabaceae**
Avena barbata	Slender Wild Oats	exotic	annual	grass	Moderate	Poaceae
Avena fatua	Common Wild Oats	exotic	annual	grass	Moderate	Poaceae
Bellardia trixago	Mediterranean Lineseed	exotic	annual	forb	Limited	Scrophulariaceae
Brachypodium distachyon	Purple False-brome	exotic	annual	grass	Moderate	Poaceae
Brassica nigra	Black Mustard	exotic	annual	forb	Moderate	Brassicaceae
Brodiaea elegans	**Harvest brodiaea**	**native**	**perennial**	**forb**		**Liliaceae**
Bromus carinatus	**California Brome**	**native**	**perennial**	**grass**		**Poaceae**
Bromus diandrus	Ripgut Brome	exotic	annual	grass	Moderate	Poaceae
Bromus hordeaceus	Soft Chess	exotic	annual	grass	Limited	Poaceae
Bromus madritensis ssp. madritensis	Foxtail Brome	exotic	annual	grass		Poaceae
Bromus madritensis ssp. rubens	Red Brome	exotic	annual	grass	High	Poaceae
Bromus sterilis	Sterile Brome	exotic	annual	grass		Poaceae
Calochortus luteus	**Yellow Mariposa Lily**	**native**	**perennial**	**forb**		**Liliaceae**
Calystegia subacaulis	**Stemless Morning-glory**	**native**	**perennial**	**forb**		**Convolvulaceae**
Carduus pycnocephalus	Italian Thistle	exotic	annual	forb	Moderate	Asteraceae
Carduus tenuiflorus	Slender flowered thistle	exotic	annual	forb		Asteraceae
Castilleja attenuata	**Valley tassels**	**native**	**annual**	**forb**		**Scrophulariaceae**
Castilleja exserta	**Purple Owl's Clover**	**native**	**annual**	**forb**		**Scrophulariaceae**
Centaurea solstitialis	Yellow Star-thistle	exotic	annual	forb	High	Asteraceae
Cerastium glomeratum	Mouse-ear Chickweed	exotic	annual	forb		Caryophyllaceae
Chenopodium californicum	**California goosefoot**	**native**	**perennial**	**forb**		**Chenopodiaceae**
Chlorogalum pomeridianum	**Soap Plant**	**native**	**perennial**	**forb**		**Liliaceae**
Clarkia affinis	**Chaparral Clarkia**	**native**	**annual**	**forb**		**Onagraceae**

Clarkia purpurea	**Purple Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Claytonia perfoliata	**Miner's lettuce**	**native**	**annual**	**forb**		**Portulacaceae**
Conium maculatum	Poison hemlock	exotic	perennial	forb	Moderate	Apiaceae
Convolvulus arvensis	Bindweed	exotic	perennial	forb		Convolvulaceae
Crepis vesicaria ssp. taraxacifolia	Weedy Hawksbeard	exotic	annual, perennial	forb		Asteraceae
Cynosurus echinatus	Hedgehog dogtail	exotic	annual	grass	Moderate	Poaceae
Delphinium variegatum	**Royal Larkspur**	**native**	**perennial**	**forb**		**Ranunculaceae**
Dichelostemma capitatum	**Bluedicks**	**native**	**perennial**	**forb**		**Liliaceae**
Eleocharis acicularis	**Needle Spikerush**	**native**	**perennial**	**graminoid**		**Cyperaceae**
Elymus glaucus	**Blue Wildrye**	**native**	**perennial**	**grass**		**Poaceae**
Elymus multisetus	**Big Squirreltail**	**native**	**perennial**	**grass**		**Poaceae**
Epilobium brachycarpum	**Panicled Willow-herb**	**native**	**annual**	**forb**		**Onagraceae**
Eremocarpus setigerus	**Turkey Mullein**	**native**	**annual**	**forb**		**Euphorbiaceae**
Erodium botrys	Broad-leaf Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Erodium cicutarium	Redstem Filaree	exotic	annual	forb	Limited	Geraniaceae
Erodium moschatum	White-stemmed Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Eschscholzia californica	**California Poppy**	**native**	**annual**	**forb**		**Papaveraceae**
Filago gallica	Narrow-leaved Filago	exotic	annual	forb		Asteraceae
Foeniculum vulgare	Fennel	exotic	perennial	forb	High	Apiaceae
Galium aparine	**Common Bedstraw**	**native**	**annual**	**forb**		**Rubiaceae**
Galium murale	Yellow Wall Bedstraw	exotic	annual	forb		Rubiaceae
Galium parisiense	Wall Bedstraw	exotic	annual	forb		Rubiaceae
Geranium dissectum	Cutleaf Geranium	exotic	annual	forb	Moderate	Geraniaceae
Geranium molle	Dovefoot Geranium	exotic	annual	forb	Eval No List	Geraniaceae
Gilia tricolor	**Bird's Eye Gilia**	**native**	**annual**	**forb**		**Polemoniaceae**
Gnaphalium sp.	Cudweed	unknown	unknown	forb		Asteraceae
Grindelia sp.	**Gumweed**	**native**	**perennial**	**forb**		**Asteraceae**
Hesperevax sparsiflora	**Erect Dwarf-cudweed**	**native**	**annual**	**forb**		**Asteraceae**
Heterotheca sessiliflora	**False Goldenaster**	**native**	**unknown**	**forb**		**Asteraceae**
Holocarpha heermannii	**Heermann's Tarweed**	**native**	**annual**	**forb**		**Asteraceae**
Hordeum marinum ssp. gussoneanum	Mediterranean Barley	exotic	annual	grass	Moderate	Poaceae

Hordeum murinum	Foxtail Barley	exotic	annual	grass	Moderate	Poaceae
Hypochaeris glabra	Smooth Cat's Ear	exotic	annual	forb	Limited	Asteraceae
Hypochaeris radicata	Rough Cat's Ear	exotic	perennial	forb	Moderate	Asteraceae
Juncus bufonius	**Toad Rush**	**native**	**annual**	**graminoid**		**Juncaceae**
Lactuca serriola	Prickly Lettuce	exotic	annual	forb	Eval No List	Asteraceae
Lagophylla ramosissima	**Common Hareleaf**	**native**	**annual**	**forb**		**Asteraceae**
Lathyrus sp.	Pea	unknown	unknown	forb		Fabaceae
Lepidium nitidum	**Shining Pepperweed**	**native**	**annual**	**forb**		**Brassicaceae**
Linanthus bicolor	**Bicolor Linanthus**	**native**	**annual**	**forb**		**Polemoniaceae**
Linanthus parviflorus	**Common Linanthus**	**native**	**annual**	**forb**		**Polemoniaceae**
Lolium multiflorum	Italian Rye-grass	exotic	annual	grass	Moderate	Poaceae
Lomatium utriculatum	**Common Lomatium**	**native**	**perennial**	**forb**		**Apiaceae**
Lotus wrangelianus	**Chilean Trefoil**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus bicolor	**Bicolored Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus formosus	**Summer Lupine**	**native**	**perennial**	**forb**		**Fabaceae**
Lupinus nanus	**Sky Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus succulentus	**Succulent Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Madia gracilis	**Slender Tarweed**	**native**	**annual**	**forb**		**Asteraceae**
Marah fabaceus	**Wild-cucumber**	**native**	**perennial**	**forb**		**Cucurbitaceae**
Medicago polymorpha	Bur Clover	exotic	annual	forb	Limited	Fabaceae
Melica californica	**California Melicgrass**	**native**	**perennial**	**grass**		**Poaceae**
Melilotus indica	Annual Yellow Sweetclover	exotic	annual	forb		Fabaceae
Micropus californicus	**Slender Cottonweed or Q-tips**	**native**	**annual**	**forb**		**Asteraceae**
Microseris douglasii	**Douglas' Silverpuffs**	**native**	**annual**	**forb**		**Asteraceae**
Nassella pulchra	**Purple Needlegrass**	**native**	**perennial**	**grass**		**Poaceae**
Phalaris paradoxa	Hood Canarygrass	exotic	annual	forb		Poaceae
Plagiobothrys canescens	**Valley Popcorn Flower**	**native**	**annual**	**forb**		**Boraginaceae**
Plagiobothrys nothofulvus	**Rusty Popcorn Flower**	**native**	**annual**	**forb**		**Boraginaceae**
Plantago erecta	**Foothill Plantain**	**native**	**annual**	**forb**		**Plantaginaceae**
Poa secunda ssp. secunda	**Pine Bluegrass**	**native**	**perennial**	**grass**		**Poaceae**
Quercus douglasii	**Blue Oak**	**native**	**perennial**	**tree**		**Fagaceae**

Quercus lobata	**Valley Oak**	**native**	**perennial**	**tree**		**Fagaceae**
Ranunculus californicus	**California Buttercup**	**native**	**perennial**	**forb**		**Ranunculaceae**
Rumex acetosella	Sheep Sorrel	exotic	perennial	forb	Moderate	Polygonaceae
Rumex crispus	Curly-leaved Dock	exotic	perennial	forb	Limited	Polygonaceae
Rumex pulcher	Fiddle Dock	exotic	perennial	forb		Polygonaceae
Sanicula bipinnata	**Poison Sanicle**	**native**	**annual**	**forb**		**Apiaceae**
Sanicula bipinnatifida	**Snakeroot**	**native**	**perennial**	**forb**		**Apiaceae**
Scandix pecten-veneris	Shepherd's Needle	exotic	annual	forb		Apiaceae
Sherardia arvensis	Field Madder	exotic	annual	forb		Rubiaceae
Sidalcea malviflora	**Common Checkerbloom**	**native**	**perennial**	**forb**		**Malvaceae**
Silene gallica	Windmill Pink	exotic	annual	forb		Caryophyllaceae
Silybum marianum	Milk Thistle	exotic	annual	forb	Limited	Asteraceae
Sisymbrium officinale	Hedge Mustard	exotic	annual	forb		Brassicaceae
Sisyrinchium bellum	**Blue-eyed Grass**	**native**	**perennial**	**forb**		**Iridaceae**
Stebbinsoseris heterocarpa	**Grassland Silver Puffs**	**native**	**annual**	**forb**		**Asteraceae**
Taeniatherum caput-medusae	Medusahead	exotic	annual	grass	High	Poaceae
Torilis arvensis	Hedge Parsley	exotic	annual	forb	Moderate	Apiaceae
Torilis nodosa	Hedge Parsley	exotic	annual	forb		Apiaceae
Tragopogon porrifolius	Purple Salsify	exotic	perennial	forb		Asteraceae
Trichostema lanceolatum	**Vinegarweed**	**native**	**annual**	**forb**		**Lamiaceae**
Trifolium bifidum	**Notchleaf Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium campestre	Hop Clover	exotic	annual	forb		Fabaceae
Trifolium ciliolatum	**Tree Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium depauperatum	**Dwarf sack clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium dubium	Shamrock	exotic	annual	forb		Fabaceae
Trifolium fragiferum	Strawberry Clover	exotic	perennial	forb		Fabaceae
Trifolium glomeratum	Clustered Clover	exotic	annual	forb		Fabaceae
Trifolium gracilentum	**Pinpoint Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium hirtum	Rose Clover	exotic	annual	forb	Moderate	Fabaceae
Trifolium microcephalum	**Small-headed Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium microdon	**Valparaiso Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium subterraneum	Subterranean Clover	exotic	annual	forb		Fabaceae
Trifolium tomentosum	Woolly Clover	exotic	annual	forb		Fabaceae
Trifolium willdenovii	**Tomcat Clover**	**native**	**annual**	**forb**		**Fabaceae**

Triteleia laxa	**Ithuriel's Spear**	**native**	**perennial**	**forb**		**Liliaceae**
Vicia americana	**American Vetch**	**native**	**perennial**	**forb**		**Fabaceae**
Vicia sativa	Spring Vetch	exotic	annual	forb		Fabaceae
Vicia villosa	Hairy Vetch	exotic	annual	forb	Eval No List	Fabaceae
Viola pedunculata	**Johnny Jump-up**	**native**	**perennial**	**forb**		**Violaceae**
Vulpia bromoides	Brome Fescue	exotic	annual	grass	Eval No List	Poaceae
Vulpia microstachys	**Small Fescue**	**native**	**annual**	**grass**		**Poaceae**
Vulpia myuros	Foxtail Fescue	exotic	annual	grass	Moderate	Poaceae
Wyethia angustifolia	**Narrowleaf Mule Ears**	**native**	**perennial**	**forb**		**Asteraceae**

Table B-6: List of all species hit and observed on Sycamore Valley plots SV1-6; **bolded** species are native

Scientific name	Common name	Origin	Life history	Life form	Cal-IPC rating	Family
Achillea millefolium	**Common Yarrow**	**native**	**perennial**	**forb**		**Asteraceae**
Amsinckia menziesii* var. *intermedia	**Orange-flowered Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Anagallis arvensis	Scarlet Pimpernel	exotic	annual	forb		Primulaceae
Asteraceae family	Composite Family	unknown	unknown	forb		Asteraceae
Avena barbata	Slender Wild Oats	exotic	annual	grass	Moderate	Poaceae
Avena fatua	Common Wild Oats	exotic	annual	grass	Moderate	Poaceae
Bellardia trixago	Mediterranean Lineseed	exotic	annual	forb	Limited	Scrophulariaceae
Brachypodium distachyon	Purple False-brome	exotic	annual	grass	Moderate	Poaceae
Brassica nigra	Black Mustard	exotic	annual	forb	Moderate	Brassicaceae
Brodiaea elegans	**Harvest brodiaea**	**native**	**perennial**	**forb**		**Liliaceae**
Bromus carinatus	**California Brome**	**native**	**perennial**	**grass**		**Poaceae**
Bromus diandrus	Ripgut Brome	exotic	annual	grass	Moderate	Poaceae
Bromus hordeaceus	Soft Chess	exotic	annual	grass	Limited	Poaceae
Bromus madritensis ssp. *madritensis*	Foxtail Brome	exotic	annual	grass		Poaceae
Bromus madritensis ssp. *rubens*	Red Brome	exotic	annual	grass	High	Poaceae

Calystegia subacaulis	**Stemless Morning-glory**	**native**	**perennial**	**forb**		**Convolvulaceae**
Carduus pycnocephalus	Italian Thistle	exotic	annual	forb	Moderate	Asteraceae
Castilleja exserta	**Purple Owl's Clover**	**native**	**annual**	**forb**		**Scrophulariaceae**
Centaurea solstitialis	Yellow Star-thistle	exotic	annual	forb	High	Asteraceae
Chlorogalum pomeridianum	**Soap Plant**	**native**	**perennial**	**forb**		**Liliaceae**
Cirsium vulgare	Bull Thistle	exotic	perennial	forb	Moderate	Asteraceae
Clarkia affinis	**Chaparral Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Clarkia purpurea	**Purple Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Convolvulus arvensis	Bindweed	exotic	perennial	forb		Convolvulaceae
Epilobium brachycarpum	**Panicled Willow-herb**	**native**	**annual**	**forb**		**Onagraceae**
Erodium botrys	Broad-leaf Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Erodium cicutarium	Redstem Filaree	exotic	annual	forb	Limited	Geraniaceae
Erodium moschatum	White-stemmed Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Eschscholzia californica	**California Poppy**	**native**	**annual**	**forb**		**Papaveraceae**
Geranium dissectum	Cutleaf Geranium	exotic	annual	forb	Moderate	Geraniaceae
Geranium molle	Dovefoot Geranium	exotic	annual	forb	Eval No List	Geraniaceae
***Grindelia* sp.**	**Gumweed**	**native**	**perennial**	**forb**		**Asteraceae**
Hirschfeldia incana	Shortpod Mustard	exotic	perennial	forb	Moderate	Brassicaceae
Hordeum marinum ssp. *gussoneanum*	Mediterranean Barley	exotic	annual	grass	Moderate	Poaceae
Hordeum murinum	Foxtail Barley	exotic	annual	grass	Moderate	Poaceae
Hypochaeris glabra	Smooth Cat's Ear	exotic	annual	forb	Limited	Asteraceae
Hypochaeris radicata	Rough Cat's Ear	exotic	perennial	forb	Moderate	Asteraceae
Lactuca serriola	Prickly Lettuce	exotic	annual	forb	Eval No List	Asteraceae
Lolium multiflorum	Italian Rye-grass	exotic	annual	grass	Moderate	Poaceae
Lupinus bicolor	**Bicolored Lupine**	**native**	**annual**	**forb**		**Fabaceae**
***Lupinus* sp.**	**Lupine**	**native**	**unknown**	**forb**		**Fabaceae**
***Madia* sp.**	**Tarweed**	**native**	**unknown**	**forb**		**Asteraceae**

Malvella leprosa	**Alkali Mallow**	**native**	**perennial**	**forb**		**Malvaceae**
Marah fabaceus	**Wild-cucumber**	**native**	**perennial**	**forb**		**Cucurbitaceae**
Medicago polymorpha	Bur Clover	exotic	annual	forb	Limited	Fabaceae
Melilotus indica	Annual Yellow Sweetclover	exotic	annual	forb		Fabaceae
Melilotus sp.	Sweetclover	exotic	unknown	forb		Fabaceae
Phalaris aquatica	Harding Grass	exotic	perennial	grass	Moderate	Poaceae
Phalaris paradoxa	Hood Canarygrass	exotic	annual	forb		Poaceae
Picris echioides	Bristly Oxtongue	exotic	annual	forb	Limited	Asteraceae
Rumex crispus	Curly-leaved Dock	exotic	perennial	forb	Limited	Polygonaceae
Rumex pulcher	Fiddle Dock	exotic	perennial	forb		Polygonaceae
Sherardia arvensis	Field Madder	exotic	annual	forb		Rubiaceae
Silybum marianum	Milk Thistle	exotic	annual	forb	Limited	Asteraceae
Sisymbrium officinale	Hedge Mustard	exotic	annual	forb		Brassicaceae
Sisyrinchium bellum	**Blue-eyed Grass**	**native**	**perennial**	**forb**		**Iridaceae**
Sonchus asper ssp. *asper*	Prickly Sow Thistle	exotic	annual	forb		Asteraceae
Sonchus oleraceus	Common Sow Thistle	exotic	annual	forb		Asteraceae
Torilis arvensis	Hedge Parsley	exotic	annual	forb	Moderate	Apiaceae
Torilis nodosa	Hedge Parsley	exotic	annual	forb		Apiaceae
Torilis sp. or *Scandix* sp.		exotic	annual	forb		Apiaceae
Trifolium bifidum	**Notchleaf Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium campestre	Hop Clover	exotic	annual	forb		Fabaceae
Trifolium dubium	Shamrock	exotic	annual	forb		Fabaceae
Trifolium gracilentum	**Pinpoint Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium hirtum	Rose Clover	exotic	annual	forb	Moderate	Fabaceae
Triphysaria eriantha	**Butter 'n' Eggs**	**native**	**annual**	**forb**		**Scrophulariaceae**
Triteleia laxa	**Ithuriel's Spear**	**native**	**perennial**	**forb**		**Liliaceae**
Vicia sativa	Spring Vetch	exotic	annual	forb		Fabaceae
Vicia villosa	Hairy Vetch	exotic	annual	forb	Eval No List	Fabaceae
Vulpia bromoides	Brome Fescue	exotic	annual	grass	Eval No	Poaceae

					List	
Vulpia myuros	Foxtail Fescue	exotic	annual	grass	Moderate	Poaceae

Table B-7: List of all species hit and observed on Vasco Caves plots VC1-17; **bolded** species are native

Scientific name	Common name	Origin	Life history	Life form	Cal-IPC rating	Family
Achillea millefolium	**Common Yarrow**	**native**	**perennial**	**forb**		**Asteraceae**
Achyrachaena mollis	**Blow Wives**	**native**	**annual**	**forb**		**Asteraceae**
Agoseris sp.	**Dandelion**	**native**	**annual, perennial**	**forb**		**Asteraceae**
Allium serra	**Jeweled Onion**	**native**	**perennial**	**forb**		**Liliaceae**
Amsinckia menziesii	**Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Amsinckia menziesii var. intermedia	**Orange-flowered Menzies' Fiddleneck**	**native**	**annual**	**forb**		**Boraginaceae**
Anagallis arvensis	Scarlet Pimpernel	exotic	annual	forb		Primulaceae
Aphanes occidentalis	**Western Lady's Mantle**	**native**	**annual**	**forb**		**Rosaceae**
Asclepias fascicularis	**Narrow-leaf Milkweed**	**native**	**perennial**	**forb**		**Asclepiadaceae**
Astragalus asymmetricus	**San Joaquin Milk Vetch**	**native**	**perennial**	**forb**		**Asteraceae**
Astragalus sp.	**Milkvetch**	**native**	**unknown**	**forb**		**Fabaceae**
Athysanus pusillus	**Common Sandweed**	**native**	**annual**	**forb**		**Brassicaceae**
Avena barbata	Slender Wild Oats	exotic	annual	grass	Moderate	Poaceae
Avena fatua	Common Wild Oats	exotic	annual	grass	Moderate	Poaceae
Bellardia trixago	Mediterranean Lineseed	exotic	annual	forb	Limited	Scrophulariaceae
Brachypodium distachyon	Purple False-brome	exotic	annual	grass	Moderate	Poaceae
Brassica nigra	Black Mustard	exotic	annual	forb	Moderate	Brassicaceae
Brodiaea elegans	**Harvest brodiaea**	**native**	**perennial**	**forb**		**Liliaceae**
Bromus diandrus	Ripgut Brome	exotic	annual	grass	Moderate	Poaceae
Bromus hordeaceus	Soft Chess	exotic	annual	grass	Limited	Poaceae
Bromus madritensis ssp. madritensis	Foxtail Brome	exotic	annual	grass		Poaceae
Bromus madritensis ssp. rubens	Red Brome	exotic	annual	grass	High	Poaceae
Bromus sterilis	Sterile Brome	exotic	annual	grass		Poaceae
Calandrinia ciliata	**Red Maids**	**native**	**annual**	**forb**		**Portulacaceae**
Calystegia subacaulis	**Stemless Morning-glory**	**native**	**perennial**	**forb**		**Convolvulaceae**

Capsella bursa-pastoris	Shepherd's purse	exotic	annual	forb		Brassicaceae
Carduus pycnocephalus	Italian Thistle	exotic	annual	forb	Moderate	Asteraceae
Carduus tenuiflorus	Slender flowered thistle	exotic	annual	forb		Asteraceae
Castilleja attenuata	**Valley tassels**	**native**	**annual**	**forb**		**Scrophulariaceae**
Castilleja exserta	**Purple Owl's Clover**	**native**	**annual**	**forb**		**Scrophulariaceae**
Centaurea melitensis	Maltese Star-thistle	exotic	annual	forb	Moderate	Asteraceae
Centaurea solstitialis	Yellow Star-thistle	exotic	annual	forb	High	Asteraceae
Cerastium glomeratum	Mouse-ear Chickweed	exotic	annual	forb		Caryophyllaceae
Chlorogalum pomeridianum	**Soap Plant**	**native**	**perennial**	**forb**		**Liliaceae**
Clarkia affinis	**Chaparral Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Clarkia purpurea	**Purple Clarkia**	**native**	**annual**	**forb**		**Onagraceae**
Claytonia parviflora	**Streambank springbeauty**	**native**	**annual**	**forb**		**Portulacaceae**
Claytonia perfoliata	**Miner's lettuce**	**native**	**annual**	**forb**		**Portulacaceae**
Collinsia sparsiflora	**Few-flowered collinsia**	**native**	**annual**	**forb**		**Scrophulariaceae**
Crassula connata	**Pygmyweed**	**native**	**annual**	**forb**		**Crassulaceae**
Crepis sp.	Hawksbeard	unknown	unknown	forb		Asteraceae
Delphinium sp.	**Larkspur**	**native**	**perennial**	**forb**		**Ranunculaceae**
Dichelostemma capitatum	**Bluedicks**	**native**	**perennial**	**forb**		**Liliaceae**
Digitaria sp.	Crabgrass	unknown	unknown	grass		Poaceae
Distichlis spicata	**Inland Saltgrass**	**native**	**perennial**	**grass**		**Poaceae**
Dodecatheon clevelandii	**Padre's shootingstar**	**native**	**perennial**	**forb**		**Primulaceae**
Elymus glaucus	**Blue Wildrye**	**native**	**perennial**	**grass**		**Poaceae**
Elymus multisetus	**Big Squirreltail**	**native**	**perennial**	**grass**		**Poaceae**
Epilobium brachycarpum	**Panicled Willow-herb**	**native**	**annual**	**forb**		**Onagraceae**
Epilobium canum	**California Fuchsia**	**native**	**perennial**	**forb**		**Onagraceae**
Eremocarpus setigerus	**Turkey Mullein**	**native**	**annual**	**forb**		**Euphorbiaceae**
Erodium botrys	Broad-leaf Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Erodium brachycarpum	Short-fruit Stork's Bill	exotic	annual	forb		Geraniaceae
Erodium cicutarium	Redstem Filaree	exotic	annual	forb	Limited	Geraniaceae
Erodium moschatum	White-stemmed Filaree	exotic	annual	forb	Eval No List	Geraniaceae
Eschscholzia californica	**California Poppy**	**native**	**annual**	**forb**		**Papaveraceae**
Euphorbia spathulata	**Warty Spurge**	**native**	**annual**	**forb**		**Euphorbiaceae**

Filago gallica	Narrow-leaved Filago	exotic	annual	forb		Asteraceae
Galium aparine	**Common Bedstraw**	**native**	**annual**	**forb**		**Rubiaceae**
Galium parisiense	Wall Bedstraw	exotic	annual	forb		Rubiaceae
Galium sp.	Bedstraw	unknown	annual	forb		Rubiaceae
Geranium dissectum	Cutleaf Geranium	exotic	annual	forb	Moderate	Geraniaceae
Geranium molle	Dovefoot Geranium	exotic	annual	forb	Eval No List	Geraniaceae
Grindelia camporum	**Great Valley Gumweed**	**native**	**perennial**	**forb**		**Asteraceae**
Hesperevax sparsiflora	**Erect Dwarf-cudweed**	**native**	**annual**	**forb**		**Asteraceae**
Hirschfeldia incana	Shortpod Mustard	exotic	perennial	forb	Moderate	Brassicaceae
Hordeum marinum ssp. gussoneanum	Mediterranean Barley	exotic	annual	grass	Moderate	Poaceae
Hordeum murinum	Foxtail Barley	exotic	annual	grass	Moderate	Poaceae
Hypochaeris glabra	Smooth Cat's Ear	exotic	annual	forb	Limited	Asteraceae
Hypochaeris radicata	Rough Cat's Ear	exotic	perennial	forb	Moderate	Asteraceae
Juncus mexicanus	**Mexican rush**	**native**	**perennial**	**forb**		**Juncaceae**
Lactuca serriola	Prickly Lettuce	exotic	annual	forb	Eval No List	Asteraceae
Lagophylla ramosissima	**Common Hareleaf**	**native**	**annual**	**forb**		**Asteraceae**
Lepidium nitidum	**Shining Pepperweed**	**native**	**annual**	**forb**		**Brassicaceae**
Lepidium sp.	Cress	unknown	annual, perennial	forb		Brassicaceae
Leymus triticoides	**Creeping Wildrye**	**native**	**perennial**	**grass**		**Poaceae**
Linanthus bicolor	**Bicolor Linanthus**	**native**	**annual**	**forb**		**Polemoniaceae**
Lolium multiflorum	Italian Rye-grass	exotic	annual	grass	Moderate	Poaceae
Lotus wrangelianus	**Chilean Trefoil**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus affinis	**Fleshy Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus bicolor	**Bicolored Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus microcarpus ssp. densiflorus	**Chick Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus microcarpus var. microcarpus	**Chick Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus nanus	**Sky Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Lupinus succulentus	**Succulent Lupine**	**native**	**annual**	**forb**		**Fabaceae**
Madia sp.	**Tarweed**	**native**	**unknown**	**forb**		**Asteraceae**

Marah fabaceus	**Wild-cucumber**	**native**	**perennial**	**forb**		**Cucurbitaceae**
Marrubium vulgare	Horehound	exotic	perennial	forb	Limited	Lamiaceae
Medicago polymorpha	Bur Clover	exotic	annual	forb	Limited	Fabaceae
Melica californica	**California Melicgrass**	**native**	**perennial**	**grass**		**Poaceae**
Melica torreyana	**Torrey's Melicgrass**	**native**	**perennial**	**grass**		**Poaceae**
Melilotus indica	Annual Yellow Sweetclover	exotic	annual	forb		Fabaceae
Microseris douglasii	**Douglas' Silverpuffs**	**native**	**annual**	**forb**		**Asteraceae**
Microseris douglasii ssp. tenella	**Douglas' Silverpuffs**	**native**	**annual**	**forb**		**Asteraceae**
Nassella pulchra	**Purple Needlegrass**	**native**	**perennial**	**grass**		**Poaceae**
Picris echioides	Bristly Oxtongue	exotic	annual	forb	Limited	Asteraceae
Plagiobothrys canescens	**Valley Popcorn Flower**	**native**	**annual**	**forb**		**Boraginaceae**
Plagiobothrys nothofulvus	**Rusty Popcorn Flower**	**native**	**annual**	**forb**		**Boraginaceae**
Plantago erecta	**Foothill Plantain**	**native**	**annual**	**forb**		**Plantaginaceae**
Poa secunda ssp. secunda	**Pine Bluegrass**	**native**	**perennial**	**grass**		**Poaceae**
Polypogon monspeliensis	Rabbit's Foot	exotic	annual	grass	Limited	Poaceae
Ranunculus californicus	**California Buttercup**	**native**	**perennial**	**forb**		**Ranunculaceae**
Rumex crispus	Curly-leaved Dock	exotic	perennial	forb	Limited	Polygonaceae
Rumex pulcher	Fiddle Dock	exotic	perennial	forb		Polygonaceae
Sanicula bipinnata	**Poison Sanicle**	**native**	**annual**	**forb**		**Apiaceae**
Sanicula bipinnatifida	**Snakeroot**	**native**	**perennial**	**forb**		**Apiaceae**
Senecio vulgaris	Common Groundsel	exotic	annual	forb		Asteraceae
Sherardia arvensis	Field Madder	exotic	annual	forb		Rubiaceae
Silene gallica	Windmill Pink	exotic	annual	forb		Caryophyllaceae
Silybum marianum	Milk Thistle	exotic	annual	forb	Limited	Asteraceae
Sonchus asper	Prickly Sow Thistle	exotic	annual	forb		Asteraceae
Sonchus oleraceus	Common Sow Thistle	exotic	annual	forb		Asteraceae
Stellaria media	Common Chickweed	exotic	annual	forb		Caryophyllaceae
Torilis arvensis	Hedge Parsley	exotic	annual	forb	Moderate	Apiaceae
Torilis nodosa	Hedge Parsley	exotic	annual	forb		Apiaceae
Tragopogon sp.	Salsify	exotic	unknown	forb		Asteraceae
Trifolium bifidum	**Notchleaf Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium ciliolatum	**Tree Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium depauperatum	**Dwarf sack clover**	**native**	**annual**	**forb**		**Fabaceae**

Trifolium depauperatum var. amplectens	**Pale sack clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium fragiferum	Strawberry Clover	exotic	perennial	forb		Fabaceae
Trifolium gracilentum	**Pinpoint Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium hirtum	Rose Clover	exotic	annual	forb	Moderate	Fabaceae
Trifolium microcephalum	**Small-headed Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium microdon	**Valparaiso Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium oliganthum	**Few-flowered Clover**	**native**	**annual**	**forb**		**Fabaceae**
Trifolium willdenovii	**Tomcat Clover**	**native**	**annual**	**forb**		**Fabaceae**
Triphysaria eriantha	**Butter 'n' Eggs**	**native**	**annual**	**forb**		**Scrophulariaceae**
Triphysaria pusilla	**Dwarf Owl's Clover**	**native**	**annual**	**forb**		**Scrophulariaceae**
Triteleia laxa	**Ithuriel's Spear**	**native**	**perennial**	**forb**		**Liliaceae**
Urtica urens	Dwarf Nettle	exotic	annual	forb		Urticaceae
Vicia americana	**American Vetch**	**native**	**perennial**	**forb**		**Fabaceae**
Vicia sativa	Spring Vetch	exotic	annual	forb		Fabaceae
Vicia sp.	Vetch	unknown	unknown	forb		Fabaceae
Vulpia bromoides	Brome Fescue	exotic	annual	grass	Eval No List	Poaceae
Vulpia myuros	Foxtail Fescue	exotic	annual	grass	Moderate	Poaceae

Appendix C: Recommended vegetation monitoring methods

In this appendix, we describe several vegetation monitoring methods the District may wish to consider:
- Photo points
- Frequency plots
- Relevé plots
- Line-point transects, and
- Residual dry matter (RDM) monitoring and mapping.

We refer to several publications, generally available on-line, that provide greater detail on the implementation of these monitoring methods.

For the Grassland Monitoring Project, we started sampling in early April at Vasco Caves and proceeded generally westward, finishing the annual sampling effort at Lake Chabot-Fairmont Ridge in the first week of June. A typical sampling year (2007) saw us at Vasco Caves during April and the first week of May, Brushy Peak in early May, Sunol-Ohlone in mid-May, Morgan Territory in mid- to late May, Pleasanton Ridge at the end of May, and Sycamore Valley followed by Lake Chabot-Fairmont Ridge during the first week of June. Note that this sampling calendar reflects not only regional plant phenology, but also the exigencies of student class schedules, students being the Project's primary labor input.

Estimating time required to complete a plot using the various methods is inexact because plots vary in complexity and personnel vary in expertise. Note that times we provide do not include travel time to plot nor time spent establishing a new plot or re-locating a pre-existing plot. Based on our experience, a trained crew of 5 people takes about 1 hour to complete our 280-point research transects; a line-point transect of 50-100 points would take correspondingly less time. A $100m^2$ relevé plot takes one experienced field crew member armed with a local species list about 30-60 minutes to complete. A frequency plot of the design described below takes two crew members (one person sampling the quadrats, the other recording the data) about 20 minutes to complete. RDM monitoring and mapping time depends too greatly on the topography, size, RDM variability, vehicular accessibility, etc. of an individual site to generalize with confidence, but in good conditions, an experienced crew of two can cover several hundred acres in a day.

Recommended vegetation monitoring methods

Table Appendix C-1 lists the recommended vegetation monitoring methods, broadly ranked from least to most expensive, the kind of information that the method provides, and the goals that each method is best suited to meet. By matching goals with appropriate methods, a suitable monitoring methodology can be developed.

Table Appendix C-1: Recommended vegetation monitoring methods, ranked based on relative cost of the technique and how much information the technique generates: from top to bottom – inexpensive to expensive, limited information to most information

Sampling method	Data generated	Typical goals
Permanent photo points	Visual evidence of large changes in biomass and species composition	Independent check on plant changes indicated by quantitative data; changes in abundance for some invasive species; public presentations
Frequency	Presence/absence of species of interest	Broad changes in species abundance, estimates of species richness
Cover: relevé plot	Small-scale cover, including rare species; species richness, including rare species;	Presence of rare plants; localized changes in species composition, richness, and abundance
Cover: line-point transects	Cover of dominant species especially; species richness	Changes in species composition, abundance; estimates of species richness; functional group analysis; effect of management
Residual dry matter (RDM) sampling	Dry weight of above ground biomass	Monitoring distribution and intensity of grazing; compliance with minimum RDM standards

Photo points

Permanent (i.e., at a GPS-ed location with a fixed azimuth and a fixed field of view) photo points retaken every year can be an inexpensive but broadly effective method of monitoring for large changes in vegetation, e.g., cover of invasive plants, coyote brush invasion. They can also serve as useful indexes of annual herbaceous production and of residual dry matter (RDM).

Frequency plots

To monitor species of interest (e.g., native or invasive), the District may wish to employ the frequency plot method. The frequency plot method is "useful for monitoring vegetation changes over time at the same locations or for comparisons of different locations" (Despain et al. 1991) and can provide this information at relatively low cost. Despain et al. (1991) define frequency as: "the number of times a plant species is present within a given number of sample quadrats of uniform size placed repeatedly across a stand of vegetation . . . It is generally expressed as a percentage of total placements and reflects the probability of encountering a particular species at any location within the stand . . ." Average frequency values can be followed from year to year and provide an index of a species' density and dispersion (Despain et al. 1991).

Although we did not use this technique for the Grassland Monitoring Project, the UC Berkeley Range Lab has used the technique for other projects. Although frequency plot specifics can vary based on monitoring needs, a frequency plot may, for example, comprise a 10 meter transect with 20 quadrats on alternating sides of the transect. Within each quadrat, we determine whether any individual of the species under consideration is rooted within the quadrat. The resulting metric is the species' frequency of occurrence in the 20 quadrats of the plot (e.g., if species A occurred in 15 of 20 quadrats along a transect, its frequency for that plot is 0.75).

Quadrat size has a significant effect on frequency values (Despain et al. 1991) and so must be carefully selected. Frequency sampling works best when a species' frequency values fall between 20% and 80% (Despain et al. 1991) so quadrat size must be selected to provide values that fall within that range. Typically, larger-sized quadrats will include sparsely distributed species but will result in almost 100% frequencies for common species, reducing one's ability to detect change in common species; smaller quadrats solve this problem but can miss sparsely distributed species (Despain et al. 1991). Because frequency varies based on species size, abundance, and distribution in the plot area, it is necessary to determine in the field which quadrat size is most suitable. We initially employ nested quadrats of 5x5 cm, 10x10 cm, 25x25 cm, and 50x50 cm and then determine which quadrat size is most appropriate for the situation.

We typically take two photographs of each frequency plot, the first from the start of the transect to the end of the transect and the second in the reverse direction.

Relevé plots

To monitor native species richness, the District may wish to establish permanent relevé plots (e.g., a 5m x 20m rectangular plot, which gives a100m^2 plot) in native species rich sites. Relevé plots should be sited within a single, continuous vegetation type. Field crew visually estimate cover of all species occurring in the relevé. The relevé plot method generates data on rare species, is time- and labor-efficient, and is likely to provide data robust enough for adaptive management needs. It is a technique used by the California Native Plant Society for classifying vegetation and so could allow for comparisons between data from District properties and alliances in the *Manual of California Vegetation* (Sawyer et al. 2009).

The relevé plot method provides data on a site's species richness including any uncommon species, while the line-point transect method delivers reliable cover values for the site's dominant species. The UC Berkeley Range Lab has developed a hybrid relevé/line-point transect technique, designed to collect species composition and abundance information in adequate detail at reasonable cost. The technique involves establishing: 1) a permanent 100m^2 relevé plot to provide data on plant diversity and capture rare plant species, and 2) four 25-meter, 50-point line-point transects radiating from the corners of the relevé plot to provide data on dominant species cover. The relevé is a 5m by 20m rectangular plot; all species within the relevé are listed with an ocular estimation of cover for each species. Along the line-point transects, field crew record the first species hit every half meter. Again, relevé plots should be sited within a single, continuous vegetation type; if including line-point transects in the plot, be sure the transects also fall within the single, continuous vegetation type. We recommend taking photographs of the relevé plot and the line point transects (in both directions along each transect).

Line-point transects

Line-point transects work well to monitor cover of a dominant species, including purple needlegrass in areas where it is abundant. Transects would also be useful for monitoring cover of native forbs in areas that have abundant cover of multiple forb species. We used line-point transects to collect most of the vegetation data in the Grassland Monitoring Project. We collected line-point transect data at an intensity designed for research purposes; for monitoring, a less intensive and simpler design may be appropriate.

For the Grassland Monitoring Project, our line-point transect research design was as follows: each plot comprised four 17-m vegetation transects radiating in the 4 cardinal directions from a central, permanently marked centroid. From a vertical line dropped perpendicular to the transect line, first-hit plant species was recorded every 10 cm for the first 4.5 m and every 50 cm from 5 to 17 m, for a total of 70 points per transect and 280 points per plot. We also took 2 photos of each transect: 1 from the centroid out to the end of the transect and another from the end of the transect in to the centroid (8 photos per plot). This radial design allowed integration of standard wildlife monitoring protocols with the vegetation monitoring (see Appendix A).

For monitoring purposes, a possible design could be a 25m transect with points taken every 50cm for 50 points total or a 50m transect with points taken every 50cm for 100 points total, depending on the size of the area of interest and the degree of precision desired. Typically, line-point transects would be sited within a single, continuous vegetation type. Transects should be randomly located within the area of interest, and the azimuth of the transect should be randomly selected (even if the range of acceptable azimuths is constrained). We recommend permanently marking the beginning of transect (either with a stake or rebar or taking a sub-meter GPS reading) and recording the azimuth of the transect. We recommend taking photographs of the line point transects in both directions along each transect.

RDM monitoring and mapping

The distribution and intensity of grazing can be monitored through assessment of residual dry matter (RDM). Traditionally, the standard method for monitoring RDM requires the establishment of several permanent monitoring locations in a grazed site. In each location, RDM is determined in early fall, before the onset of germinating rain, through the use of photo guides and the comparative yield method. See Bartolome et al. 2006, Bush 2006, Guenther and Hayes 2008 for descriptions of RDM monitoring techniques. The Coastal Training Program at the Elkhorn Slough National Estuarine Research Reserve in Watsonville periodically offers well-received short-courses on RDM monitoring (see http://www.elkhornsloughctp.org/training/show_train_detail.php?TRAIN_ID=Ho5BX3W, accessed June 2012).

Within the last decade, the RDM mapping technique has been developed and implemented in California, an innovation that allows for a clearer picture of the spatial distribution of RDM (Guenther and Hayes 2008; Harris et al. 2002). RDM mapping is easy to learn and often requires less time to complete than the traditional permanent plot-based method, while still producing robust information. Sites with too little or too much RDM can be quickly identified, and solutions based on manipulating animal distribution may also be more easily developed. Annual time-series of RDM maps can be assessed for areas requiring management attention. The Contra Costa Water District has successfully implemented RDM mapping at Los Vaqueros Reservoir.

RDM mapping requires developing RDM classes (e.g., 0-500 lbs/acre, 500-1000 lbs/acre, >1000 lbs/acre etc.) based on the manager's goals, and then mapping RDM classes based on visual estimation of fairly large areas (up to several hectares), with either a paper map or GPS in-hand. Visual estimations are calibrated during the mapping process by clipping and weighing RDM from small, representative plots (25cm x 25cm quadrat). Photographs are taken of large areas of representative RDM classes and of the plots prior to clipping.

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Note: all links current as of June 28, 2012.

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Vol I: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5172119.pdf;
Vol II: http://californiarangeland.ucdavis.edu/Publications%20pdf/Volume_II.pdf.

Appendix D: Nitrogen deposition

Table D-1 lists the estimated total nitrogen deposition for each plot in the seven study parks: Brushy Peak (BP), Lake Chabot-Fairmont Ridge (CR), Morgan Territory (MT), Pleasanton Ridge (PR), Sunol-Ohlone (SU), Sycamore Valley (SV), and Vasco Caves (VC). Estimates are derived from the model developed by Tonnesen et al. (2007)

Table D-1: Total nitrogen deposition (lbs/acre/year) estimates, from model developed by Tonnesen et al. (2007)

Name	**Total N (lbs/ac/ year)**	**Name**	**Total N (lbs/ac/ year)**	**Name**	**Total N (lbs/ac/ year)**	**Name**	**Total N (lbs/ac/ year)**	**Name**	**Total N (lbs/ac/ year)**	**Name**	**Total N (lbs/ac/ year)**	**Name**	**Total N (lbs/ac/ year)**
BP1	8.9428	CR1	10.4488	MT1	5.4229	PR1	6.6698	SU1	5.0707	SV1	5.1310	VC1	5.8442
BP2	8.9428	CR2	10.4488	MT2	5.0189	PR2	6.6698	SU2	5.0707	SV2	5.1310	VC2	6.8110
BP3	8.9428	CR3	10.4488	MT3	5.0189	PR3	6.6698	SU3	5.0707	SV3	5.1310	VC3	6.8110
BP4	8.9428	CR4	10.4488	MT4	5.4229	PR4	6.6698	SU4	5.6301	SV4	4.8542	VC4	6.8110
BP5	8.9428	CR5	5.1824	MT5	5.4229	PR5	6.6698	SU5	5.6301	SV5	4.8542	VC5	6.8110
BP6	8.9428	CR6	5.1824	MT6	5.4229	PR6	6.6698	SU6	5.6301	SV6	4.8542	VC6	6.8110
BP7	8.1539	**Average:**	**8.7**	MT7	5.4229	PR7	6.6698	SU7	5.8013	**Average:**	**5.0**	VC7	6.8110
BP8	8.9428			MT8	5.4229	PR8	6.6698	SU8	5.6301			VC8	6.8110
BP9	8.9428			MT9	5.0189	PR9	6.6698	SU9	5.6301			VC9	6.8110
Average:	**8.9**			MT10	5.4229	**Average:**	**6.7**	SU10	5.6301			VC10	6.8110
				MT11	5.4700			SU11	5.0707			VC11	5.8442
				MT12	5.4700			SU12	5.0707			VC12	5.8442
				MT13	5.4229			**Average:**	**5.4**			VC13	5.8442
				MT14	5.4229							VC14	5.8442
				MT15	5.4229							VC15	6.8110
				MT16	5.4229							VC16	6.8110
				Average:	**5.4**							VC17	6.8110
												Average:	**6.5**

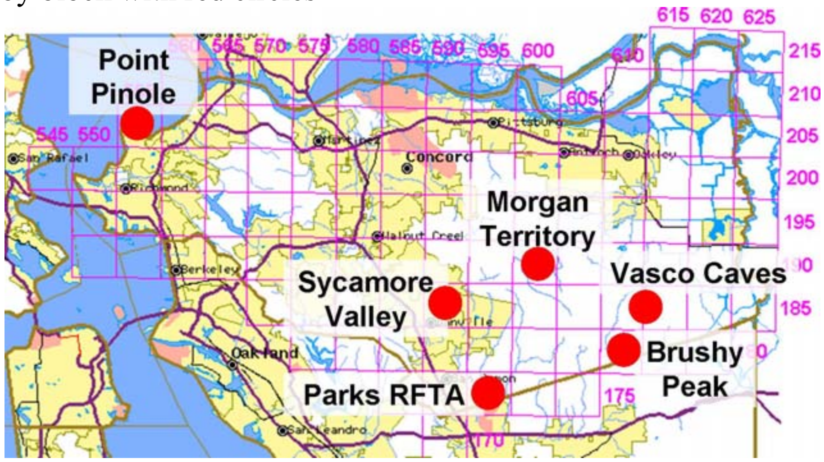
Tonnesen, G., Z. Wang, M. Omary, and C.J. Chien. 2007. **Assessment of nitrogen deposition: modeling and habitat assessment**. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2005-032. Available at: http://www.energy.ca.gov/2006publications/CEC-500-2006-032/CEC-500-2006-032.PDF.

Appendix E: Comparison of EBRPD grassland bird guild data with Breeding Bird Atlas data of Contra Costa and Alameda counties

The Breeding Bird Atlas (BBA) for Contra Costa County was conducted in 1998-2002 and for Alameda County in 1993-1997. The atlas information is coded on each map with the EBRPD number codes superimposed.

The definitions for possible, probable and confirmed breeder categories are part of the standard BBA protocol. The EBRPD data (breeding bird status table in this appendix) also follows standard BBA protocol and uses all observations of these species in the dataset. EBRPD breeding status categories are coded X = no detections, Obs = individual observed, 1 = possible, 2 = probable, and 3 = confirmed breeder for both atlas comparisons. Point Pinole, a coastal prairie grassland, is included in the distribution information although the Grassland Monitoring Project surveys only include 2003-2004. Parks Reserve Forces Training Area (Parks RFTA) is included in the distribution information because it is a similar grassland area surveyed by the Range Ecology Lab with the same point-count protocol in 2003-2005.

Figure E-1: Contra Costa County Breeding Bird Atlas (top), 1998-2002, Alameda County Breeding Bird Atlas (bottom), 1993-1997, parks included from the EBRPD dataset are located by block with red circles



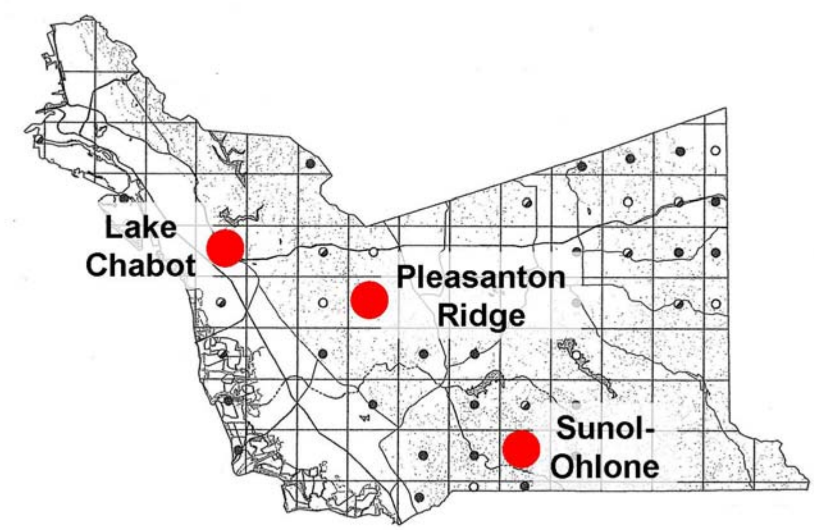
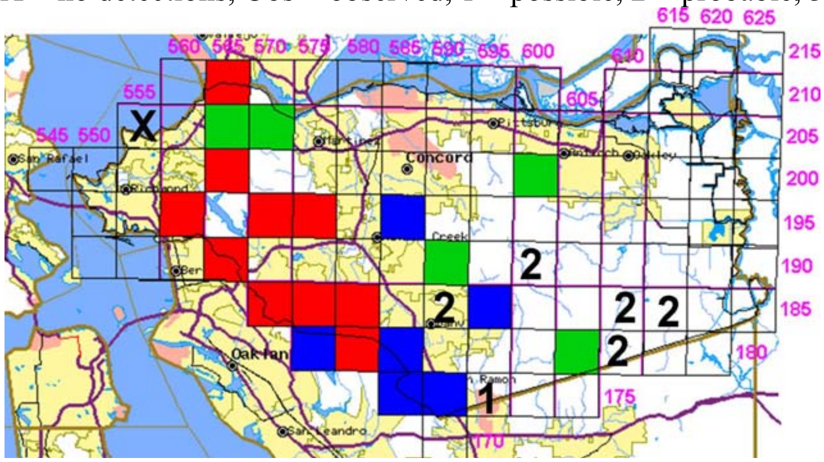


Figure E-2: **Grasshopper Sparrow** breeding status and distribution in Contra Costa County (top), BBA codes: green = possible, blue = probable, red = confirmed; Alameda County (bottom), BBA codes: **A** = possible, ◑ = probable, ● = confirmed; EBRPD codes (both atlases): X = no detections, Obs = observed, 1 = possible, 2 = probable, 3 = confirmed



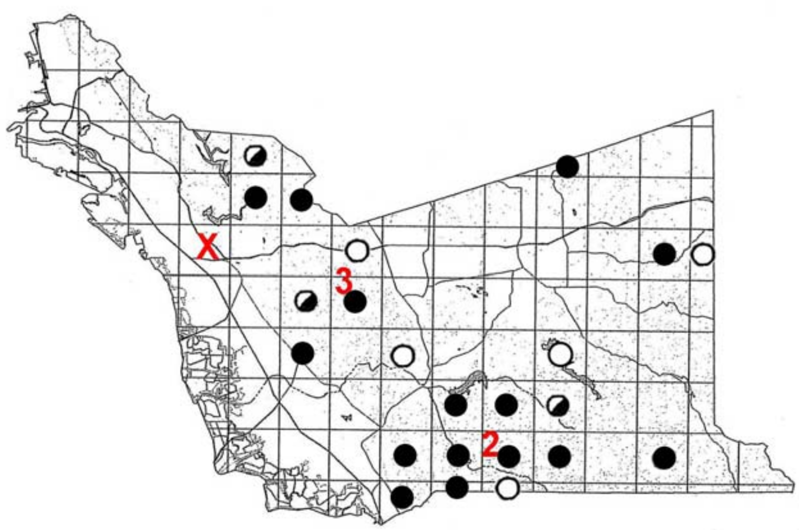
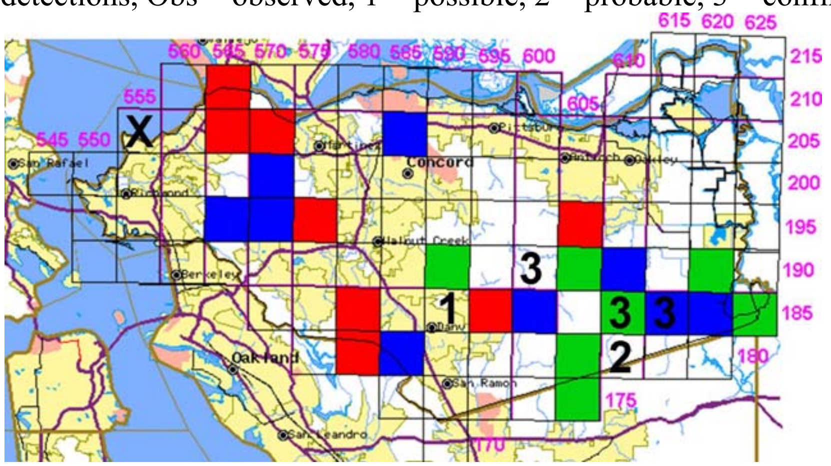


Figure E-3: **Horned Lark** breeding status and distribution in Contra Costa County (top), BBA codes: green = possible, blue = probable, red = confirmed; Alameda County (bottom), BBA codes: **A** = possible, ◑ = probable, ● = confirmed; EBRPD codes (both atlases): X = no detections, Obs = observed, 1 = possible, 2 = probable, 3 = confirmed



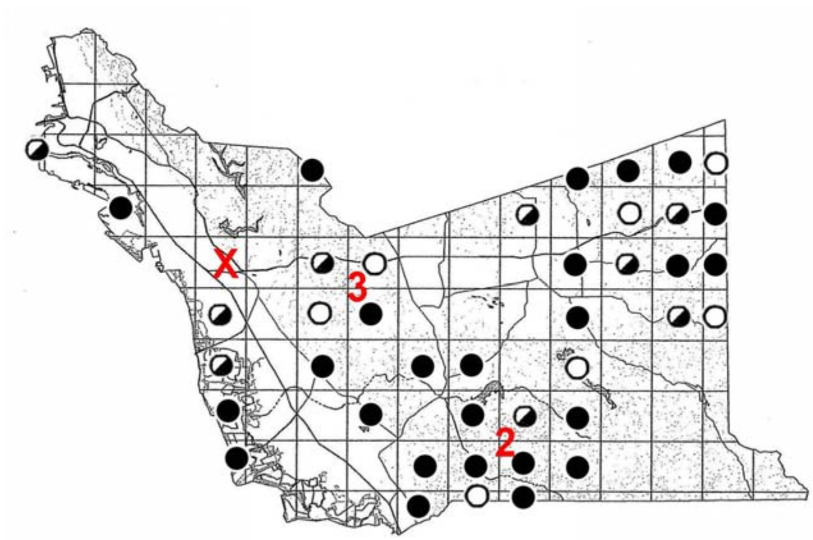
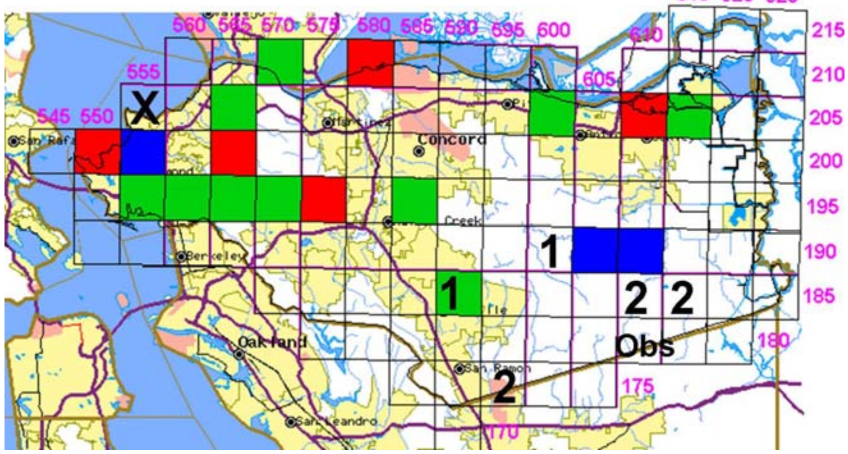


Figure E-4: **Savannah Sparrow** breeding status and distribution in Contra Costa County (top), BBA codes: green = possible, blue = probable, red = confirmed; Alameda County (bottom), BBA codes: **A** = possible, ◑ = probable, ● = confirmed; EBRPD codes (both atlases): X = no detections, Obs = observed, 1 = possible, 2 = probable, 3 = confirmed



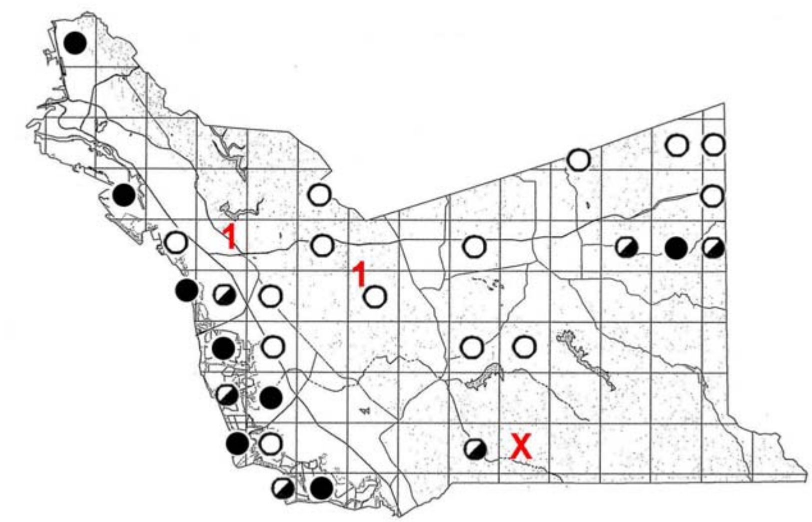
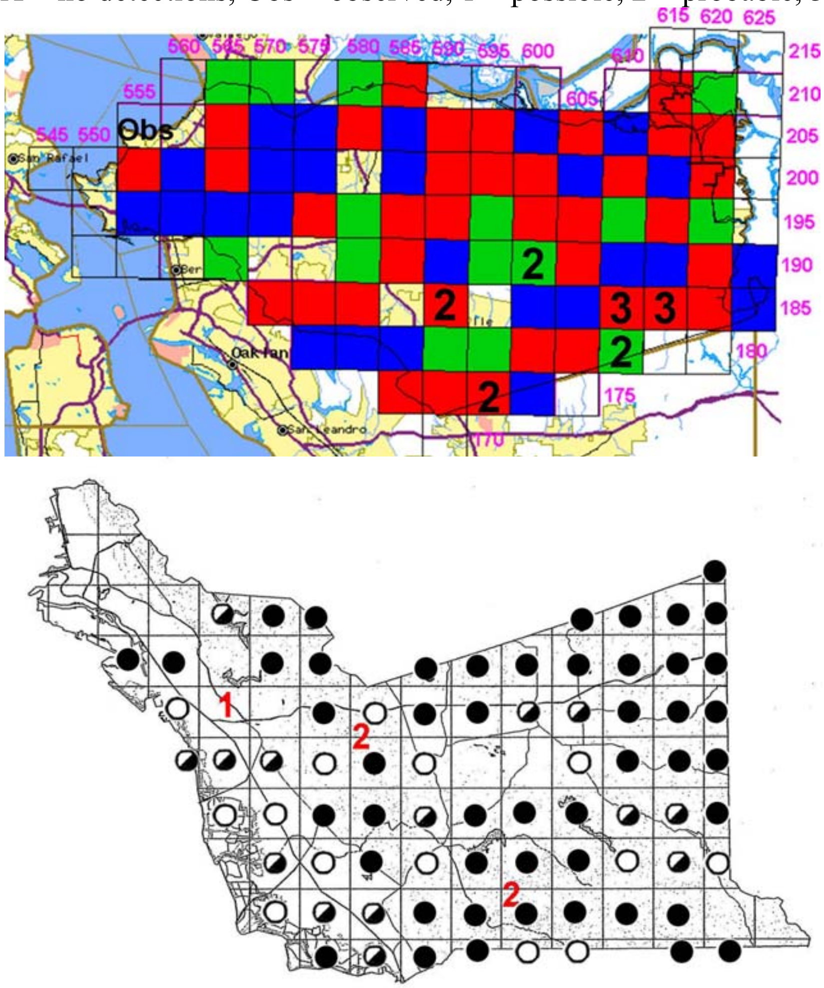


Figure E-5: **Western Meadowlark** breeding status and distribution in Contra Costa County (top), BBA codes: green = possible, blue = probable, red = confirmed; Alameda County (bottom), BBA codes: **A** = possible, ◑ = probable, ● = confirmed; EBRPD codes (both atlases): X = no detections, Obs = observed, 1 = possible, 2 = probable, 3 = confirmed



Appendix F: Park-specific bird tables

Tables F.1-1 through F.1-8 include: 2004-2011 point count summary for each park and the annual park total and average detections for each species.

Tables F.1-2 through F.8-2 include: Breeding bird status species list for each park 2004-2011; includes full dataset or all observations from vegetation and point count surveys; bold are California Partners in Flight (CPIF) grassland bird conservation plan grassland focal species

Breeding bird status code explanation:

Breeding bird status codes are based on the following observations:

•) No evidence of breeding: bird encountered but no territorial or breeding behavior noted.
1) Possible breeder: bird encountered singing or acting territorial only once during the breeding season (in suitable habitat).
2) Probable breeder: singing individual encountered on two or more days of point count surveys (within a season, at least one week apart); territorial behavior noted more than once at the same location; pair observed in courtship behavior.
3) Confirmed breeder: nest building observed; nesting material or fecal sac being carried by adult; active nest observed; dependent juveniles with adults.

1.0 Brushy Peak

Table F.1-1: Brushy Peak 2004-2008, 2010-2011 (2009 park not surveyed) point count summary (plots 4-9); annual park total and average detections; restricted dataset (≤100m); italics are grassland focal species; *2009 point count survey not conducted at Brushy Peak

	2004		2005		2006		2007		2008		2010*	
Species	Total Det	Avg Det	Total Det	Avg Det	Total Det	Avg Det	Total Det	Avg Det	Total Det	Avg Det	Total Det	Avg Det
ACWO	1	0.17	0	0	0	0	0	0	0	0	0	0
AMCR	1	0.17	0	0	4	0.67	1	0.17	1	0.17	0	0
AMKE	0	0	0	0	0	0	2	0.33	0	0	0	0
AMPI	55	9.17	0	0	0	0	0	0	0	0	0	0
ANHU	0	0	1	0.17	0	0	0	0	0	0	0	0
BHCO	0	0	0	0	0	0	1	0.17	0	0	0	0
BLPH	0	0	0	0	0	0	2	0.33	1	0.17	0	0
BRBL	16	2.67	0	0	2	0.33	9	1.50	0	0	29	4.83
BUOR	1	0.17	0	0	3	0.50	0	0	3	0.50	0	0
CORA	0	0	0	0	0	0	1	0.17	0	0	0	0
EUST	3	0.50	27	4.50	2	0.33	3	0.50	13	2.17	8	1.33
GOEA	1	0.17	1	0.17	0	0	0	0	0	0	0	0
GRSP	***3***	***0.50***	***0***	***0***	***2***	***0.33***	***1***	***0.17***	***0***	***0***	***0***	***0***
HOFI	0	0	0	0	0	0	0	0	0	0	2	0.33
HOLA	***0***	***0***	***4***	***0.67***	***2***	***0.33***	***0***	***0***	***3***	***0.50***	***11***	***1.83***
LEGO	0	0	0	0	0	0	1	0.17	0	0	0	0
LOSH	1	0.17	1	0.17	2	0.33	2	0.33	0	0	2	0.33
MODO	2	0.33	2	0.33	3	0.50	6	1.00	6	1.00	2	0.33
NOMO	0	0	0	0	0	0	3	0.50	4	0.67	4	0.67
RODO	0	0	0	0	5	0.83	0	0	0	0	0	0
RTHA	1	0.17	0	0	1	0.17	0	0	0	0	0	0
RWBL	2	0.33	15	2.50	53	8.83	8	1.33	2	0.33	3	0.50
SAVS	***9***	***1.50***	***1***	***0.17***	***1***	***0.17***	***1***	***0.17***	***0***	***0***	***0***	***0***
STJA	0	0	0	0	1	0.17	0	0	0	0	0	0
WEKI	4	0.67	1	0.17	4	0.67	0	0	5	0.83	2	0.33
WEME	***13***	***2.17***	***1***	***0.17***	***12***	***2.00***	***13***	***2.17***	***15***	***2.50***	***22***	***3.67***
WETA	0	0	0	0	1	0.17	0	0	0	0	0	0
WIWA	0	0	0	0	0	0	0	0	0	0	1	0.17
XXSP	0	0	0	0	1	0.17	0	0	2	0.33	0	0
XXWA	0	0	0	0	0	0	0	0	1	0.17	0	0
YRWA	0	0	0	0	0	0	0	0	1	0.17	0	0
Total Det	113		54		99		54		57		86	

Table F.1-1 continued: Brushy Peak 2004-2008, 2010-2011 (2009 park not surveyed) point count summary (plots 4-9); annual park total and average detections; restricted dataset (≤100m); italics are grassland focal species; *2009 point count survey not conducted at Brushy Peak

	2011		2004-2008, 2010-2011		
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Std Dev**
ACWO	0	0	1	0.02	0.06
AMCR	0	0	7	0.17	0.24
AMKE	0	0	2	0.05	0.13
AMPI	0	0	55	1.31	3.46
ANHU	0	0	1	0.02	0.06
BHCO	0	0	1	0.02	0.06
BLPH	1	0.17	4	0.10	0.13
BRBL	8	1.33	64	1.52	1.75
BUOR	1	0.17	8	0.19	0.22
CORA	0	0	1	0.02	0.06
EUST	3	0.5	59	1.40	1.51
GOEA	0	0	2	0.05	0.08
GRSP	**0**	**0**	**6**	**0.14**	**0.20**
HOFI	1	0.17	3	0.07	0.13
HOLA	**4**	**0.7**	**24**	**0.57**	**0.62**
LEGO	0	0	1	0.02	0.06
LOSH	2	0.33	10	0.24	0.13
MODO	6	1	27	0.64	0.34
NOMO	2	0.33	13	0.31	0.31
RODO	2	0.33	7	0.17	0.32
RTHA	0	0	2	0.05	0.08
RWBL	19	3.17	102	2.43	3.04
SAVS	**2**	**0.33**	**14**	**0.33**	**0.53**
STJA	0	0	1	0.02	0.06
WEKI	1	0.17	17	0.40	0.32
WEME	**24**	**4**	**100**	**2.38**	**1.25**
WETA	0	0	1	0.02	0.06
WIWA	0	0	1	0.02	0.06
XXSP	0	0	3	0.07	0.13
XXWA	0	0	1	0.02	0.06
YRWA	0	0	1	0.02	0.06
Total Det	76		539		

Table F.1-2: Species list Brushy Peak 2004-2008, 2010-2011 (2009 park not surveyed) Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
ACWO	Acorn Woodpecker	*Melanerpes formicivorus*	•
ALHU	Allen's Hummingbird	*Selasphorus sasin*	•
AMCO	American Coot	*Fulica americana*	•
AMCR	American Crow	*Corvus brachyrhynchos*	•
AMKE	American Kestrel	*Falco sparverius*	3
AMPI	American Pipit	*Anthus rubescens*	•
ANHU	Anna's Hummingbird	*Calypte anna*	•
ATFL	Ash-throated Flycatcher	*Myiarchus cinerascens*	1
BARS	Barn Swallow	*Hirundo rustica*	3
BEWR	Bewick's Wren	*Thryomanes bewickii*	1
BLPH	Black Phoebe	*Sayornis nigricans*	•
BNST	Black-necked Stilt	*Himantopus mexicanus*	•
BRBL	Brewer's Blackbird	*Euphagus cyanocephalus*	3
BHCO	Brown-headed Cowbird	*Molothrus ater*	•
BUOR	Bullock's Oriole	*Icterus bullockii*	1
CAQU	California Quail	*Callipepla californica*	•
CALT	California Towhee	*Pipilo crissalis*	1
CAGO	Canada Goose	*Branta canadensis*	•
CLSW	Cliff Swallow	*Petrochelidon pyrrhonota*	•
CORA	Common Raven	*Corvus corax*	1
EUST	European Starling	*Sturnus vulgaris*	3
GOEA	Golden Eagle	*Aquila chrysaetos*	•
GCSP	Golden-crowned Sparrow	*Zonotrichia atricapilla*	1
GRSP	**Grasshopper Sparrow**	***Ammodramus savannarum***	**2**
HOLA	**Horned Lark**	***Eremophila alpestris***	**2**
HOFI	House Finch	*Carpodacus mexicanus*	2
KILL	Killdeer	*Charadrius vociferus*	3
LEGO	Lesser Goldfinch	*Carduelis psaltria*	•
LOSH	Loggerhead Shrike	*Lanius ludovicianus*	•
MALL	**Mallard**	***Anas platyrhynchos***	**•**
MODO	Mourning Dove	*Zenaida macroura*	3
NOHA	**Northern Harrier**	***Circus cyaneus***	**•**
NOMO	Northern Mockingbird	*Mimus polyglottos*	1
PRFA	**Prairie Falcon**	***Falco mexicanus***	**•**
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	1
RWBL	Red-winged Blackbird	*Agelaius phoeniceus*	2
RODO	Rock Dove	*Columba livia*	•
RCKI	Ruby-crowned Kinglet	*Regulus calendula*	1
SAVS	**Savannah Sparrow**	***Passerculus sandwichensis***	**•**
STJA	Steller's Jay	*Cyanocitta stelleri*	•
TRES	Tree Swallow	*Tachycineta bicolor*	•
TRBL	**Tricolored Blackbird**	***Agelaius tricolor***	**•**
TUVU	Turkey Vulture	*Cathartes aura*	•
VGSW	Warbling Vireo	*Tachycineta thalassina*	•

Table F.1-2 continued: Species list Brushy Peak 2004-2008, 2010-2011 (2009 park not surveyed) Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
WEBL	Western Bluebird	*Sialia mexicana*	3
WEGU	Western Gull	*Larus occidentalis*	•
WEKI	Western Kingbird	*Tyrannus verticalis*	2
WEME	**Western Meadowlark**	***Sturnella neglecta***	**2**
WESJ	Western Scrub Jay	*Aphelocoma californica*	•
WETA	Western Tanager	*Piranga ludoviciana*	•
WCSP	White-crowned Sparrow	*Zonotrichia leucophrys*	•
WTKI	**White-tailed Kite**	***Elanus leucurus***	**•**
WTSW	White-throated Swift	*Aeronautes saxatalis*	•
WILL	Willet	*Catoptrophorus semipalmatus*	•
WIWA	Wilson's Warbler	*Wilsonia pusilla*	1
WREN	Wrentit	*Chamaea fasciata*	•
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	1

2.0 Lake Chabot-Fairmont Ridge

Table F.2-1: Lake Chabot-Fairmont Ridge 2004-2007 point count summary (plots 1, 3-6); annual park total and average detections; restricted dataset (≤100m); italics are grassland focal species

	2004		2005		2006		2007		2004-2007			
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Avg Det**	**Std Dev**
AMKE	0	0	0	0	4	0.8	4	0.8	8	0.4	0.40	0.75
AMRO	0	0	1	0.2	0	0	2	0.4	3	0.15	0.15	0.49
ANHU	1	0.2	1	0.2	3	0.6	3	0.6	8	0.4	0.40	0.82
BEWR	2	0.4	4	0.8	0	0	2	0.4	8	0.4	0.40	0.94
BHCO	0	0	0	0	1	0.2	0	0	1	0.05	0.05	0.22
BLPH	0	0	1	0.2	0	0	0	0	1	0.05	0.05	0.22
BUOR	1	0.2	0	0	4	0.8	4	0.8	9	0.45	0.45	0.83
CALT	2	0.4	7	1.4	1	0.2	2	0.4	12	0.6	0.60	0.88
CAQU	0	0	0	0	1	0.2	0	0	1	0.05	0.05	0.22
CBCH	3	0.6	3	0.6	0	0	4	0.8	10	0.5	0.50	0.83
CEDW	60	12	0	0	60	12	0	0	120	6	6.00	16.98
EUST	37	7.4	33	6.6	28	5.6	25	5	123	6.15	6.15	7.53
GCSP	0	0	27	5.4	5	1	2	0.4	34	1.7	1.70	5.62
HAWO	0	0	0	0	1	0.2	0	0	1	0.05	0.05	0.22
HOFI	0	0	4	0.8	3	0.6	3	0.6	10	0.5	0.50	1.05
LAZB	0	0	1	0.2	0	0	0	0	1	0.05	0.05	0.22
LEGO	0	0	0	0	0	0	1	0.2	1	0.05	0.05	0.22
MODO	1	0.2	2	0.4	4	0.8	1	0.2	8	0.4	0.40	0.82
NOMO	2	0.4	1	0.2	1	0.2	1	0.2	5	0.25	0.25	0.44
NUWO	1	0.2	1	0.2	1	0.2	2	0.4	5	0.25	0.25	0.55
OATI	0	0	0	0	0	0	1	0.2	1	0.05	0.05	0.22
OCWA	1	0.2	1	0.2	0	0	0	0	2	0.1	0.10	0.31
ORJU	1	0.2	1	0.2	1	0.2	6	1.2	9	0.45	0.45	0.60
PSFL	1	0.2	0	0	1	0.2	0	0	2	0.1	0.10	0.31
RCSP	2	0.4	0	0	0	0	0	0	2	0.1	0.10	0.31
RSFL	0	0	0	0	0	0	1	0.2	1	0.05	0.05	0.22
RSHA	0	0	0	0	0	0	1	0.2	1	0.05	0.05	0.22
SPTO	0	0	4	0.8	2	0.4	4	0.8	10	0.5	0.50	0.69
STJA	0	0	1	0.2	2	0.4	2	0.4	5	0.25	0.25	0.55
TRES	0	0	0	0	1	0.2	0	0	1	0.05	0.05	0.22
WEBL	2	0.4	5	1	2	0.4	7	1.4	16	0.8	0.80	1.51
WEKI	0	0	0	0	0	0	1	0.2	1	0.05	0.05	0.22
WEME	***0***	***0***	***0***	***0***	***0***	***0***	***4***	***0.8***	***4***	***0.2***	***0.20***	***0.70***
WESJ	1	0.2	3	0.6	7	1.4	2	0.4	13	0.65	0.65	1.18
WETA	0	0	0	0	1	0.2	0	0	1	0.05	0.05	0.22
WREN	0	0	0	0	0	0	1	0.2	1	0.05	0.05	0.22
Total Det	119		101		136		88		444			

Table F.2-2: Species list Lake Chabot-Fairmont Ridge 2002-2007; Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
AMKE	American Kestrel	*Falco sparverius*	3
AMRO	American Robin	*Turdus migratorius*	1
ANHU	Anna's Hummingbird	*Calypte anna*	2
BTPI	Band-tailed Pigeon	*Columbia fasciata*	•
BARS	Barn Swallow	*Hirundo rustica*	•
BEWR	Bewick's Wren	*Thryomanes bewickii*	2
BLPH	Black Phoebe	*Sayornis nigricans*	1
BCNH	Black-crowned Night Heron	*Nycticorax nycticorax*	3
BHGR	Black-headed Grosbeak	*Pheucticus melanocephalus*	1
BHCO	Brown-headed Cowbird	*Molothrus ater*	•
BUOR	Bullock's Oriole	*Icterus bullockii*	2
BUSH	Bushtit	*Psaltriparus minimus*	1
CAQU	California Quail	*Callipepla californica*	•
CALT	California Towhee	*Pipilo crissalis*	1
CEDW	Cedar Waxwing	*Bombycilla cedrorum*	1
CBCH	Chestnut-backed Chickadee	*Poecile rufescens*	2
CLSW	Cliff Swallow	*Petrochelidon pyrrhonota*	3
CORA	Common Raven	*Corvus corax*	•
COHA	Cooper's Hawk	*Accipiter cooperii*	•
XXCO	Cormorant species	*Phalacrocorax sp.*	•
ORJU	Dark-eyed Junco	*Junco hyemalis*	2
EUST	European Starling	*Sturnus vulgaris*	3
GCSP	Golden-crowned Sparrow	*Zonotrichia atricapilla*	1
GRSP	**Grasshopper Sparrow**	***Ammodramus savannarum***	•
HAWO	Hairy Woodpecker	*Picoides villosus*	•
HOFI	House Finch	*Carpodacus mexicanus*	2
KILL	Killdeer	*Charadrius vociferus*	•
LAZB	Lazuli Bunting	*Passerina amoena*	2
LEGO	Lesser Goldfinch	*Carduelis psaltria*	•
LBCU	Long-billed Curlew	*Numenius americanus*	•
MALL	**Mallard**	***Anas platyrhynchos***	•
MODO	Mourning Dove	*Zenaida macroura*	2
RSFL	Northern Flicker	*Colaptes auratus*	•
NOMO	Northern Mockingbird	*Mimus polyglottos*	2
NRWS	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	•
NUWO	Nutall's Woodpecker	*Picoides nuttallii*	1
OATI	Oak Titmouse	*Baeolophus inornatus*	1
OCWA	Orange-crowned Warbler	*Vermivora celata*	1
PSFL	Pacific-slope Flycatcher	*Empidonax difficilis*	1
PUFI	Purple Finch	*Carpodacus purpureus*	1
RSHA	Red-shouldered Hawk	*Buteo lineatus*	•
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	•

Table F.2-2 continued: Species list Lake Chabot-Fairmont Ridge 2002-2007; Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
RODO	Rock Dove	*Columba livia*	•
RCSP	Rufous-crowned Sparrow	*Aimophila ruficeps*	2
SAVS	**Savannah Sparrow**	***Passerculus sandwichensis***	**1**
SPTO	Spotted Towhee	*Pipilo maculatus*	2
STJA	Steller's Jay	*Cyanocitta stelleri*	•
TRES	Tree Swallow	*Tachycineta bicolor*	•
TUVU	Turkey Vulture	*Cathartes aura*	•
VGSW	Violet-green Swallow	*Tachycineta thalassina*	•
WEBL	Western Bluebird	*Sialia mexicana*	1
WEKI	Western Kingbird	*Tyrannus verticalis*	1
WEME	**Western Meadowlark**	***Sturnella neglecta***	**1**
WESJ	Western Scrub Jay	*Aphelocoma californica*	2
WETA	Western Tanager	*Piranga ludoviciana*	•
WCSP	White-crowned Sparrow	*Zonotrichia leucophrys*	•
WTSW	White-throated Swift	*Aeronautes saxatalis*	•
WITU	Wild Turkey	*Meleagris gallopavo*	•
WREN	Wrentit	*Chamaea fasciata*	2
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	•

3.0 Morgan Territory

Table F.3-1: Morgan Territory 2004-2011 point count summary (2004 plots 1-6, 2005-2011 plots 1-10); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2004		2005		2006		2007		2008	
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**
ACWO	0	0	0	0	0	0	0	0	0	0
AMCR	0	0	1	0.1	4	0.4	4	0.4	3	0.3
AMKE	1	0.17	2	0.2	3	0.3	0	0	0	0
AMPI	2	0.33	0	0	0	0	0	0	0	0
AMRO	0	0	0	0	1	0.1	0	0	0	0
ANHU	0	0	1	0.1	1	0.1	0	0	0	0
BEWR	0	0	0	0	1	0.1	0	0	0	0
BHGR	0	0	0	0	1	0.1	0	0	0	0
BLPH	0	0	0	0	0	0	0	0	0	0
BTPI	0	0	0	0	0	0	1	0.1	0	0
BUOR	0	0	1	0.1	0	0	1	0.1	0	0
CALT	0	0	1	0.1	5	0.5	1	0.1	0	0
CORA	0	0	0	0	0	0	0	0	0	0
GOEA	0	0	1	0.1	0	0	0	0	0	0
GRSP	***2***	***0.33***	***3***	***0.3***	***1***	***0.1***	***5***	***0.5***	***1***	***0.1***
HOLA	***6***	***1.00***	***10***	***1***	***12***	***1.2***	***4***	***0.4***	***11***	***1.1***
HOWR	0	0	0	0	0	0	0	0	0	0
HUVI	0	0	0	0	1	0.1	0	0	0	0
LASP	0	0	0	0	0	0	0	0	0	0
LAZB	4	0.67	7	0.7	11	1.1	3	0.3	4	0.4
LEGO	2	0.33	4	0.4	10	1	0	0	0	0
MODO	0	0	0	0	0	0	0	0	0	0
NUWO	0	0	0	0	0	0	0	0	0	0
OATI	1	0.17	6	0.6	5	0.5	0	0	3	0.3
OCWA	1	0.17	1	0.1	1	0.1	0	0	0	0
ORJU	0	0	0	0	0	0	1	0.1	0	0
PUFI	0	0	0	0	1	0.1	0	0	0	0
RCSP	0	0	0	0	0	0	0	0	0	0
RSFL	0	0	0	0	1	0.1	0	0	0	0
RWBL	10	1.67	16	1.6	27	2.7	12	1.2	16	1.6
SAVS	***0***	***0***	***2***	***0.2***	***0***	***0***	***0***	***0***	***0***	***0***
SPTO	0	0	2	0.2	0	0	0	0	0	0
STJA	0	0	0	0	1	0.1	0	0	2	0.2
TUVU	0	0	0	0	0	0	0	0	0	0
WAVI	1	0.17	2	0.2	0	0	0	0	0	0
WEBL	1	0.17	0	0	0	0	0	0	2	0.2
WEME	***7***	***1.17***	***2***	***0.2***	***3***	***0.3***	***0***	***0***	***0***	***0***
WESJ	1	0.17	5	0.5	2	0.2	2	0.2	2	0.2
WETA	0	0	0	0	0	0	0	0	1	0.1
WIWA	0	0	0	0	0	0	0	0	0	0
XXSP	0	0	1	0.1	0	0	1	0.1	0	0
XXWO	0	0	0	0	0	0	0	0	0	0
Total Det	39		68		92		35		45	

Table F.3-1 continued: Morgan Territory 2004-2011 point count summary (2004 plots 1-6, 2005-2011 plots 1-10); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2009		2010		2011		2004-2011		
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Std Dev**
ACWO	2	0.2	0	0	0	0	2	0.03	0.07
AMCR	4	0.4	3	0.3	0	0	19	0.24	0.18
AMKE	0	0	0	0	0	0	6	0.08	0.12
AMPI	0	0	0	0	0	0	2	0.04	0.12
AMRO	1	0.1	0	0	0	0	2	0.03	0.05
ANHU	0	0	0	0	0	0	2	0.03	0.05
BEWR	0	0	0	0	0	0	1	0.01	0.04
BHGR	0	0	0	0	0	0	1	0.01	0.04
BLPH	1	0.1	0	0	0	0	1	0.01	0.04
BTPI	0	0	0	0	0	0	1	0.01	0.04
BUOR	2	0.2	0	0	0	0	4	0.05	0.08
CALT	0	0	0	0	0	0	7	0.09	0.17
CORA	0	0	0	0	2	0.2	2	0.03	0.07
GOEA	0	0	0	0	0	0	1	0.01	0.04
GRSP	***0***	***0***	***4***	***0.4***	***5***	***0.5***	***21***	***0.28***	***0.19***
HOLA	***13***	***1.3***	***5***	***0.5***	***7***	***0.7***	***68***	***0.90***	***0.33***
HOWR	0	0	0	0	1	0.1	1	0.01	0.04
HUVI	0	0	0	0	0	0	1	0.01	0.04
LASP	0	0	0	0	1	0.1	1	0.01	0.04
LAZB	3	0.3	14	1.4	9	0.9	55	0.72	0.40
LEGO	2	0.2	1	0.1	1	0.1	20	0.27	0.33
MODO	1	0.1	0	0	0	0	1	0.01	0.04
NUWO	0	0	2	0.2	2	0.2	4	0.05	0.09
OATI	7	0.7	7	0.7	2	0.2	31	0.40	0.27
OCWA	0	0	0	0	0	0	3	0.05	0.07
ORJU	0	0	0	0	0	0	1	0.01	0.04
PUFI	0	0	0	0	0	0	1	0.01	0.04
RCSP	0	0	1	0.1	0	0	1	0.01	0.04
RSFL	0	0	0	0	0	0	1	0.01	0.04
RWBL	18	1.8	12	1.2	24	2.4	135	1.77	0.53
SAVS	***0***	***0***	***0***	***0***	***0***	***0***	***2***	***0.03***	***0.07***
SPTO	0	0	0	0	0	0	2	0.03	0.07
STJA	0	0	2	0.2	3	0.3	8	0.10	0.12
TUVU	0	0	1	0.1	0	0	1	0.01	0.04
WAVI	3	0.3	1	0.1	0	0	7	0.10	0.12
WEBL	0	0	6	0.6	0	0	9	0.12	0.21
WEME	***1***	***0.1***	***0***	***0***	***1***	***0.1***	***14***	***0.23***	***0.39***
WESJ	7	0.7	0	0	4	0.4	23	0.30	0.22
WETA	0	0	0	0	0	0	1	0.01	0.04
WIWA	0	0	0	0	1	0.1	1	0.01	0.04
XXSP	0	0	0	0	1	0.1	3	0.04	0.05
XXWO	0	0	1	0.1	0	0	1	0.01	0.04
Total Det	65		60		64		468		

Table F3-2: Species list Morgan Territory 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
ACWO	Acorn Woodpecker	*Melanerpes formicivorus*	•
ALHU	Allen's Hummingbird	*Selasphorus sasin*	1
AMCO	American Coot	*Fulica americana*	•
AMCR	American Crow	*Corvus brachyrhynchos*	2
AMGO	American Goldfinch	*Carduelis tristis*	1
AMKE	American Kestrel	*Falco sparverius*	•
AMPI	American Pipit	*Anthus rubescens*	•
AMRO	American Robin	*Turdus migratorius*	2
ANHU	Anna's Hummingbird	*Calypte anna*	1
ATFL	Ash-throated Flycatcher	*Myiarchus cinerascens*	1
BTPI	Band-tailed pigeon	*Columbia fasciata*	•
BARS	Barn Swallow	*Hirundo rustica*	•
BEWR	Bewick's Wren	*Thryomanes bewickii*	2
BLPH	Black Phoebe	*Sayornis nigricans*	▪
BHGR	Black-headed Grosbeak	*Pheucticus melanocephalus*	2
BRBL	Brewer's Blackbird	*Euphagus cyanocephalus*	•
BHCO	Brown-headed Cowbird	*Molothrus ater*	•
BUOR	Bullock's Oriole	*Icterus bullockii*	1
BUSH	Bushtit	*Psaltriparus minimus*	1
CAQU	California Quail	*Callipepla californica*	2
CALT	California Towhee	*Pipilo crissalis*	2
CAVI	Cassin's Vireo	*Vireo cassinii*	1
CEDW	Cedar Waxwing	*Bombycilla cedrorum*	•
CBCH	Chestnut-backed Chickadee	*Poecile rufescens*	•
CLSW	Cliff Swallow	*Petrochelidon pyrrhonota*	•
CORA	Common Raven	*Corvus corax*	•
COHA	Cooper's Hawk	*Accipiter cooperii*	•
ORJU	Dark-eyed Junco	*Junco hyemalis*	2
EUST	European Starling	*Sturnus vulgaris*	•
GOEA	Golden Eagle	*Aquila chrysaetos*	•
GRSP	**Grasshopper Sparrow**	***Ammodramus savannarum***	**2**
GHOW	Great-horned Owl	*Bubo virginianus*	2
HOLA	**Horned Lark**	***Eremophila alpestris***	**3**
HOFI	House Finch	*Carpodacus mexicanus*	•
HOWR	House Wren	*Troglodytes aedon*	3
HUVI	Hutton's Vireo	*Vireo huttoni*	2
LASP	Lark Sparrow	*Chondestes grammacus*	2
LAZB	Lazuli Bunting	*Passerina amoena*	2
LEGO	Lesser Goldfinch	*Carduelis psaltria*	2
MALL	**Mallard**	***Anas platyrhynchos***	**•**
MODO	Mourning Dove	*Zenaida macroura*	3
RSFL	Northern Flicker	*Colaptes auratus*	1
NRWS	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	•

Table F.3-2 continued: Species list Morgan Territory 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
NUWO	Nutall's Woodpecker	*Picoides nuttallii*	1
OATI	Oak Titmouse	*Baeolophus inornatus*	2
OCWA	Orange-crowned Warbler	*Vermivora celata*	2
PSFL	Pacific-slope Flycatcher	*Empidonax difficilis*	•
PUFI	Purple Finch	*Carpodacus purpureus*	1
RSHA	Red-shouldered Hawk	*Buteo lineatus*	2
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	1
RWBL	**Red-winged Blackbird**	***Agelaius phoeniceus***	**2**
RODO	Rock Dove	*Columba livia*	•
RCSP	Rufous-crowned Sparrow	*Aimophila ruficeps*	1
SAVS	**Savannah Sparrow**	***Passerculus sandwichensis***	**1**
SOSP	**Song Sparrow**	***Melospiza melodia***	**1**
SPTO	Spotted Towhee	*Pipilo maculatus*	2
STJA	Steller’s Jay	*Cyanocitta stelleri*	2
TRES	Tree Swallow	*Tachycineta bicolor*	•
TUVU	Turkey Vulture	*Cathartes aura*	•
VASW	Vaux's Swift	*Chaetura vauxi*	•
VGSW	Violet-green Swallow	*Tachycineta thalassina*	•
WAVI	Warbling Vireo	*Vireo gilvus*	2
WEBL	Western Bluebird	*Sialia mexicana*	•
WEKI	Western Kingbird	*Tyrannus verticalis*	•
WEME	**Western Meadowlark**	***Sturnella neglecta***	**2**
WESJ	Western Scrub Jay	*Aphelocoma californica*	2
WETA	Western Tanager	*Piranga ludoviciana*	1
WEWP	Western Wood-peewee	*Contopus sordidulus*	1
WTKI	**White-tailed Kite**	***Elanus leucurus***	**•**
WTSW	White-throated Swift	*Aeronautes saxatalis*	•
WITU	Wild Turkey	*Meleagris gallopavo*	1
WIWA	Wilson's Warbler	*Wilsonia pusilla*	1
WREN	Wrentit	*Chamaea fasciata*	1

4.0 Pleasanton Ridge

Table F.4-1: Pleasanton Ridge 2004-2011 point count summary (plots 4-9); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2004		2005		2006		2007		2008	
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**
AMKE	0	0	0	0	1	0.17	1	0.17	0	0
AMPI	0	0	27	4.50	0	0	0	0	0	0
AMRO	0	0	2	0.33	4	0.67	0	0	5	0.83
BEWR	0	0	0	0	0	0	0	0	1	0.17
BGGN	0	0	0	0	0	0	0	0	1	0.17
BLPH	0	0	0	0	1	0.17	0	0	1	0.17
BRBL	0	0	0	0	0	0	3	0.50	0	0
BUOR	0	0	0	0	0	0	0	0	1	0.17
BUSH	0	0	0	0	1	0.17	0	0	1	0.17
CALT	0	0	0	0	1	0.17	0	0	0	0
CAQU	0	0	0	0	0	0	0	0	0	0
CBCH	0	0	0	0	0	0	2	0.33	8	1.33
CORA	0	0	0	0	0	0	1	0.17	0	0
EUST	0	0	0	0	1	0.17	0	0	0	0
GRSP	***8***	***1.33***	***4***	***0.67***	***6***	***1.00***	***2***	***0.33***	***0***	***0***
GRYE	0	0	1	0.17	0	0	0	0	0	0
HOFI	0	0	0	0	0	0	0	0	1	0.17
HOLA	***15***	***2.50***	***16***	***2.67***	***22***	***3.67***	***12***	***2.00***	***16***	***2.67***
HUVI	0	0	0	0	0	0	0	0	1	0.17
KILL	2	0.33	3	0.50	3	0.50	4	0.67	6	1.00
LASP	1	0.17	0	0	1	0.17	0	0	1	0.17
LAZB	0	0	0	0	0	0	0	0	0	0
LEGO	4	0.67	0	0	1	0.17	4	0.67	0	0
MALL	0	0	0	0	2	0.33	0	0	0	0
MAWA	0	0	0	0	0	0	0	0	1	0.17
MODO	6	1.00	1	0.17	0	0	2	0.33	3	0.50
NUWO	0	0	0	0	0	0	0	0	2	0.33
OATI	0	0	0	0	8	1.33	5	0.83	2	0.33
OCWA	0	0	0	0	4	0.67	1	0.17	2	0.33
ORJU	0	0	0	0	4	0.67	1	0.17	2	0.33
PUFI	0	0	0	0	0	0	0	0	0	0
RCKI	0	0	0	0	0	0	0	0	0	0
RSFL	0	0	0	0	1	0.17	0	0	0	0
RTHA	1	0.17	0	0	0	0	0	0	0	0
RWBL	0	0	0	0	0	0	0	0	0	0
SAVS	***3***	***0.50***	***5***	***0.83***	***3***	***0.50***	***2***	***0.33***	***0***	***0***
SPTO	0	0	0	0	0	0	1	0.17	0	0
STJA	0	0	0	0	9	1.50	7	1.17	1	0.17
WAVI	0	0	0	0	0	0	0	0	0	0
WEBL	0	0	2	0.33	1	0.17	2	0.33	0	0
WEKI	0	0	0	0	2	0.33	0	0	0	0
WEME	***2***	***0.33***	***11***	***1.83***	***0***	***0***	***0***	***0***	***1***	***0.17***
WESJ	0	0	0	0	1	0.17	2	0.33	2	0.33
WITU	0	0	0	0	1	0.17	0	0	0	0
WREN	0	0	0	0	0	0	1	0.17	0	0
Total Det	42		72		79		54		60	

Table F.4-1 continued: Pleasanton Ridge 2004-2011 point count summary (plots 4-9); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2009		2010		2011		2004-2011		
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Std Dev**
AMKE	0	0	0	0	0	0	2	0.04	0.08
AMPI	0	0	0	0	0	0	27	0.56	1.59
AMRO	1	0.17	1	0.17	3	0.50	16	0.33	0.31
BEWR	0	0	0	0	0	0	1	0.02	0.06
BGGN	0	0	0	0	0	0	1	0.02	0.06
BLPH	0	0	0	0	0	0	2	0.04	0.08
BRBL	0	0	0	0	0	0	3	0.06	0.18
BUOR	0	0	0	0	0	0	1	0.02	0.06
BUSH	0	0	0	0	0	0	2	0.04	0.08
CALT	1	0.17	0	0	1	0.17	3	0.06	0.09
CAQU	0	0	1	0.17	0	0	1	0.02	0.06
CBCH	3	0.50	6	1.00	2	0.33	21	0.44	0.50
CORA	0	0	0	0	0	0	1	0.02	0.06
EUST	0	0	0	0	2	0.33	3	0.06	0.12
GRSP	***7***	***1.17***	***5***	***0.83***	***10***	***1.67***	***42***	***0.88***	***0.54***
GRYE	0	0	0	0	0	0	1	0.02	0.06
HOFI	0	0	2	0.33	0	0	3	0.06	0.12
HOLA	***10***	***1.67***	***10***	***1.67***	***17***	***2.83***	***118***	***2.46***	***0.67***
HUVI	0	0	0	0	0	0	1	0.02	0.06
KILL	1	0.17	2	0.33	3	0.50	24	0.50	0.25
LASP	0	0	1	0.17	0	0	4	0.08	0.09
LAZB	0	0	3	0.50	1	0.17	4	0.08	0.18
LEGO	1	0.17	0	0	0	0	10	0.21	0.29
MALL	1	0.17	2	0.33	1	0.17	6	0.13	0.15
MAWA	0	0	0	0	0	0	1	0.02	0.06
MODO	0	0	2	0.33	1	0.17	15	0.31	0.33
NUWO	0	0	0	0	2	0.33	4	0.08	0.15
OATI	1	0.17	2	0.33	2	0.33	20	0.42	0.45
OCWA	2	0.33	0	0	5	0.83	14	0.29	0.32
ORJU	2	0.33	6	1.00	1	0.17	16	0.33	0.35
PUFI	1	0.17	0	0	0	0	1	0.02	0.06
RCKI	0	0	0	0	2	0.33	2	0.04	0.12
RSFL	0	0	0	0	0	0	1	0.02	0.06
RTHA	0	0	0	0	0	0	1	0.02	0.06
RWBL	14	2.33	0	0	0	0	14	0.29	0.82
SAVS	***1***	***0.17***	***2***	***0.33***	***4***	***0.67***	***20***	***0.42***	***0.27***
SPTO	1	0.17	4	0.67	1	0.17	7	0.15	0.23
STJA	7	1.17	2	0.33	4	0.67	30	0.63	0.59
WAVI	0	0	0	0	1	0.17	1	0.02	0.06
WEBL	0	0	0	0	0	0	5	0.10	0.15
WEKI	0	0	0	0	0	0	2	0.04	0.12
WEME	***2***	***0.33***	***2***	***0.33***	***13***	***2.17***	***31***	***0.65***	***0.85***
WESJ	1	0.17	2	0.33	4	0.67	12	0.25	0.22
WITU	0	0	0	0	0	0	1	0.02	0.06
WREN	2	0.33	0	0	0	0	3	0.06	0.12
Total Det	61		56		80		504		

Table F.4-2: Species list Pleasanton Ridge 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
ACWO	Acorn Woodpecker	*Melanerpes formicivorus*	•
AMCO	American Coot	*Fulica americana*	•
AMCR	American Crow	*Corvus brachyrhynchos*	1
AMKE	American Kestrel	*Falco sparverius*	•
AMPI	American Pipit	*Anthus rubescens*	•
AMRO	American Robin	*Turdus migratorius*	2
AMWI	American Wigeon	*Anas americana*	•
ANHU	Anna's Hummingbird	*Calypte anna*	•
ATFL	Ash-throated Flycatcher	*Myiarchus cinerascens*	1
BTPI	Band-tailed pigeon	*Columbia fasciata*	•
BARS	Barn Swallow	*Hirundo rustica*	•
BEWR	Bewick's Wren	*Thryomanes bewickii*	2
BLPH	Black Phoebe	*Sayornis nigricans*	2
BHGR	Black-headed Grosbeak	*Pheucticus melanocephalus*	2
BGGN	Blue-gray Gnatcatcher	*Polioptila caerulea*	•
BRBL	Brewer's Blackbird	*Euphagus cyanocephalus*	•
BUOR	Bullock's Oriole	*Icterus bullockii*	1
BUSH	Bushtit	*Psaltriparus minimus*	•
CAQU	California Quail	*Callipepla californica*	1
CALT	California Towhee	*Pipilo crissalis*	2
CBCH	Chestnut-backed Chickadee	*Poecile rufescens*	2
CLSW	Cliff Swallow	*Petrochelidon pyrrhonota*	•
CORA	Common Raven	*Corvus corax*	•
ORJU	Dark-eyed Junco	*Junco hyemalis*	2
EUST	European Starling	*Sturnus vulgaris*	1
GOEA	Golden Eagle	*Aquila chrysaetos*	•
GCSP	Golden-crowned Sparrow	*Zonotrichia atricapilla*	•
GRSP	**Grasshopper Sparrow**	***Ammodramus savannarum***	**3**
GBHE	Great Blue Heron	*Ardea herodias*	•
GREG	Great Egret	*Ardea albus*	•
GRYE	Greater Yellowlegs	*Tringa melanoleuca*	•
GHOW	Great-horned Owl	*Bubo virginianus*	1
HAWO	Hairy Woodpecker	*Picoides villosus*	•
HOLA	**Horned Lark**	***Eremophila alpestris***	**3**
HOFI	House Finch	*Carpodacus mexicanus*	2
HOWR	House Wren	*Troglodytes aedon*	1
HUVI	Hutton's Vireo	*Vireo huttoni*	•
KILL	Killdeer	*Charadrius vociferus*	2
LASP	Lark Sparrow	*Chondestes grammacus*	2
LAZB	Lazuli Bunting	*Passerina amoena*	2
LEGO	Lesser Goldfinch	*Carduelis psaltria*	2
MAWA	MacGillivray's Warbler	*Oporornis tolmiei*	1

Table F.4-2 continued: Species list Pleasanton Ridge 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
MALL	**Mallard**	***Anas platyrhynchos***	**3**
MODO	Mourning Dove	*Zenaida macroura*	2
RSFL	Northern Flicker	*Colaptes auratus*	•
NOMO	Northern Mockingbird	*Mimus polyglottos*	2
NUWO	Nutall's Woodpecker	*Picoides nuttallii*	2
OATI	Oak Titmouse	*Baeolophus inornatus*	2
OCWA	Orange-crowned Warbler	*Vermivora celata*	2
PUFI	Purple Finch	*Carpodacus purpureus*	2
RSHA	Red-shouldered Hawk	*Buteo lineatus*	•
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	2
RWBL	Red-winged Blackbird	*Agelaius phoeniceus*	2
RNDU	Ring-necked Duck	*Aythya collaris*	•
RODO	Rock Dove	*Columba livia*	•
RCKI	Ruby-crowned Kinglet	*Regulus calendula*	•
SAVS	**Savannah Sparrow**	***Passerculus sandwichensis***	**1**
SOSP	**Song Sparrow**	***Melospiza melodia***	**•**
SPTO	Spotted Towhee	*Pipilo maculatus*	2
STJA	Steller’s Jay	*Cyanocitta stelleri*	2
TUVU	Turkey Vulture	*Cathartes aura*	•
VGSW	Violet-green Swallow	*Tachycineta thalassina*	•
WAVI	Warbling Vireo	*Vireo gilvus*	1
WEBL	Western Bluebird	*Sialia mexicana*	1
WEKI	Western Kingbird	*Tyrannus verticalis*	•
WEME	**Western Meadowlark**	***Sturnella neglecta***	**2**
WESJ	Western Scrub Jay	*Aphelocoma californica*	2
WCSP	White-crowned Sparrow	*Zonotrichia leucophrys*	1
WTSW	White-throated Swift	*Aeronautes saxatalis*	•
WITU	Wild Turkey	*Meleagris gallopavo*	2
WIWA	Wilson's Warbler	*Wilsonia pusilla*	1
WREN	Wrentit	*Chamaea fasciata*	2
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	•

5.0 Sunol-Ohlone

Table F.5-1: Sunol-Ohlone 2005-2011 point count summary (plots 1-9); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2005		2006		2007		2008		2009	
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**
ACWO	4	0.44	15	1.67	7	0.78	6	0.67	4	0.44
AMCR	3	0.33	0	0	0	0	3	0.33	0	0
AMKE	0	0	1	0.11	2	0.22	0	0	0	0
AMRO	0	0	0	0	2	0.22	0	0	0	0
ANHU	0	0	2	0.22	3	0.33	2	0.22	3	0.33
ATFL	4	0.44	3	0.33	2	0.22	5	0.56	1	0.11
BEWR	0	0	0	0	0	0	0	0	0	0
BHCO	0	0	1	0.11	0	0	0	0	0	0
BLPH	0	0	0	0	2	0.22	6	0.67	0	0
BRBL	0	0	0	0	3	0.33	0	0	0	0
BRCR	0	0	0	0	0	0	0	0	0	0
BUOR	2	0.22	4	0.44	4	0.44	6	0.67	2	0.22
CALT	2	0.22	1	0.11	1	0.11	2	0.22	0	0
CAQU	0	0	0	0	0	0	0	0	0	0
CAVI	0	0	0	0	0	0	0	0	2	0.22
CBCH	0	0	0	0	2	0.22	6	0.67	3	0.33
CLSW	0	0	0	0	0	0	0	0	0	0
COHA	0	0	1	0.11	0	0	0	0	0	0
EUST	10	1.11	48	5.33	30	3.33	12	1.33	37	4.11
GHOW	0	0	0	0	0	0	0	0	0	0
GRSP	***5***	***0.56***	***5***	***0.56***	***3***	***0.33***	***0***	***0***	***2***	***0.22***
HOFI	3	0.33	4	0.44	4	0.44	12	1.33	6	0.67
HOLA	***11***	***1.22***	***16***	***1.78***	***7***	***0.78***	***7***	***0.78***	***7***	***0.78***
LASP	6	0.67	2	0.22	1	0.11	3	0.33	6	0.67
LAZB	8	0.89	2	0.22	3	0.33	2	0.22	1	0.11
LEGO	0	0	17	1.89	5	0.56	7	0.78	14	1.56
MAWA	0	0	1	0.11	0	0	0	0	1	0.11
MODO	2	0.22	1	0.11	6	0.67	1	0.11	1	0.11
NRWS	2	0.22	0	0	0	0	0	0	0	0
NUWO	0	0	3	0.33	0	0	2	0.22	1	0.11
OATI	3	0.33	13	1.44	6	0.67	3	0.33	9	1.00
OCWA	1	0.11	2	0.22	1	0.11	3	0.33	0	0
ORJU	0	0	2	0.22	8	0.89	2	0.22	1	0.11
PUFI	0	0	0	0	0	0	0	0	0	0
RCSP	0	0	0	0	0	0	0	0	5	0.56
ROWR	1	0.11	4	0.44	2	0.22	1	0.11	4	0.44
RSFL	0	0	0	0	0	0	0	0	1	0.11
RTHA	0	0	0	0	0	0	1	0.11	0	0
RWBL	0	0	13	1.44	3	0.33	0	0	0	0
SPTO	1	0.11	0	0	2	0.22	1	0.11	0	0
STJA	1	0.11	1	0.11	0	0	0	0	2	0.22
TRES	0	0	0	0	0	0	0	0	0	0
VGSW	0	0	2	0.22	0	0	0	0	4	0.44
WAVI	0	0	0	0	0	0	3	0.33	2	0.22
WBNU	0	0	0	0	0	0	0	0	0	0

Table F.5-1 continued: Sunol-Ohlone 2005-2011 point count summary (plots 1-9); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2005		2006		2007		2008		2009	
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**
WEBL	4	0.44	6	0.67	6	0.67	7	0.78	18	2.00
WEKI	1	0.11	3	0.33	2	0.22	5	0.56	1	0.11
WEME	***8***	***0.89***	***9***	***1.00***	***7***	***0.78***	***14***	***1.56***	***2***	***0.22***
WESJ	1	0.11	1	0.11	2	0.22	5	0.56	3	0.33
WETA	0	0	1	0.11	0	0	0	0	0	0
WITU	0	0	3	0.33	1	0.11	0	0	0	0
WIWA	0	0	0	0	0	0	0	0	0	0
WTKI	0	0	1	0.11	1	0.11	0	0	0	0
XXHU	0	0	1	0.11	0	0	0	0	0	0
XXWA	0	0	1	0.11	0	0	0	0	0	0
XXWO	0	0	2	0.22	0	0	0	0	0	0
XXXX	0	0	0	0	0	0	0	0	2	0.22
YBMA	0	0	1	0.11	3	0.33	1	0.11	0	0
Total Det	83		193		131		128		145	

Table F.5-1 continued: Sunol-Ohlone 2005-2011 point count summary (plots 1-9); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2010		2011		2004-2011		
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Std Dev**
ACWO	3	0.33	10	1.11	49	0.78	0.47
AMCR	0	0	0	0	6	0.10	0.16
AMKE	0	0	2	0.22	5	0.08	0.11
AMRO	0	0	1	0.11	3	0.05	0.09
ANHU	0	0	2	0.22	12	0.19	0.14
ATFL	0	0	1	0.11	16	0.25	0.20
BEWR	1	0.11	1	0.11	2	0.03	0.05
BHCO	0	0	0	0	1	0.02	0.04
BLPH	1	0.11	0	0	9	0.14	0.25
BRBL	0	0	2	0.22	5	0.08	0.14
BRCR	0	0	1	0.11	1	0.02	0.04
BUOR	2	0.22	3	0.33	23	0.37	0.17
CALT	0	0	4	0.44	10	0.16	0.16
CAQU	0	0	1	0.11	1	0.02	0.04
CAVI	0	0	0	0	2	0.03	0.08
CBCH	3	0.33	1	0.11	15	0.24	0.24
CLSW	0	0	1	0.11	1	0.02	0.04
COHA	0	0	0	0	1	0.02	0.04
EUST	6	0.67	11	1.22	154	2.44	1.81
GHOW	0	0	1	0.11	1	0.02	0.04
GRSP	***1***	***0.11***	***6***	***0.67***	***22***	***0.35***	***0.25***
HOFI	2	0.22	5	0.56	36	0.57	0.37
HOLA	***4***	***0.44***	***14***	***1.56***	***66***	***1.05***	***0.48***
LASP	3	0.33	1	0.11	22	0.35	0.24

Table F.5-1 continued: Sunol-Ohlone 2005-2011 point count summary (plots 1-9); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2010		2011		2004-2011		
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Std Dev**
LAZB	1	0.11	3	0.33	20	0.32	0.27
LEGO	0	0	10	1.11	53	0.84	0.73
MAWA	0	0	0	0	2	0.03	0.05
MODO	0	0	0	0	11	0.17	0.23
NRWS	0	0	0	0	2	0.03	0.08
NUWO	4	0.44	3	0.33	13	0.21	0.17
OATI	4	0.44	8	0.89	46	0.73	0.41
OCWA	2	0.22	0	0	9	0.14	0.12
ORJU	7	0.78	10	1.11	30	0.48	0.44
PUFI	1	0.11	0	0	1	0.02	0.04
RCSP	0	0	0	0	5	0.08	0.21
ROWR	2	0.22	4	0.44	18	0.29	0.16
RSFL	1	0.11	1	0.11	3	0.05	0.06
RTHA	0	0	1	0.11	2	0.03	0.05
RWBL	0	0	15	1.67	31	0.49	0.74
SPTO	1	0.11	0	0	5	0.08	0.08
STJA	3	0.33	1	0.11	8	0.13	0.12
TRES	0	0	1	0.11	1	0.02	0.04
VGSW	1	0.11	1	0.11	8	0.13	0.16
WAVI	0	0	0	0	5	0.08	0.14
WBNU	4	0.44	3	0.33	7	0.11	0.19
WEBL	1	0.11	5	0.56	47	0.75	0.59
WEKI	1	0.11	0	0	13	0.21	0.19
WEME	***7***	***0.78***	***7***	***0.78***	***54***	***0.86***	***0.39***
WESJ	5	0.56	3	0.33	20	0.32	0.19
WETA	0	0	0	0	1	0.02	0.04
WITU	0	0	0	0	4	0.06	0.13
WIWA	0	0	1	0.11	1	0.02	0.04
WTKI	0	0	0	0	2	0.03	0.05
XXHU	0	0	0	0	1	0.02	0.04
XXWA	0	0	0	0	1	0.02	0.04
XXWO	0	0	0	0	2	0.03	0.08
XXXX	0	0	0	0	2	0.03	0.08
YBMA	0	0	2	0.22	7	0.11	0.13
Total Det	71		147		898		

Table F.5-2: Species list Sunol-Ohlone 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
ACWO	Acorn Woodpecker	*Melanerpes formicivorus*	•
AMCR	American Crow	*Corvus brachyrhynchos*	•
AMKE	American Kestrel	*Falco sparverius*	•
AMRO	American Robin	*Turdus migratorius*	2
ANHU	Anna’s Hummingbird	*Calypte anna*	2
ATFL	Ash-throated Flycatcher	*Myiarchus cinerascens*	1
BTPI	Band-tailed pigeon	*Columbia fasciata*	•
BARS	Barn Swallow	*Hirundo rustica*	•
BEWR	Bewick’s Wren	*Thryomanes bewickii*	2
BLPH	Black Phoebe	*Sayornis nigricans*	1
BHGR	Black-headed Grosbeak	*Pheucticus melanocephalus*	2
BRBL	Brewer’s Blackbird	*Euphagus cyanocephalus*	•
BRCR	Brown Creeper	*Certhia americana*	1
BHCO	Brown-headed Cowbird	*Molothrus ater*	•
BUFF	Bufflehead	*Bucephala albeola*	•
BUOR	Bullock's Oriole	*Icterus bullockii*	2
CAQU	California Quail	*Callipepla californica*	1
CALT	California Towhee	*Pipilo crissalis*	2
CAVI	Cassin's Vireo	*Vireo cassinii*	2
CBCH	Chestnut-backed Chickadee	*Poecile rufescens*	2
CLSW	Cliff Swallow	*Petrochelidon pyrrhonota*	•
CORA	Common Raven	*Corvus corax*	•
COHA	Cooper’s Hawk	*Accipiter cooperii*	•
ORJU	Dark-eyed Junco	*Junco hyemalis*	3
EUST	European Starling	*Sturnus vulgaris*	2
GOEA	Golden Eagle	*Aquila chrysaetos*	•
GCSP	Golden-crowned Sparrow	*Zonotrichia atricapilla*	1
GRSP	**Grasshopper Sparrow**	***Ammodramus savannarum***	**2**
GHOW	Great-horned Owl	*Bubo virginianus*	•
HAWO	Hairy Woodpecker	*Picoides villosus*	•
HOLA	**Horned Lark**	***Eremophila alpestris***	**2**
HOFI	House Finch	*Carpodacus mexicanus*	2
HOWR	House Wren	*Troglodytes aedon*	1
HUVI	Hutton’s Vireo	*Vireo huttoni*	2
KILL	Killdeer	*Charadrius vociferus*	1
LASP	Lark Sparrow	*Chondestes grammacus*	2
LAZB	Lazuli Bunting	*Passerina amoena*	2
LEGO	Lesser Goldfinch	*Carduelis psaltria*	2
MAWA	MacGillivray's Warbler	*Oporornis tolmiei*	1
MALL	**Mallard**	***Anas platyrhynchos***	**•**
MODO	Mourning Dove	*Zenaida macroura*	2
RSFL	Northern Flicker	*Colaptes auratus*	•
NOHA	**Northern Harrier**	***Circus cyaneus***	**•**

Table F.5-2 continued: Species list Sunol-Ohlone 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
NOMO	Northern Mockingbird	*Mimus polyglottos*	1
NRWS	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	•
NUWO	Nutall's Woodpecker	*Picoides nuttallii*	•
OATI	Oak Titmouse	*Baeolophus inornatus*	3
OCWA	Orange-crowned Warbler	*Vermivora celata*	2
PUFI	Purple Finch	*Carpodacus purpureus*	1
RSHA	Red-shouldered Hawk	*Buteo lineatus*	•
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	•
RWBL	Red-winged Blackbird	*Agelaius phoeniceus*	2
RNPH	**Ring-necked Pheasant**	***Phasianus colchicus***	**•**
ROWR	Rock Wren	*Salpinctes obsoletus*	2
RCSP	Rufous-crowned Sparrow	*Aimophila ruficeps*	•
SPTO	Spotted Towhee	*Pipilo maculatus*	2
STJA	Steller's Jay	*Cyanocitta stelleri*	•
TRES	Tree Swallow	*Tachycineta bicolor*	•
TUVU	Turkey Vulture	*Cathartes aura*	•
VGSW	Violet-green Swallow	*Tachycineta thalassina*	3
WAVI	Warbling Vireo	*Vireo gilvus*	2
WEBL	Western Bluebird	*Sialia mexicana*	1
WEKI	Western Kingbird	*Tyrannus verticalis*	1
WEME	**Western Meadowlark**	***Sturnella neglecta***	**2**
WESJ	Western Scrub Jay	*Aphelocoma californica*	1
WETA	Western Tanager	*Piranga ludoviciana*	1
WEWP	Western Wood-peewee	*Contopus sordidulus*	1
WBNU	White-breasted Nuthatch	*Sitta carolinensis*	1
WTKI	**White-tailed Kite**	***Elanus leucurus***	**2**
WTSW	White-throated Swift	*Aeronautes saxatalis*	•
WITU	Wild Turkey	*Meleagris gallopavo*	3
WIWA	Wilson's Warbler	*Wilsonia pusilla*	1
WREN	Wrentit	*Chamaea fasciata*	2
YBMA	Yellow-billed Magpie	*Pica nuttalli*	•
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	1

6.0 Sycamore Valley

Table F.6-1: Sycamore Valley 2004-2011 point count summary (plots 1-6); annual park total and average detections; restricted dataset (≤100m); italics are grassland focal species

	2004		2005		2006		2007		2008	
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**
ACWO	0	0	0	0	0	0	2	0.33	0	0
ANHU	2	0.33	4	0.67	4	0.67	3	0.50	0	0
ATFL	0	0	0	0	1	0.17	0	0	0	0
BARS	0	0	0	0	2	0.33	0	0	0	0
BLGR	0	0	1	0.17	0	0	0	0	0	0
BLPH	0	0	0	0	0	0	0	0	1	0.17
BRBL	0	0	0	0	0	0	1	0.17	0	0
BUOR	0	0	0	0	5	0.83	1	0.17	2	0.33
CALT	1	0.17	0	0	1	0.17	0	0	0	0
CAQU	21	3.50	10	1.67	1	0.17	2	0.33	0	0
CBCH	0	0	0	0	0	0	0	0	1	0.17
COHA	0	0	0	0	0	0	0	0	0	0
EUST	0	0	9	1.50	2	0.33	20	3.33	0	0
GCSP	6	1.00	0	0	0	0	0	0	0	0
GHOW	0	0	0	0	0	0	0	0	0	0
GRSP	***0***	***0***	***3***	***0.50***	***7***	***1.17***	***7***	***1.17***	***6***	***1.00***
HOFI	3	0.50	9	1.50	9	1.50	9	1.50	9	1.50
HOLA	***0***	***0***	***0***	***0***	***0***	***0***	***2***	***0.33***	***0***	***0***
HOWR	0	0	0	0	0	0	0	0	0	0
LAZB	0	0	2	0.33	2	0.33	1	0.17	0	0
LEGO	4	0.67	7	1.17	10	1.67	18	3.00	12	2.00
LOSH	1	0.17	0	0	0	0	0	0	0	0
MODO	2	0.33	2	0.33	1	0.17	1	0.17	1	0.17
NOMO	0	0	2	0.33	1	0.17	3	0.50	2	0.33
NUWO	1	0.17	0	0	0	0	0	0	0	0
OATI	0	0	0	0	5	0.83	0	0	0	0
ORJU	0	0	0	0	1	0.17	0	0	0	0
RCSP	0	0	0	0	0	0	1	0.17	0	0
RNPH	5	0.83	0	0	1	0.17	0	0	0	0
RTHA	0	0	0	0	1	0.17	0	0	0	0
RWBL	125	20.83	69	11.50	32	5.33	36	6.00	27	4.50
SAVS	***1***	***0.17***	***0***	***0***	***0***	***0***	***1***	***0.17***	***0***	***0***
SOSP	0	0	0	0	0	0	2	0.33	0	0
SPTO	0	0	0	0	0	0	0	0	0	0
STJA	0	0	0	0	0	0	1	0.17	0	0
VGSW	0	0	0	0	0	0	3	0.50	0	0
WCSP	1	0.17	3	0.50	0	0	0	0	0	0
WEBL	0	0	4	0.67	0	0	1	0.17	3	0.50
WEKI	0	0	2	0.33	0	0	5	0.83	4	0.67
WEME	***14***	***2.33***	***9***	***1.50***	***5***	***0.83***	***2***	***0.33***	***5***	***0.83***
WESJ	0	0	0	0	0	0	3	0.50	1	0.17
WITU	13	2.17	0	0	16	2.67	1	0.17	0	0
WTSW	0	0	0	0	0	0	0	0	0	0
Total Det	200		136		108		126		74	

Table F.6-1 continued: Sycamore Valley 2004-2011 point count summary (plots 1-6); annual park total and average detections; restricted dataset (≤100m); italics are grassland focal species

	2009		2010		2011		2004-2011		
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Std Dev**
ACWO	0	0	0	0	1	0.17	3	0.06	0.13
ANHU	0	0	2	0.33	1	0.17	16	0.33	0.28
ATFL	0	0	1	0.17	0	0.00	2	0.04	0.08
BARS	0	0	0	0	0	0.00	2	0.04	0.13
BLGR	0	0	0	0	0	0.00	1	0.02	0.06
BLPH	0	0	0	0	0	0.00	1	0.02	0.06
BRBL	0	0	1	0.17	0	0.00	2	0.04	0.08
BUOR	1	0.17	0	0	0	0.00	9	0.19	0.30
CALT	0	0	1	0.17	1	0.17	4	0.08	0.09
CAQU	1	0.17	1	0.17	6	1.00	42	0.88	1.30
CBCH	0	0	2	0.33	0	0.00	3	0.06	0.13
COHA	1	0.17	0	0	0	0.00	1	0.02	0.06
EUST	1	0.17	3	0.50	0	0.00	35	0.73	1.22
GCSP	1	0.17	0	0	0	0.00	7	0.15	0.37
GHOW	0	0	0	0	1	0.17	1	0.02	0.00
GRSP	***4***	***0.67***	***7***	***1.17***	***14***	***2.33***	***48***	***1.00***	***0.45***
HOFI	28	4.67	8	1.33	13	2.17	88	1.83	1.32
HOLA	***0***	***0***	***0***	***0***	***0***	***0.00***	***2***	***0.04***	***0.13***
HOWR	0	0	0	0	2	0.33	2	0.04	0.00
LAZB	0	0	0	0	1	0.17	6	0.13	0.16
LEGO	7	1.17	12	2.00	9	1.50	79	1.65	0.76
LOSH	0	0	0	0	0	0.00	1	0.02	0.06
MODO	7	1.17	1	0.17	0	0.00	15	0.31	0.37
NOMO	3	0.50	1	0.17	1	0.17	13	0.27	0.19
NUWO	0	0	0	0	1	0.17	2	0.04	0.06
OATI	0	0	0	0	0	0.00	5	0.10	0.31
ORJU	1	0.17	1	0.17	0	0.00	3	0.06	0.09
RCSP	0	0	0	0	1	0.17	2	0.04	0.06
RNPH	1	0.17	2	0.33	3	0.50	12	0.25	0.30
RTHA	2	0.33	2	0.33	2	0.33	7	0.15	0.16
RWBL	47	7.83	59	9.83	44	7.33	439	9.15	5.63
SAVS	***1***	***0.17***	***0***	***0***	***1***	***0.17***	***4***	***0.08***	***0.09***
SOSP	0	0	0	0	1	0.17	3	0.06	0.13
SPTO	0	0	1	0.17	0	0.00	1	0.02	0.06
STJA	0	0	0	0	0	0.00	1	0.02	0.06
VGSW	0	0	0	0	0	0.00	3	0.06	0.19
WCSP	0	0	0	0	0	0.00	4	0.08	0.19
WEBL	3	0.50	1	0.17	2	0.33	14	0.29	0.27
WEKI	3	0.50	1	0.17	1	0.17	16	0.33	0.33
WEME	***7***	***1.17***	***17***	***2.83***	***13***	***2.17***	***72***	***1.50***	***0.89***
WESJ	1	0.17	2	0.33	2	0.33	9	0.19	0.19
WITU	6	1.00	1	0.17	4	0.67	41	0.85	1.11
WTSW	1	0.17	0	0	0	0.00	1	0.02	0.06
Total Det	128		127		125		1024		

Table F.6-2: Species list Sycamore Valley 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
ACWO	Acorn Woodpecker	*Melanerpes formicivorus*	2
AMCR	American Crow	*Corvus brachyrhynchos*	2
AMGO	American Goldfinch	*Carduelis tristis*	1
AMKE	American Kestrel	*Falco sparverius*	1
AMRO	American Robin	*Turdus migratorius*	1
ANHU	Anna's Hummingbird	*Calypte anna*	3
ATFL	Ash-throated Flycatcher	*Myiarchus cinerascens*	2
BARS	Barn Swallow	*Hirundo rustica*	•
BEWR	Bewick's Wren	*Thryomanes bewickii*	1
BLPH	Black Phoebe	*Sayornis nigricans*	1
BHGR	Black-headed Grosbeak	*Pheucticus melanocephalus*	1
BLGR	**Blue Grosbeak**	***Guiraca caerulea***	**•**
BRBL	Brewer's Blackbird	*Euphagus cyanocephalus*	•
BHCO	Brown-headed Cowbird	*Molothrus ater*	•
BUOR	Bullock's Oriole	*Icterus bullockii*	2
CAQU	California Quail	*Callipepla californica*	2
CALT	California Towhee	*Pipilo crissalis*	2
CAGO	Canada Goose	*Branta canadensis*	•
CBCH	Chestnut-backed Chickadee	*Poecile rufescens*	1
CLSW	Cliff Swallow	*Petrochelidon pyrrhonota*	•
CORA	Common Raven	*Corvus corax*	•
COHA	Cooper's Hawk	*Accipiter cooperii*	•
ORJU	Dark-eyed Junco	*Junco hyemalis*	1
EUST	European Starling	*Sturnus vulgaris*	•
GCSP	Golden-crowned Sparrow	*Zonotrichia atricapilla*	1
GRSP	**Grasshopper Sparrow**	***Ammodramus savannarum***	**2**
GHOW	Great-horned Owl	*Bubo virginianus*	•
HOLA	**Horned Lark**	***Eremophila alpestris***	**1**
HOFI	House Finch	*Carpodacus mexicanus*	2
HOWR	House Wren	*Troglodytes aedon*	2
HUVI	Hutton's Vireo	*Vireo huttoni*	1
KILL	Killdeer	*Charadrius vociferus*	•
LAZB	Lazuli Bunting	*Passerina amoena*	2
LEGO	Lesser Goldfinch	*Carduelis psaltria*	2
LOSH	Loggerhead Shrike	*Lanius ludovicianus*	•
MALL	**Mallard**	***Anas platyrhynchos***	**•**
MODO	Mourning Dove	*Zenaida macroura*	2
NOMO	Northern Mockingbird	*Mimus polyglottos*	2
NUWO	Nutall's Woodpecker	*Picoides nuttallii*	2
OATI	Oak Titmouse	*Baeolophus inornatus*	2
OCWA	Orange-crowned Warbler	*Vermivora celata*	1
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	1
RWBL	Red-winged Blackbird	*Agelaius phoeniceus*	3
RNPH	**Ring-necked Pheasant**	***Phasianus colchicus***	**2**

Table F.6-2 continued: Species list Sycamore Valley 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
RODO	Rock Dove	*Columba livia*	•
RCSP	Rufous-crowned Sparrow	*Aimophila ruficeps*	1
SAVS	**Savannah Sparrow**	***Passerculus sandwichensis***	**2**
SOSP	**Song Sparrow**	***Melospiza melodia***	**2**
SPTO	Spotted Towhee	*Pipilo maculatus*	1
STJA	Steller's Jay	*Cyanocitta stelleri*	•
TRES	Tree Swallow	*Tachycineta bicolor*	•
TRBL	Tricolored Blackbird	*Agelaius tricolor*	•
TUVU	Turkey Vulture	*Cathartes aura*	•
VGSW	Violet-green Swallow	*Tachycineta thalassina*	•
WEBL	Western Bluebird	*Sialia mexicana*	1
WEKI	Western Kingbird	*Tyrannus verticalis*	2
WEME	**Western Meadowlark**	***Sturnella neglecta***	**2**
WESJ	Western Scrub Jay	*Aphelocoma californica*	2
WBNU	White-breasted Nuthatch	*Sitta carolinensis*	2
WCSP	White-crowned Sparrow	*Zonotrichia leucophrys*	1
WTKI	**White-tailed Kite**	***Elanus leucurus***	**•**
WTSW	White-throated Swift	*Aeronautes saxatalis*	•
WITU	Wild Turkey	*Meleagris gallopavo*	3
YRWA	Yellow-rumped Warbler	*Dendroica coronata*	•

7.0 Vasco Caves

Table F.7-1: Vasco Caves 2004-2011 point count summary (2004-2007 plots 1-10, 2008-2011 plots 1-10, 15); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2004		2005		2006		2007		2008	
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**
AMCR	0	0	0	0	2	0.20	0	0	30	2.73
AMKE	1	0.10	0	0	2	0.20	0	0	0	0
BRBL	0	0	0	0	0	0	0	0	0	0
BUOR	0	0	0	0	1	0.10	0	0	2	0.18
CAQU	0	0	0	0	0	0	0	0	0	0
CORA	0	0	0	0	0	0	2	0.20	0	0
EUST	2	0.20	0	0	0	0	0	0	0	0
GRSP	***0***	***0***	***0***	***0***	***0***	***0***	***1***	***0.10***	***2***	***0.18***
HOFI	0	0	0	0	0	0	0	0	0	0
HOLA	***23***	***2.30***	***12***	***1.20***	***14***	***1.40***	***11***	***1.10***	***14***	***1.27***
LOSH	0	0	0	0	1	0.10	0	0	0	0
MODO	0	0	0	0	0	0	0	0	0	0
ROWR	0	0	0	0	0	0	0	0	0	0
RTHA	1	0.10	1	0.10	0	0	1	0.10	0	0
RWBL	16	1.60	10	1.00	21	2.10	31	3.10	43	3.91
SAVS	***31***	***3.10***	***16***	***1.60***	***0***	***0***	***3***	***0.30***	***0***	***0***
WEBL	0	0	0	0	2	0.20	0	0	0	0
WEKI	0	0	0	0	0	0	3	0.30	3	0.27
WEME	***31***	***3.10***	***32***	***3.20***	***31***	***3.10***	***18***	***1.80***	***20***	***1.82***
XXSP	0	0	0	0	0	0	2	0.20	1	0.09
XXXX	0	0	0	0	1	0.10	0	0	0	0
Total Det	105		71		75		72		115	

Table F.7-1 continued: Vasco Caves 2004-2011 point count summary (2004-2007 plots 1-10, 2008-2011 plots 1-10, 15); annual park total and average detections; restricted dataset (≤ 100m); italics are grassland focal species

	2009		**2010**		**2011**		**2004-2011**		
Species	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Total Det**	**Avg Det**	**Std Dev**
AMCR	0	0	0	0	0	0	32	0.37	0.96
AMKE	0	0	0	0	0	0	3	0.04	0.07
BRBL	15	1.36	0	0	0	0	15	0.17	0.48
BUOR	0	0	1	0.09	1	0.09	5	0.06	0.07
CAQU	0	0	0	0	1	0.09	1	0.01	0.03
CORA	2	0.18	0	0	0	0	4	0.05	0.09
EUST	0	0	0	0	0	0	2	0.03	0.07
GRSP	***5***	***0.45***	***0***	***0***	***1***	***0.09***	***9***	***0.10***	***0.16***
HOFI	0	0	0	0	1	0.09	1	0.01	0.03
HOLA	***7***	***0.64***	***5***	***0.45***	***17***	***1.55***	***103***	***1.24***	***0.57***
LOSH	1	0.09	0	0	0	0	2	0.02	0.04
MODO	0	0	1	0.09	6	0.55	7	0.08	0.19
ROWR	0	0	0	0	1	0.09	1	0.01	0.03
RTHA	0	0	0	0	1	0.09	4	0.05	0.05
RWBL	10	0.91	42	3.82	48	4.36	221	2.60	1.37
SAVS	***2***	***0.18***	***0***	***0***	***9***	***0.82***	***61***	***0.75***	***1.10***
WEBL	0	0	0	0	0	0	2	0.03	0.07
WEKI	0	0	0	0	0	0	6	0.07	0.13
WEME	***26***	***2.36***	***45***	***4.09***	***36***	***3.27***	***239***	***2.84***	***0.79***
XXSP	4	0.36	0	0	3	0.27	10	0.12	0.15
XXXX	0	0	0	0	0	0	1	0.01	0.04
Total Det	72		94		125		729		

Table F.7-2: Species list Vasco Caves 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
AMCR	American Crow	*Corvus brachyrhynchos*	•
AMKE	American Kestrel	*Falco sparverius*	•
AMRO	American Robin	*Turdus migratorius*	1
BARS	Barn Swallow	*Hirundo rustica*	1
BEWR	Bewick's Wren	*Thryomanes bewickii*	1
BRBL	Brewer's Blackbird	*Euphagus cyanocephalus*	•
BUOR	Bullock's Oriole	*Icterus bullockii*	2
BUOW	Burrowing Owl	*Athene cunicularia*	3
CAQU	California Quail	*Callipepla californica*	•
CLSW	Cliff Swallow	*Petrochelidon pyrrhonota*	1
CORA	Common Raven	*Corvus corax*	3
ORJU	Dark-eyed Junco	*Junco hyemalis*	2
DCCO	Double-crested Cormorant	*Phalacrocorax auritus*	•
EUST	European Starling	*Sturnus vulgaris*	•
GOEA	Golden Eagle	*Aquila chrysaetos*	•
GRSP	**Grasshopper Sparrow**	***Ammodramus savannarum***	**2**
GHOW	Great-horned Owl	*Bubo virginianus*	3
HOLA	**Horned Lark**	***Eremophila alpestris***	**3**
HOFI	House Finch	*Carpodacus mexicanus*	1
KILL	Killdeer	*Charadrius vociferus*	•
LEGO	Lesser Goldfinch	*Carduelis psaltria*	1
LOSH	Loggerhead Shrike	*Lanius ludovicianus*	1
LBCU	Long-billed Curlew	*Numenius americanus*	•
MALL	**Mallard**	***Anas platyrhynchos***	**•**
MODO	Mourning Dove	*Zenaida macroura*	3
RSFL	Northern Flicker	*Colaptes auratus*	•
NOHA	**Northern Harrier**	***Circus cyaneus***	**•**
NOMO	Northern Mockingbird	*Mimus polyglottos*	1
NUWO	Nutall's Woodpecker	*Picoides nuttallii*	1
OATI	Oak Titmouse	*Baeolophus inornatus*	•
PRFA	**Prairie Falcon**	***Falco mexicanus***	**3**
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	•
RWBL	Red-winged Blackbird	*Agelaius phoeniceus*	3
RODO	Rock Dove	*Columba livia*	3
ROWR	Rock Wren	*Salpinctes obsoletus*	2
SAVS	**Savannah Sparrow**	***Passerculus sandwichensis***	**2**
SWHA	**Swainson's Hawk**	***Buteo swainsoni***	**•**
TRBL	Tricolored Blackbird	*Agelaius tricolor*	•
TUVU	Turkey Vulture	*Cathartes aura*	•
VGSW	Violet-green Swallow	*Tachycineta thalassina*	•
WEBL	Western Bluebird	*Sialia mexicana*	•
WEKI	Western Kingbird	*Tyrannus verticalis*	2
WEME	**Western Meadowlark**	***Sturnella neglecta***	**3**

Table F.7-2 continued: Species list Vasco Caves 2002-2011 Breeding bird status: **•)** no evidence of breeding, **1)** possible breeder, **2)** Probable breeder, **3)** Confirmed breeder; includes full dataset or all observations from vegetation and point count surveys; bold are CPIF grassland focal species

AOU Code	Common Name	Scientific Name	Breeding Status
WESJ	Western Scrub Jay	*Aphelocoma californica*	•
WETA	Western Tanager	*Piranga ludoviciana*	•
WCSP	White-crowned Sparrow	*Zonotrichia leucophrys*	1
WTKI	**White-tailed Kite**	***Elanus leucurus***	•
WTSW	White-throated Swift	*Aeronautes saxatalis*	•
WIWA	Wilson's Warbler	*Wilsonia pusilla*	1

Appendix G: Global positioning system coordinates for all plots sampled in the Grassland Monitoring Project

Table G-1 lists the global positioning system coordinates for plot centroids for all plots sampled in the Grassland Monitoring Project. Coordinates are in Universal Transverse Mercator (UTM) projection, North American Datum 1983. All plots fall within UTM zone 10.

Table G-1: Global positioning system coordinates for plot centroids for all plots sampled in the Grassland Monitoring Project

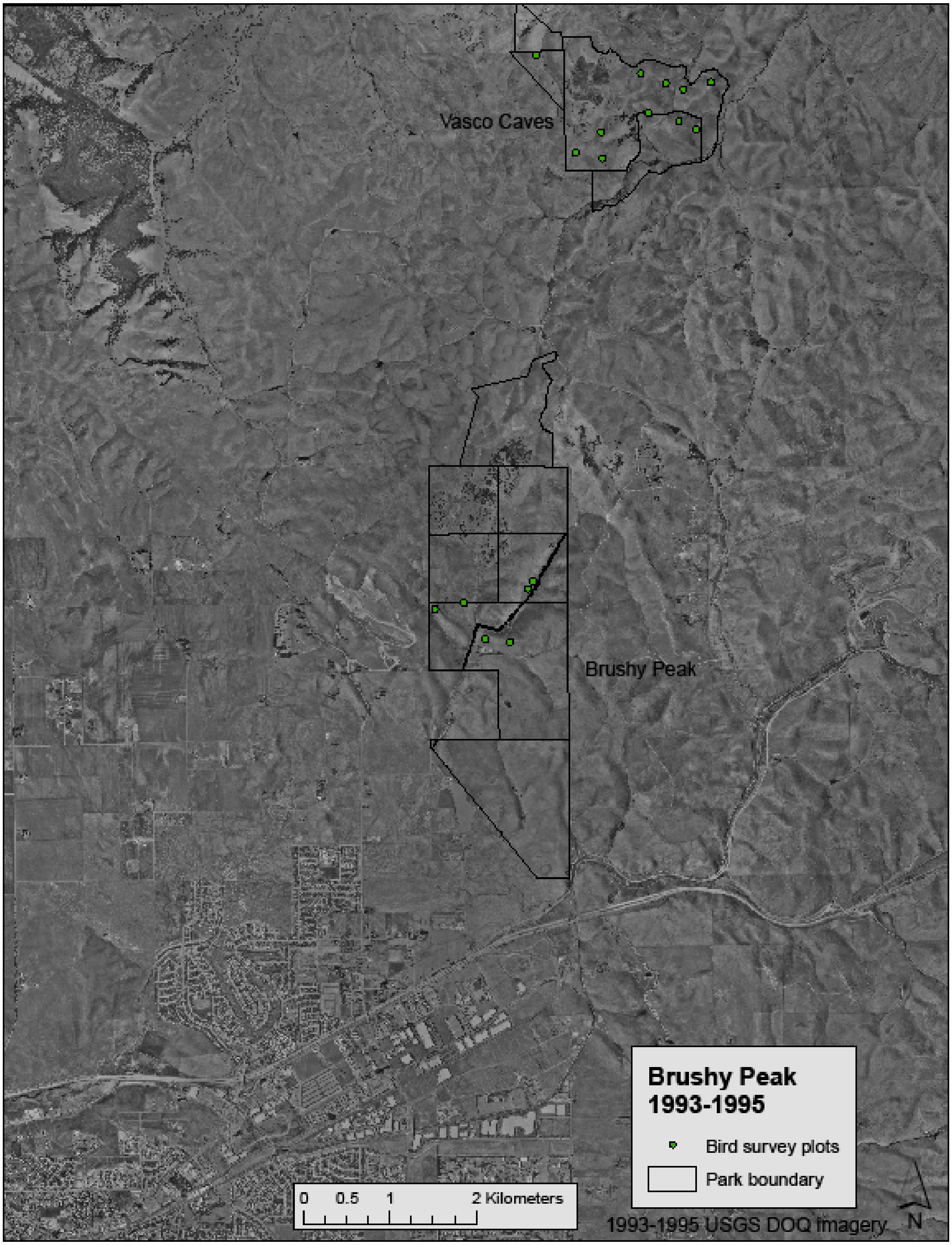
NAD 1983, UTM Zone 10				
Park	**Plot**	**Easting (X)**	**Northing (Y)**	**Location notes**
Brushy Peak	BP1	614192.1	4178900.1	
Brushy Peak	BP2	614014.6	4178769.6	under stock pond 2006
Brushy Peak	BP3	613822.1	4179238.8	
Brushy Peak	BP4	614377.8	4179263.0	
Brushy Peak	BP5	614435.4	4179348.9	
Brushy Peak	BP6	613631.6	4179096.0	
Brushy Peak	BP7	613287.8	4179017.3	
Brushy Peak	BP8	613877.5	4178674.2	
Brushy Peak	BP9	614169.0	4178641.4	
Brushy Peak	BP10	614105.6	4181269.5	
Brushy Peak	BP11	613964.5	4180977.8	
Brushy Peak	BP12	614889.9	4181204.8	Livermore Area RPD
Brushy Peak	BP13	615306.1	4181459.1	Livermore Area RPD
Lake Chabot-Fairmont Ridge	CR1	577722.7	4175463.1	
Lake Chabot-Fairmont Ridge	CR2	577817.8	4175345.1	
Lake Chabot-Fairmont Ridge	CR3	577837.3	4175314.2	
Lake Chabot-Fairmont Ridge	CR4	577886.8	4175163.3	
Lake Chabot-Fairmont Ridge	CR5	578097.0	4174830.5	
Lake Chabot-Fairmont Ridge	CR6	578165.2	4174709.3	
Diablo Foothills	DF1	588289.2	4195384.4	
Diablo Foothills	DF2	588507.9	4195268.1	
Diablo Foothills	DF3	588636.2	4195154.4	
Morgan Territory	MT1	601279.6	4187305.7	Mt. Diablo State Park
Morgan Territory	MT2	600803.2	4187250.9	Mt. Diablo State Park
Morgan Territory	MT3	600734.0	4187480.2	Mt. Diablo State Park
Morgan Territory	MT4	602299.6	4188400.0	
Morgan Territory	MT5	602577.7	4188204.8	
Morgan Territory	MT6	603379.9	4187677.1	
Morgan Territory	MT7	602937.0	4187788.9	
Morgan Territory	MT8	603459.3	4187341.3	
Morgan Territory	MT9	600543.8	4187925.4	Mt. Diablo State Park
Morgan Territory	MT10	600958.4	4187421.4	Mt. Diablo State Park
Morgan Territory	MT11	599909.3	4189509.5	Mt. Diablo State Park
Morgan Territory	MT12	600497.8	4189666.9	Mt. Diablo State Park

Park	Plot	Easting (X)	Northing (Y)	Location notes
Morgan Territory	MT13	601870.7	4188368.6	Mt. Diablo State Park
Morgan Territory	MT14	603070.0	4187781.5	
Morgan Territory	MT15	603418.5	4187556.1	
Morgan Territory	MT16	603471.3	4187079.5	
Point Pinole	PP1	556227.2	4206367.0	
Point Pinole	PP2	556317.2	4206294.6	
Point Pinole	PP3	556818.3	4206513.9	
Point Pinole	PP4	556708.5	4206606.9	
Point Pinole	PP5	557135.7	4206471.5	
Point Pinole	PP6	557267.6	4206556.0	
Pleasanton Ridge	PR1	591644.1	4169951.9	
Pleasanton Ridge	PR2	591746.1	4169832.0	
Pleasanton Ridge	PR3	591802.3	4169644.3	
Pleasanton Ridge	PR4	591448.3	4169813.8	
Pleasanton Ridge	PR5	591756.1	4170146.7	
Pleasanton Ridge	PR6	591996.4	4169950.2	
Pleasanton Ridge	PR7	592608.4	4169188.6	
Pleasanton Ridge	PR8	593397.5	4168539.6	
Pleasanton Ridge	PR9	593371.5	4168813.5	
Sunol-Ohlone	SU1	607478.3	4153829.9	
Sunol-Ohlone	SU2	607418.7	4154505.7	
Sunol-Ohlone	SU3	607156.6	4154619.0	
Sunol-Ohlone	SU4	603491.4	4154058.3	
Sunol-Ohlone	SU5	603758.7	4153788.2	
Sunol-Ohlone	SU6	603463.3	4153727.4	
Sunol-Ohlone	SU7	604697.9	4151888.2	
Sunol-Ohlone	SU8	603423.4	4153109.2	
Sunol-Ohlone	SU9	603408.9	4153216.4	
Sunol-Ohlone	SU10	603506.4	4153588.9	
Sunol-Ohlone	SU11	607496.8	4154202.3	
Sunol-Ohlone	SU12	607616.3	4153953.2	
Sycamore Valley	SV1	592151.3	4185635.7	
Sycamore Valley	SV2	592234.9	4185603.9	
Sycamore Valley	SV3	593018.6	4185889.5	
Sycamore Valley	SV4	593618.7	4185421.1	
Sycamore Valley	SV5	593780.8	4185204.0	
Sycamore Valley	SV6	593967.9	4185293.4	
Vasco Caves	VC1	614470.0	4185475.7	
Vasco Caves	VC2	615248.1	4184274.2	
Vasco Caves	VC3	616131.1	4184704.4	
Vasco Caves	VC4	615982.6	4185148.8	
Vasco Caves	VC5	616189.4	4185078.9	
Vasco Caves	VC6	616505.7	4185161.2	
Vasco Caves	VC7	616335.3	4184609.6	

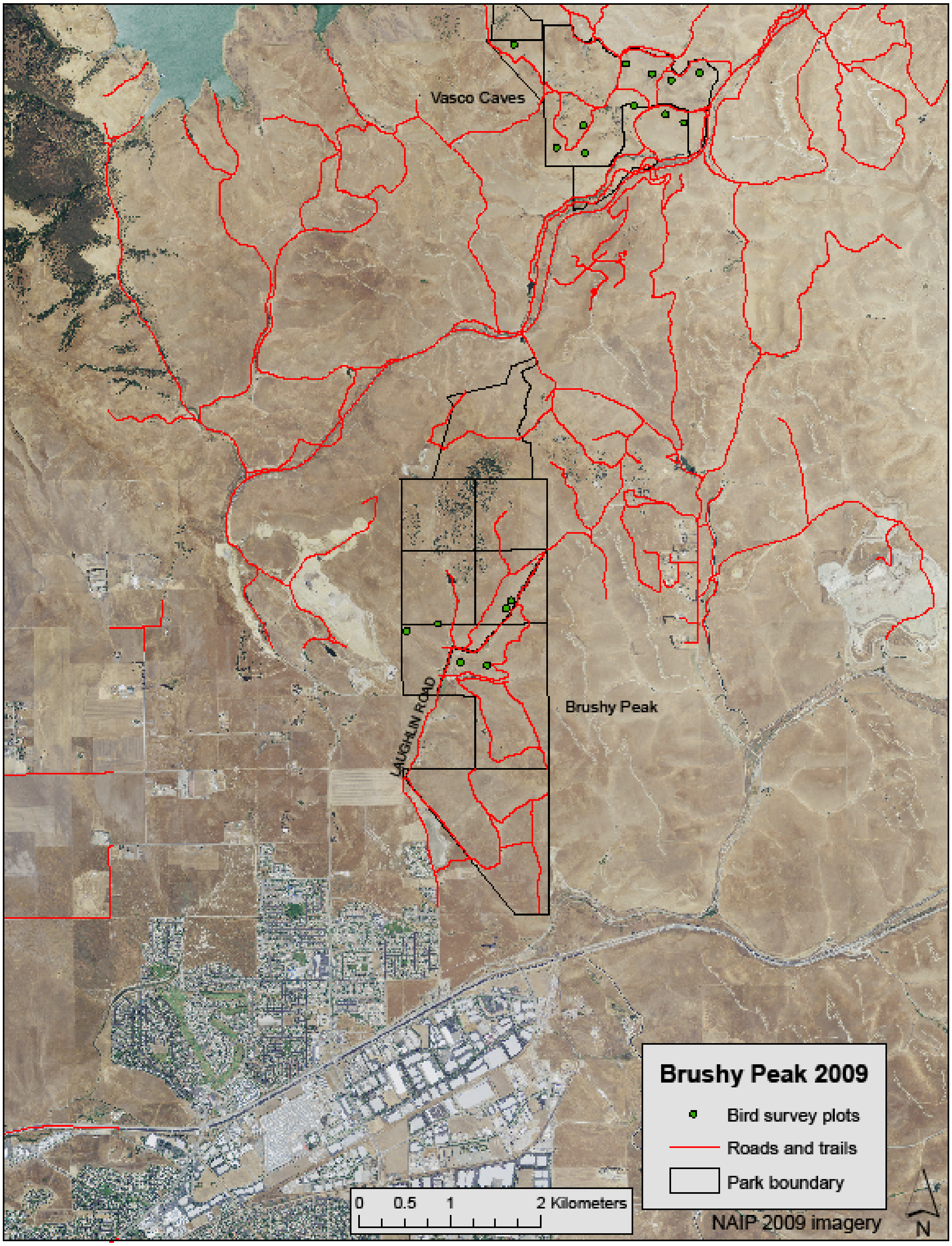
Park	Plot	Easting (X)	Northing (Y)	Location notes
Vasco Caves	VC8	615225.4	4184581.4	
Vasco Caves	VC9	614932.2	4184337.4	
Vasco Caves	VC10	615690.1	4185257.8	
Vasco Caves	VC11	615562.3	4185633.1	
Vasco Caves	VC12	615948.4	4185858.1	
Vasco Caves	VC13	616318.8	4186238.3	
Vasco Caves	VC14	616575.7	4185542.3	
Vasco Caves	VC15	615783.2	4184801.5	
Vasco Caves	VC16	615770.2	4184911.9	
Vasco Caves	VC17	615597.0	4185278.0	

Appendix H: Landscape imagery; source USDA National Agriculture Inventory Program (http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=prog&topic=nai) accessed 2009

1a) Brushy Peak Landscape 1993-1995

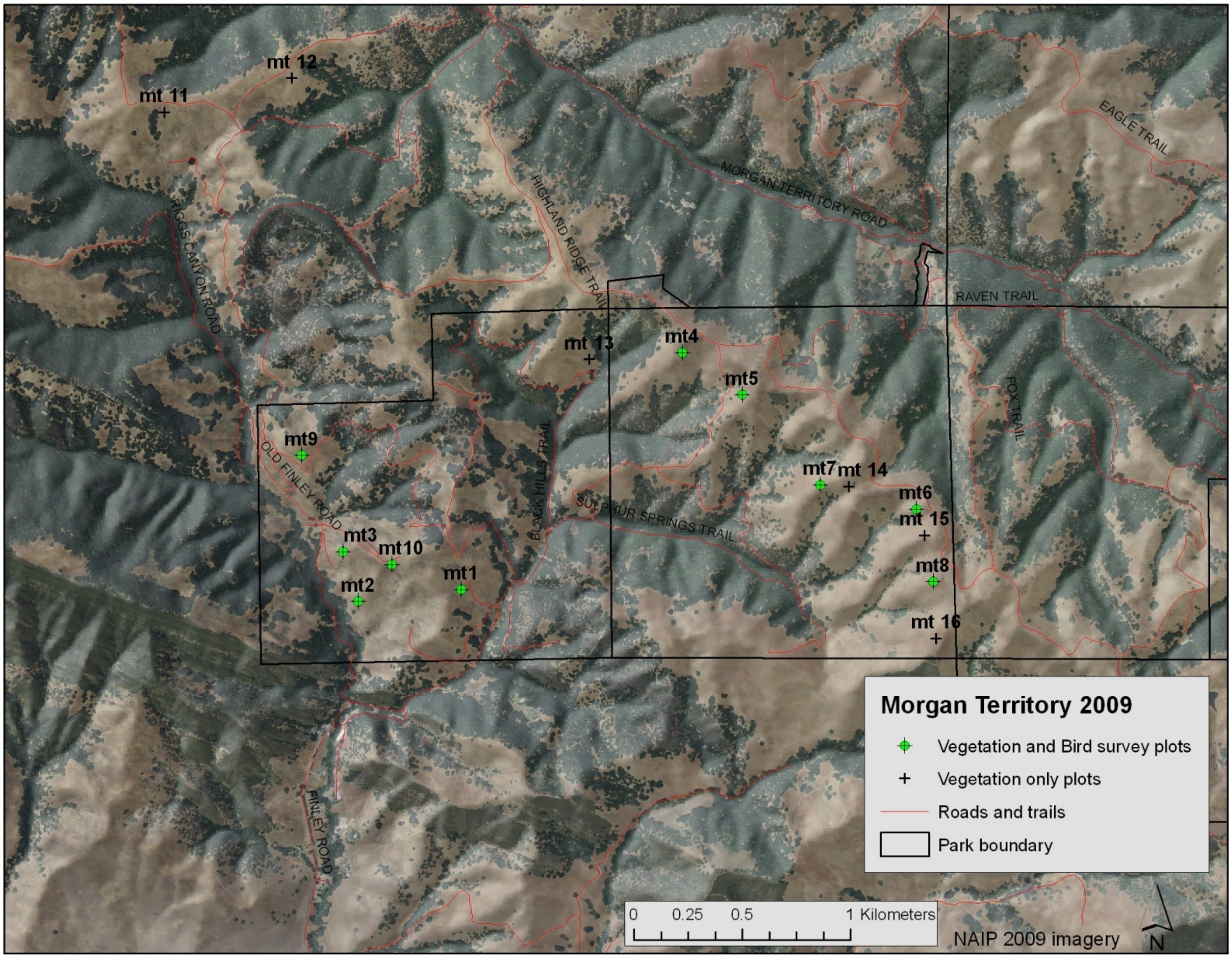


1b) Brushy Peak Landscape 2009

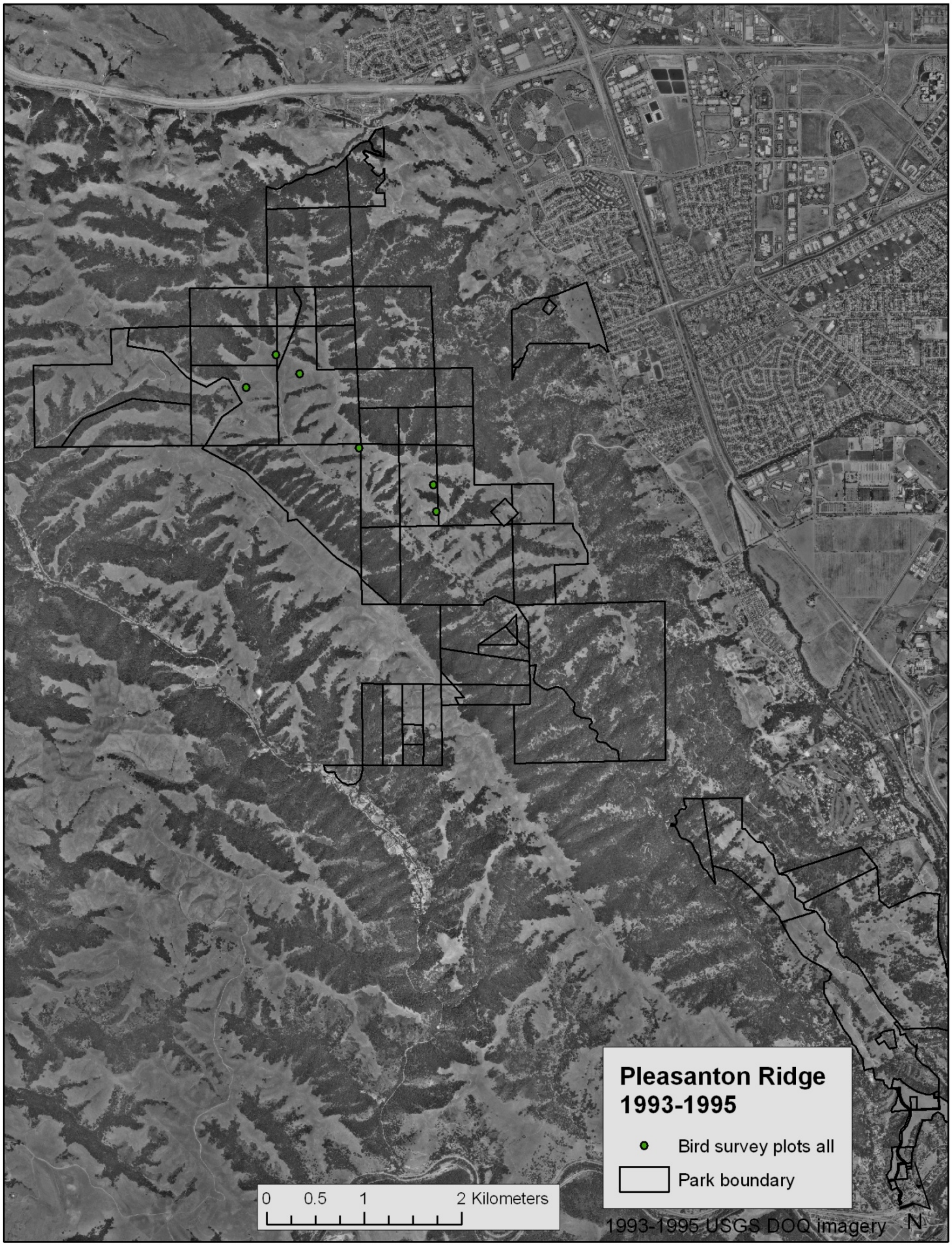


2) Lake Chabot-Fairmont Ridge Landscape 2009

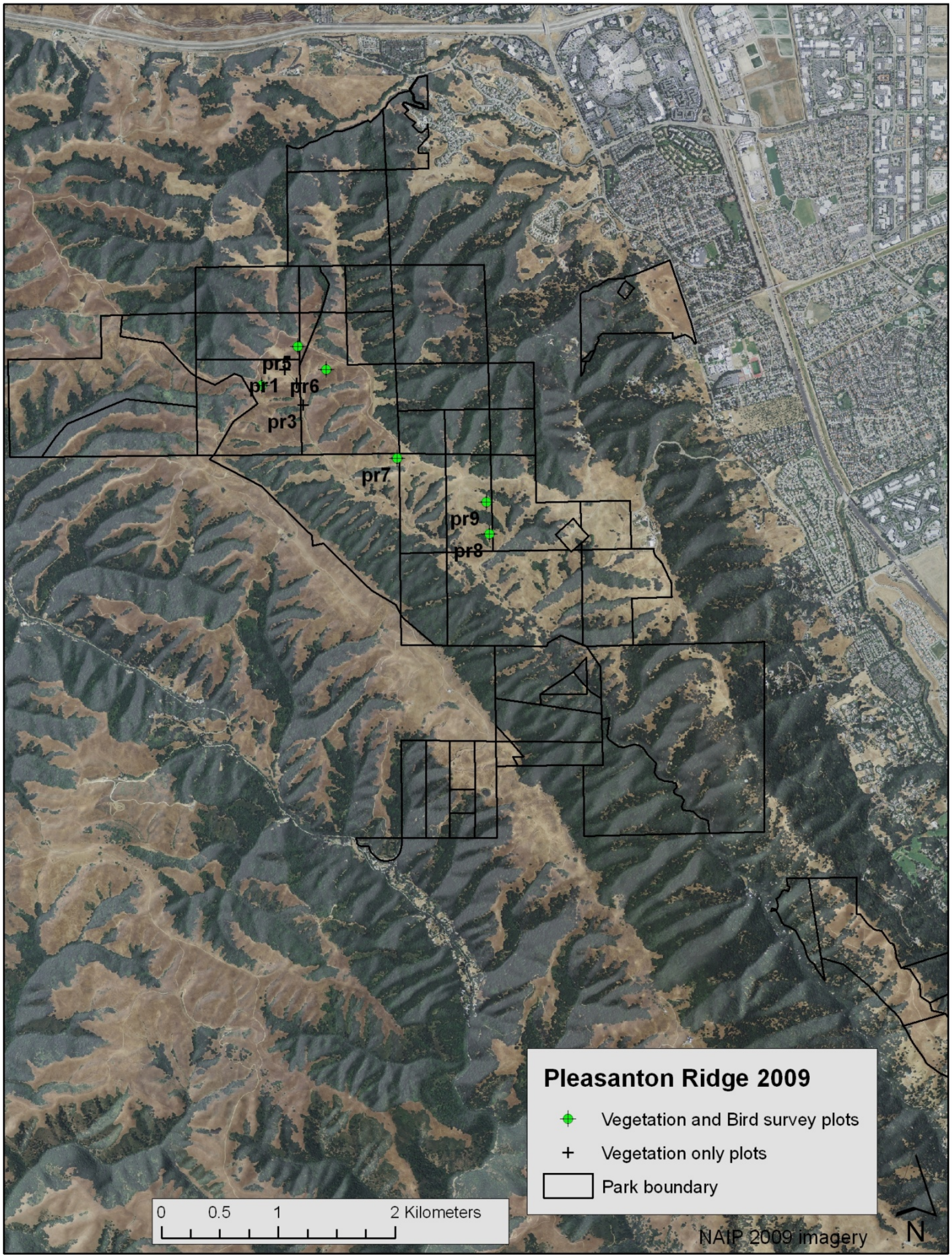
3) Morgan Territory 2009



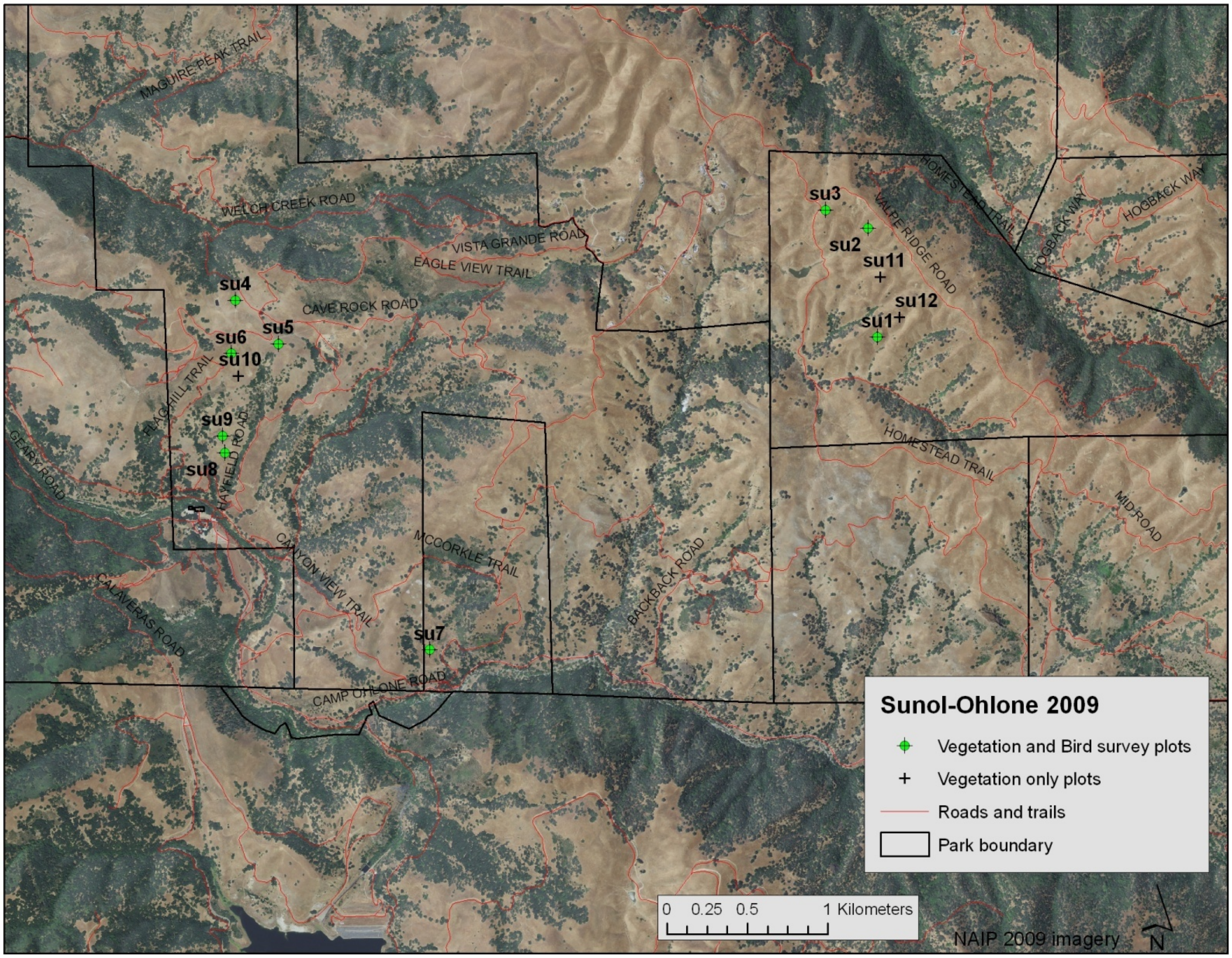
4a) Pleasanton Ridge 1993-1995



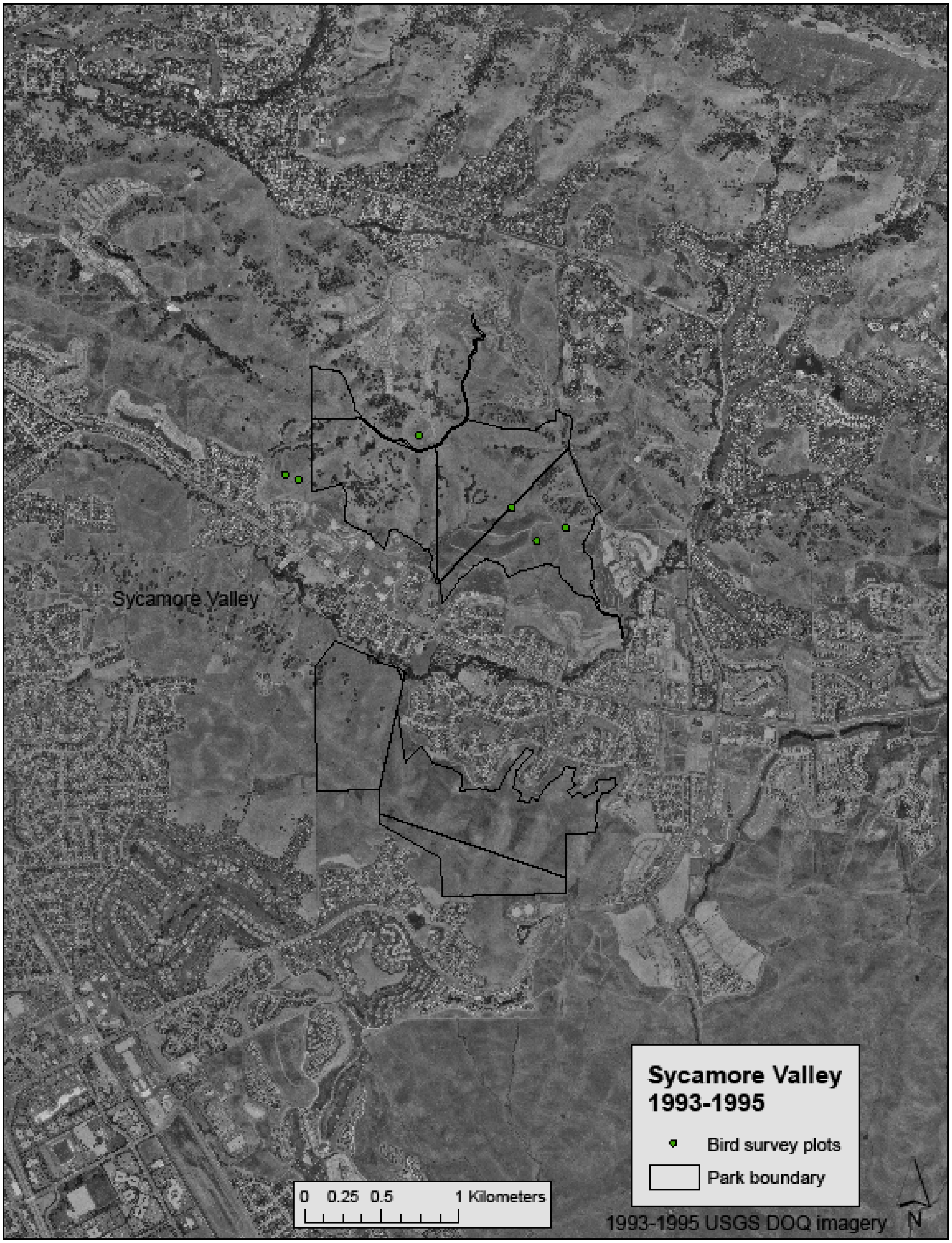
4b) Pleasanton Ridge 2009



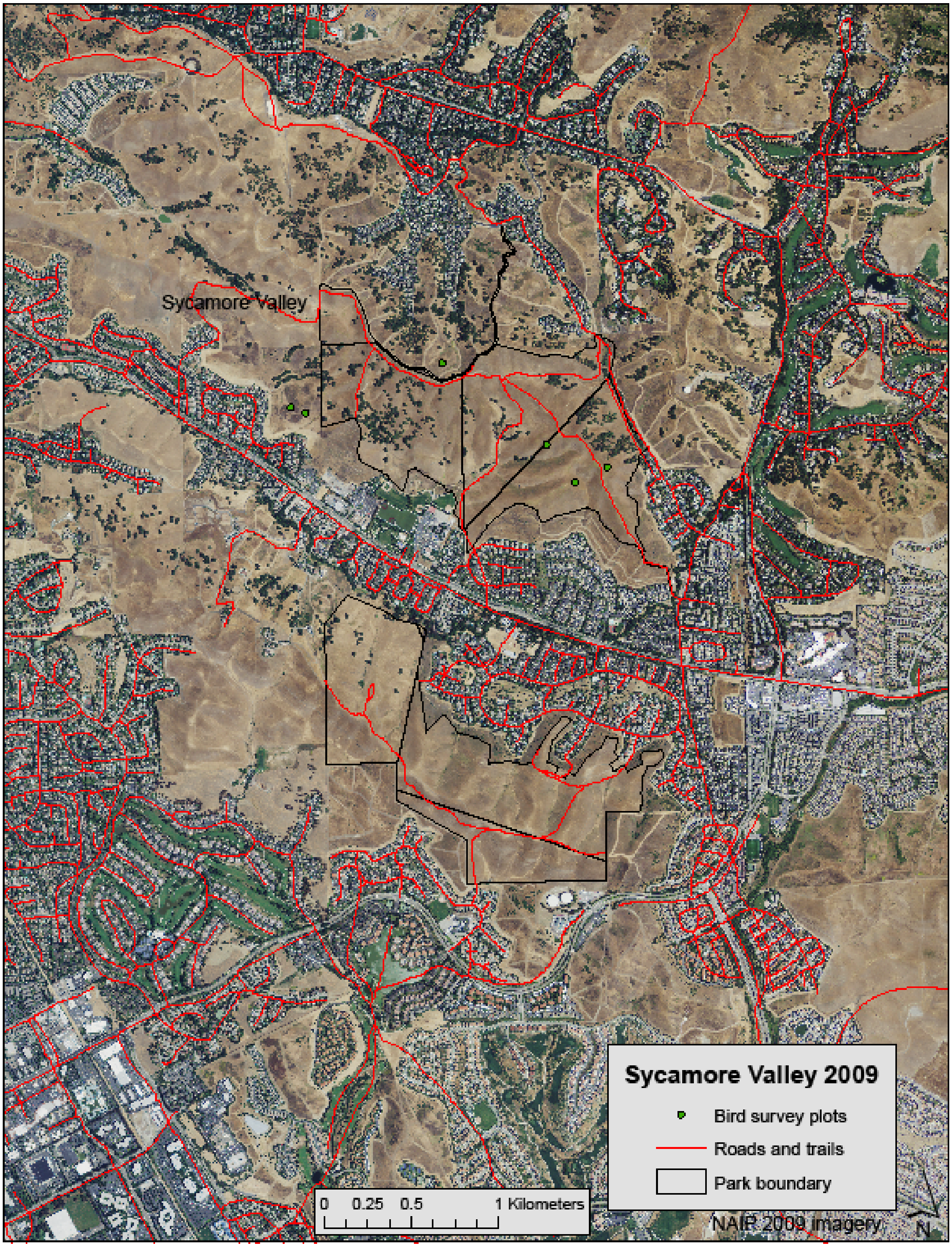
5) Sunol-Ohlone 2009



6a) Sycamore Valley Landscape 1993-1995



6b) Sycamore Valley Landscape 2009



7) Vasco Caves 2009