Assessing Effectiveness of Management Actions on Recovery of CSS Plant Communities Over-Time
Final Report

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Introduction

Historically, over 4,000 acres of the Orange County Central & Coastal Sub region NCCP/HCP Reserve System have been invaded by a number of exotic plant species including several annual grasses, artichoke thistle (*Cynara cardunculus*, CYCA), mustards and other exotic forbs. Invasion has resulted in displacement of many desirable plant species and overall degradation of the reserve's target plant community, coastal sage scrub. To control the spread of CYCA, the Nature Reserve of Orange County (NROC) established a management program involving spot application of herbicide (Fusillade and Round-up) to individual plants. Since 1994, thousands of acres have been treated annually. Additionally, NROC has chemically and mechanically managed other exotic, invasive species such as *Ricinus communis* (castor bean) and *Nicotiana glauca* (tree tobacco). While these weed control efforts reduce target invasive species, whether the native plant community is recovering is not necessarily clear, nor is the long-term sustainability of control efforts.

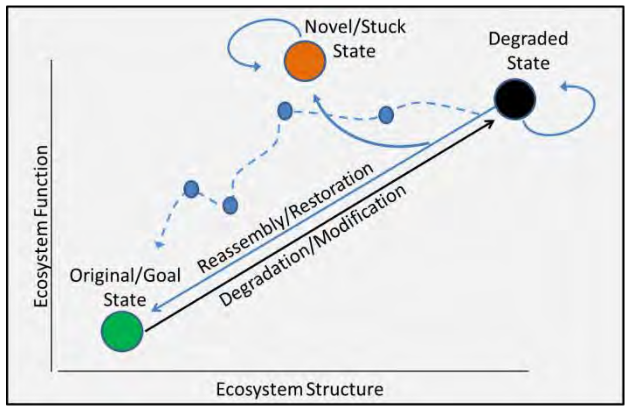


Fig. 1 Recovery from degradation may follow multiple trajectories towards the goal state or an alternative and stuck state. Modified from Bradshaw; Cramer et al. 2008.

Following degradation, recovery of a native system rarely follows the reverse path of degradation (Fig. 1). Instead alternative paths that may or may not have a trajectory towards the original or goal state can occur (Bradshaw; Cramer et al 2008). In highly degraded areas, sites may become stuck in an alternative or novel state. These novel or alternative trajectories and states play a key role in recovery and restoration and may be dependent on management action. A common example of this is the replacement of a targeted exotic species by a new exotic following control of the original target exotic (Denslow & D'Anonio 2005; Flory & Clay 2009). Within the NROC community, there has been concern that such a replacement occurred following the long-term CYCA removal program such that *Brassica nigra* (black mustard, BRNI) replaced CYCA. Assessing recovery after control measures is a powerful tool to aid in restoration decision-making and ultimately guiding future management actions for the reserve system.

<u>Goals and Objectives:</u>

Our objectives were to address a number of critical issues relevant to restoration planning at NROC, including:

- Task 1: Provide an updated description of the vegetation community at 109 sites within the Reserve System previously sampled in 1998, 2007 and 2008.

- Task 2: Teasing apart trends due to management efforts from other trends due to environment or land use change (e.g., grazing cessation in the early 1990s).

- Task 3: Determining thresholds in both native and weed species abundance that will allow for further unassisted recovery.

- Task 4: Identifying areas where sites are “stuck” (i.e., not recovering) and need additional intervention (e.g., seeding, mowing, soil amendments).

By capitalizing on past vegetation monitoring and additional analysis of monitoring data, we hoped to reveal the mechanisms underlying the complex dynamics of vegetation recovery over time and inform restoration decision-making within the NCCP/HCP Reserve System.

Methods

Field Methods

Between February 19th and June 3rd of 2013, we resurveyed 110 sites that had previously been surveyed in 1998, 2007 and 2008. We used a rapid, releve technique, which is a technique equivalent to that used in previous sampling years to allow for seamless comparisons over time. Sites were walked by two observers in straight lines approximately 5 feet apart repeated until the full site was covered. Presence of all species was recorded and percent cover estimated. We developed a ranking system for those species representing less than one percent of the site to better determine the contribution of less common, individual species in 2013. The ranking was as follows: 0.1% = a single individual, 0.2% = less than ten individuals of small species or 2-3 shrub and sub shrub individuals, 0.3% = 11-50 small individuals or less than 4-10 shrub/sub-shrub, 0.4% = 51-100 small individuals or 11-15 shrub/sub-shrub individuals, 0.5% estimated cover of half a percent, 0.8% estimated cover is greater than half a percent and not exceeding one percent. Each site required between 30 minutes to 6 hours depending on richness (need to key out new species)and size of site. On average sites took 1.5 hours to complete surveys. Voucher specimens were collected and unknowns identified at the UC Riverside herbarium.

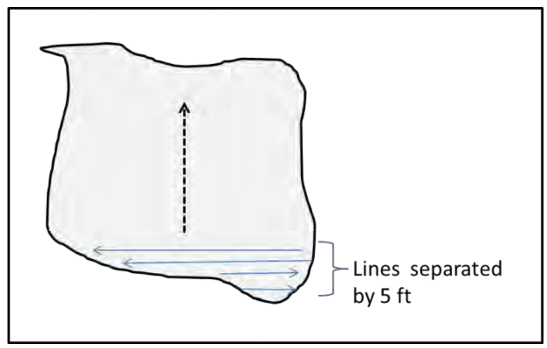


Figure 2. Study survey method using two observers to systematically survey each site and record species cover and richness. Lines separated by 5 ft were walked across each site until the entire site was surveyed

Statistical Analysis

Task 1: Provide an updated description of the vegetation community at 109 sites within the Reserve System previously sampled in 1998, 2007and 2008.

To ensure sampling efforts were adequate to capture the full diversity, we ran species area curves for the coastal polygons as a group. Life form, phynological and genus functional group summaries were compiled to describe the 2013 plant community composition. Total native and exotic plant percent cover was calculated to determine whether the current plant communities were native or exotic dominated. Additionally, we calculated the percent cover of a small number of target exotic species to describe the current state of these particular, problem species. Frequency distribution of cover classes for CYCA, BRNI, native cover and native richness (total number of native species) were summarized for 1998, 2008 and 2013 and presented in graphical form. The 2007 season data were not used in our analyses due to the extreme drought conditions experienced that year. MANOVA were conducted to assess change of CYCA, BRNI, native cover and richness over time. Several variables were not normally distributed, so individual analyses where conducted for each functional group and time frame separately using the non-parametric Kruskal Wallis to ensure accuracy of significance. Results of the MANOVA were confirmed by the Kruskal Wallis analyses so we presented only the MANOVA. For a more fine scale description of community composition, we divided and summarized data by management area

Task 2: Teasing apart trends due to management efforts from other trends due to environment or land use change (e.g., grazing cessation in the early 1990s).

ANOVA, simple regression and multivariate regression analyses were conducted independently for each time period (1998-2008 and 2008-2013) to test how land use history and disturbances impact cover classes and percent cover of CYCA, BRNI and natives. As mentioned above, some data were non-normally distributed so non-parametric analyses were used again here to confirm parametric analyses. Only parametric analyses are presented. Results of multiple regression were similar to simple regressions and ANOVA so multivariate results are primarily presented along with a few simple regressions and ANOVA that relate to questions specifically asked by stakeholders and NROC itself. Path analysis was run using environmental and land use/management history variables along with change in CYCA, BRNI cover and cover classes for each time period (1998-2008 and 2008-2013). We also regressed or ran ANOVAs of exotic grass and land management, environment, and use history and native cover because exotic grasses have become a dominant functional group reserve wide.

Task 3 and 4: Determining thresholds in both native and weed species abundance that will allow for further unassisted recovery; and, identifying areas where sites are "stuck" (i.e., not recovering) and need additional intervention (e.g., seeding, mowing, soil amendments).

Threshold analyses typically use long-term time series data sets. As this vegetation change data set consists of 3 useable time periods and annual variation in plant community is a natural characteristic of Southern California, we relied on analyses of gradients in management rather than time specifically. To determine how CYCA, BRNI and native cover have changed with increasing number of years a site was treated, we regressed these functional groups against the total number of years a site was treated. Additionally, sites were classified into native recovery rate categories based on their rates of change in cover class over time. To do this, we regressed native cover classes by time (survey years) for each site and retained the slope value as a measure of a recovery rate per site. We then used regression and ANOVA of these categories to assess whether thresholds of recovery were due to environment, management or land use history. Change in native cover class was calculated for 1998-2008, 2008-2013 and 1998-2013 and summarized for each polygon. Those polygons that have lost cover or have not had a change in cover were summarized in maps.

Stakeholder outreach:
An outreach component of this project included enlisting stakeholders in guiding a portion of the research questions and facilitating interagency communication and cooperation. In May of 2014, fifteen NROC stakeholders attended a workshop in which preliminary data along with concerns over limitations of the data set were presented and discussed by the group. The Focus was directed toward stakeholder feedback, concerns and questions. Along with the goal of sharing preliminary results, we aimed to facilitate conversation regarding monitoring protocol, a need for standardization across the reserve, how best to share the responsibility for costs of trying new and promising protocols and what the goals for NROC should be into the future.

Results and Discussion

Task 1: Provide an updated description of the vegetation community at 109 sites within the Reserve System previously sampled in 1998, 2007 and 2008.

The NROC weed program that started in collaboration with the Nature Conservancy (TNC) in 1998, has successfully reduced CYCA cover reserve wide and has aided in native species recovery. Diversity across 109 sites was relatively high at 326 species in 2013 and species area curves estimated species saturation around 60-80 sites indicating our study included an adequate sample size to describe the reserve level plant community richness (Fig. 3). Native diversity generally trended higher than exotic diversity; however, exotic plant species percent cover remained higher than native species percent cover in most management areas in 2013 (Fig.4). Twelve plant growth forms were identified with the majority of species being either forb or grass (Table 1) and either strictly perennial or annual (Table 2). Cover class analysis over time indicated that native cover and richness (richness measured as the number of native species per site) are steadily increasing (Fig. 5). Native richness doubled since 1998, however, these results should be interpreted with some caution as there may have been some differences in sampling (time spent per plot, length of the growing season, time of sampling within the growing season) between the sampling years that may indicate higher levels of increase than is actually present. Native richness was not estimated in 14 polygons in the TNC survey. This means that the 1998 richness data may not be completely accurate, adding further justification for cautious interpretation of richness data. Richness classes were defined as: 0 = not present, 1 = 1-3, 2 = 4-10, 3 = 11-20, 4 = 21-30, 5 = 31-40 and 6 > 41. We

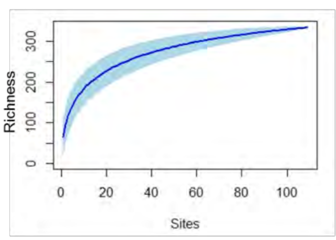


Figure 3. Species area curve for full reserve indicating that species richness leveled out between 60-80 sites samples. Therefore, sampling 110 sites was an adequate sample number to capture reserve richness/diversity.

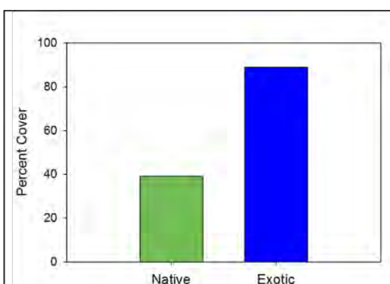


Figure 4. Percent cover of natives versus exotics across all polygons in 2013.

have no doubt that native richness has increased, but feel the magnitude of increase may be suspect.

Table 1. Total richness and the percent of richness represented by plant growth form categories in 2013.

	Richness	Percent
Aquatic	1	< 0.1
Other Monocot	3	0.1
Subshrub	4	1
Vine	2	1
Fern	6	2
Shrub/Tree	6	2
Succulent	9	2
Forb, subshrub	15	4
Tree	17	5
Shrub	33	9
Grass	44	12
Forb	229	62

Table 2. Total richness and the percent of richness represented by plant life form categories in 2013.

	Richness	Percent
Total	369	100
Native	244	66
Exotic	123	33
Unknown	2	0.1
Biennial	3	0.1
Biennial/Perennial	3	1
Annual/Biennial	10	3
Annual/Perennial	15	4
Annual	144	39
Perennial	194	53

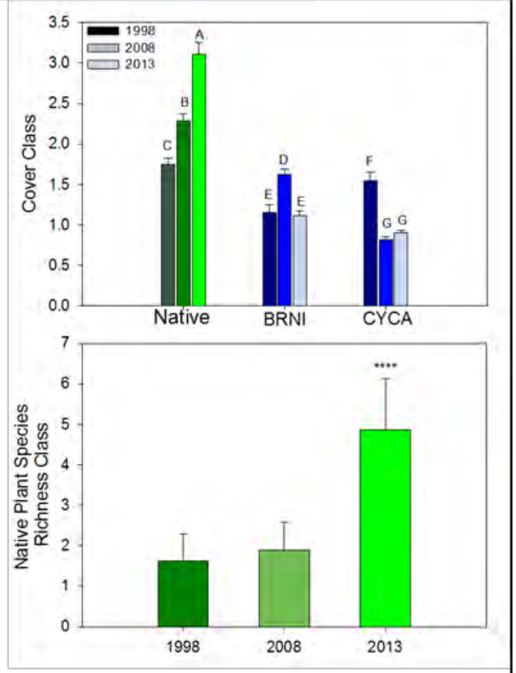


Figure 5. Plant species percent cover (top) and richness (bottom) classes for natives and exotics across all sites. Significance level of p <0.05

Changes in cover class, however, were reliable and indicate that not only is the average cover class of natives increasing, but CYCA has decreased. Cover classes were defined as 0 = not present, 1 = 0.1-10%, 2 = 11-30%, 3 = 31-50% and 4 > 50% of cover. The reduction of CYCA primarily occurred between 1998 and 2008, and has been maintained at that reduced cover since. Cover class of BRNI has not changed between 1998 and 2013, but there was a pulse in BRNI cover and cover class in 2008 (Fig. 5). This pulse did not persist into 2013 even though CYCA cover remained low (Fig. 5 & 6). This suggests that CYCA removal alone did not promote a release in BRNI and that additional factor that were favorable to BRNI in 2008, where not present in 2013. The frequency distribution of CYCA, BRNI and native species and richness also shows the successful shift from higher target exotic dominance to increased frequency of native species cover and richness (Fig. 7). To assess changes in community composition at a finer scale, we looked at percent cover of natives in general and a handful of common species of management interest in 2013. Percent cover data supports the results of cover class data; and also shows unexpected changes in a few natives. Two of the most common shrub species used to indicate whether CSS is healthy, *Artemisia californica* (California sagebrush, ARCA) and *Eriogenum fasciculatum* (California buckwheat, ERFE), have had stable percent cover from 2008 to 2013 and the native purple needle grass, *Stipa pulchra* (STPU) actually declined between 2008 and 2013. Percent cover data were not available for individual species in 1998 so we are unsure how this pattern held prior to 2008. These results indicate that increases in

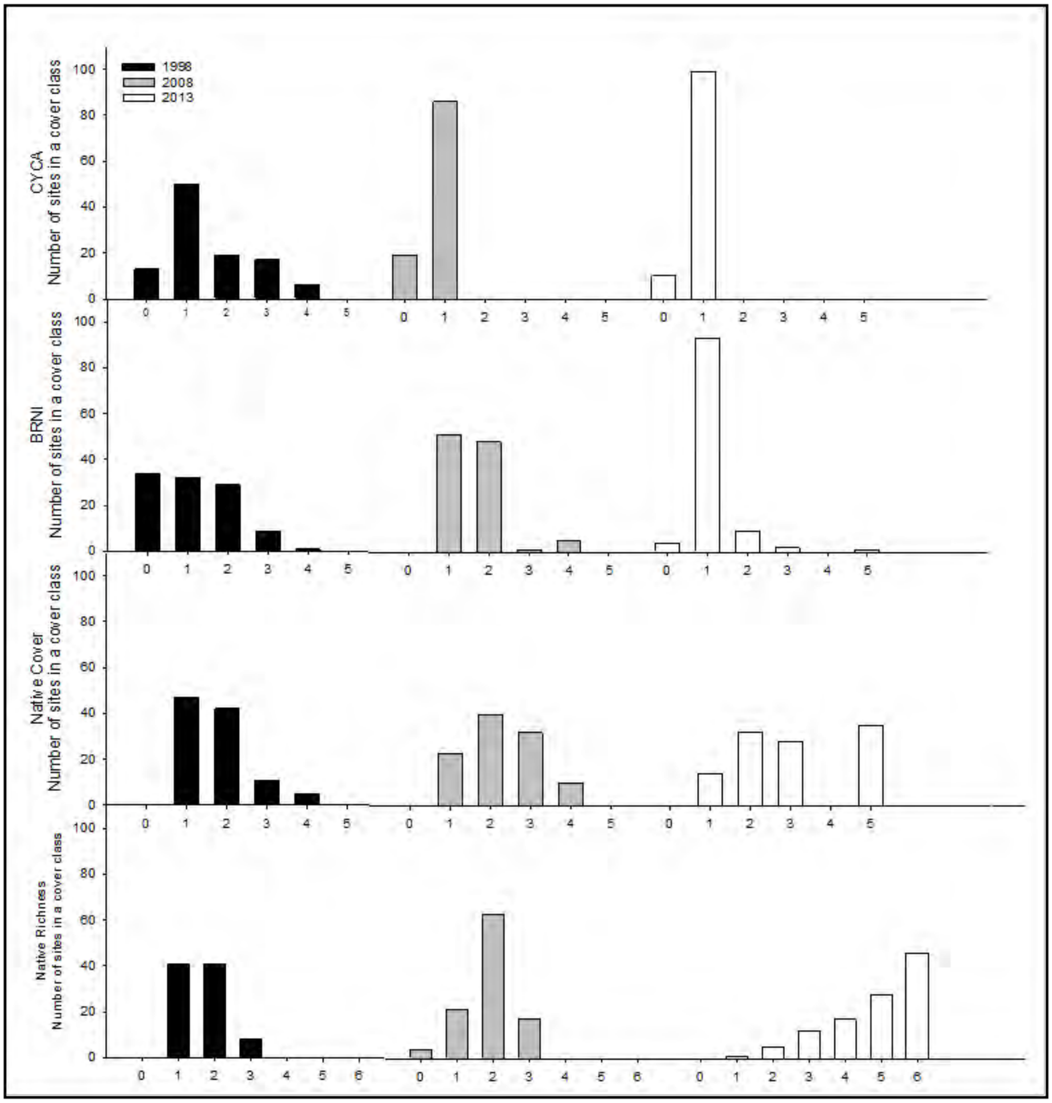


Figure 6. Changes in the frequency of distribution of CYCA, BRNI, native plant species cover and richness between 1998 and 2013.

natives are the result of increased subordinate natives reserve wide, specifically native forb species (Fig. 7). Regardless of this increase in native cover, the plant community continues to be dominated by exotics at many sites, specifically exotic grasses which doubled in percent cover between 2008 and 2013 (Fig. 7). The most common exotic grasses in 2013 were *Bromus diandrus (ripgut brome)*, *Brachypodium distachyon* (false brome), and *Avena fatua* (wild oats).

An unexpected result was that native cover class losses between 1998 and 2008 occurred at the sites with the highest initial native cover classes (1998). We had expected that areas with higher native cover would remain high due to the greater potential for dispersal, an intact seed bank and the presence of perennial species, shrub species in particular. Instead, we found that those sites with greater initial native cover reduced most because they had more potential for larger losses. The greatest increases in native cover class 1998-2008 occurred at sites with the lowest initial native cover classes (Fig. 8), but native cover class of 2013 was not related to initial native cover class.

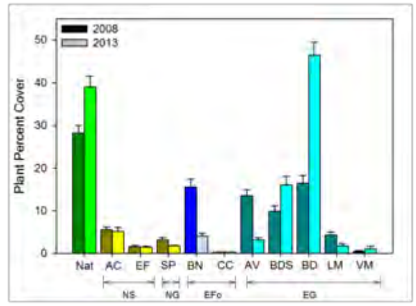


Figure 7. Plant percent cover of natives as a whole, two native shrubs (NS: AC = *Artemisia californica* and EF = *Eriogenum fasciculatum*), one native grass (NG: SP = Stipa Pulchra), the two target exotics (FEo: BN = *Brassica nigra* and CC = *Cynara cardunculus*) and five exotic grasses (EG: AV = *Avena species*, BDS = *Brachypodium distachyon*, BD = *Bromus diandrus*, LM = *Lolium multiflorum* and VM = *Festuca myuros* – formerly *Vulpia* myuros.)

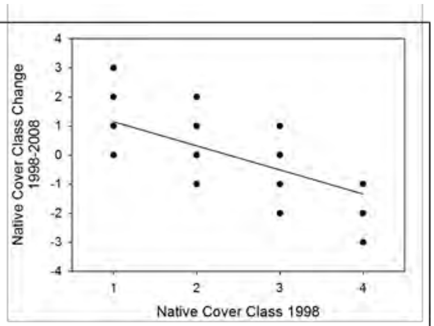


Figure 8. The change in native cover class between 1998 and 2008 is strongly related with initial native cover class in 1998. R2 = 0.367, P<.0001

Changes in cover were not equal across management units, but, exotic cover was far greater than native cover in all management areas on average (Fig. 9). There are, however, sites where native cover is higher than exotic but these are rare. Percent cover of most targeted exotics, CYCA and BRNI and *Nicotiana glauca* (tree tabaco) were low at all sites in 2013 and none reached percent cover levels greater than one percent across any single management areas in 2013 (Table 3). Three species that have recently caused concern include *Brachypodium distachyon* (BRDIS), which ranged in cover from less than one to thirty one percent cover, and *Ehrharta erecta* and *E. calycina* (annual and perennial veldt grass) which remained below one percent cover across all sites (Table 3). While the low cover of *E. calycina* might suggest that it has not reached population sizes of concern, it can rapidly establish and become a dominant. Once it is well established, it can be nearly impossible to eradicate and management methods for this species are in the experimental phases (Bossard et al 2000; www.cal-ipc.org). *E. calycina* has a variable flowering time such that it can flower later in the season and have a short flowering stage making it difficult to identify before seeds are dispersed (Magness et al 1971). Due to the well-known risks this species poses, early identification and eradication efforts are essential regardless of population numbers and size. NROC's primary target

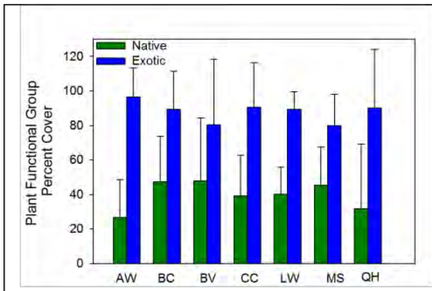


Figure 9. Exotic species percent cover was higher at all management units than native species percent cover. AW = Aliso and Woods Canyons, BC = Bommer Canyon, BV = Butterfly Valley, CC = Crystal Cove State Parke, LW = Laguna Canyon Wilderness, MS = Mule Deer and Serrano Ridge and QH = Quail Hill.

Table 3. Average percent cover of five of the most concerning exotic species including those that have been specifically targeted by weed control divided by management area.

Management Area	Artichoke Thistle (*Cynara cardunculus*)	Black Mustard (*Brassica nigra*)	False Brome (*Brachypodium distachyon*)	Short Podded Mustard (*Hirshfeldia incana*)	Tree Tabaco (*Nicotiana glauca*)	Veld Grass (*Ehrharta calycina*)
Aliso and Wood	0.3	2.0	1.6	1.1	0.1	< 0.01
Bommer	0.4	5.0	28.9	0.5	0.1	< 0.01
Butterfly	0.1	1.0	6.2	0.8	0.1	0.0
Crystal Cove	0.4	12.0	13.8	0.3	0.2	< 0.01
Laguna	0.3	1.0	0.2	0.7	0.1	0.1
Mule Deer/West	0.3	4.0	31.1	1.0	0.1	< 0.01
Quail Hill	0.4	2.0	8.2	0.4	0.1	0.0

exotic, CYCA, on the other hand, appears to be stable at the reduced percent cover obtained by 2008 and therefor may not need to be treated on an annual basis at all sites.

Table 4. Average environmental conditions and range of conditions for each management area.

Management Area	Site Size		Slope		Elevation		AWC		DRST	
	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Aliso Canyon	5.4	0.1-37.0	23	0-59	139	80-244	53.9	6-90	59.9	38-201
Bommer Canyon	13.0	1.9-29.1	21	8-35	661	310-835	63.2	9-168	79.9	8-201
Butterfly Valley	4.7	2.0-9.9	6	0-15	405	360-452	15.1	3-61	136.2	18-201
Crystal Cove	11.7	3.5-40.2	31	19-45	527	210-863	69.2	6-69	76.9	38-201
Laguna Coast	14.2	1.6-33.8	14	0-33	658	440-912	50.4	6-145	164.0	66-201
Mule Deer/Serrano Ridge	7.6	0.2-21.9	15	0-46	477	320-659	56.1	3-140	71.8	12-151
Quail Hill	16.2	7.7-34.6	23	12-45	327	259-412	89.9	7-263	76.4	38-151
Wood Canyon	5.0	1.5-10.2	11	0-29	225	120-364	112.0	11-226	105.1	12-201

Task 2: Teasing apart trends due to management efforts from other trends due to environment or land use change (e.g., grazing cessation in the early 1990s).

The environmental context within which the NROC weed management program is implemented varies greatly in slope, elevation, availability of soil water content (AWC = a measure of soil water that can be available to plants), and distance to restrictive layer (DRST = the depth to an impenetrable soil layer) (Table 4). The steepest slopes generally occurred at Crystal Cove State Park, the highest elevations at Bommer Canyon and Laguna Canyon Wilderness, greatest AWC at Wood Canyon and the deepest DRST at Bommer Canyon. There is large variation both across and within management areas. The largest weed polygons were found at Quail Hill, Laguna Canyon Wilderness, Bommer Canyon and Crystal Cove. Soils within the surveyed

Table 5. Multivariate regression analysis of CYCA, BRNI and native percent cover class change in 1998-2008 and 2008-2013 by environmental, land management and land use history. X within the Models Variables column indicates the variables retained for the best fit models.

Table 5. Multivariate regression analysis of CYCA, BRNI and native percent cover class change in 1998-2008 and 2008-2013 by environmental, land management and land use history context. X with in the Model Variables column indicates the variables retained for the best fit models.

		1998 to 2008				2008-2013			
		Model Variables	Estimate	t-value	p-value	Model Variables	Estimate	t-value	p-value
CYCA	Whole Model: 1998-2008: Adj R^2 = 0.106; 2008-2013:Adj R^2 = 0.082								
	Erosion in 1998	x	-0.3423	-3.032	**0.0031**				
	Grazing in 1998	x	-0.4139	-1.933	**0.0559**				
	Soil type					x	0.127	1.871	0.0642
	Slope (m)					x	0.004	1.617	0.1089
	Fall current year precipitation (mm)					x	0.0614	2.993	**0.0035**
BRNI	Whole Model : 1998-2008: Adj R^2 = 0.131; 2008-2013:Adj R^2 = 0.048								
	Erosion in 1998	x	0.272	2.173	**0.0321**	x	-0.137	-2.014	**0.0466**
	Grazing in 1998	x	0.339	1.258	0.2112				
	Last Year of Fire					x	-0.0001	-1.037	0.3022
	Elevation					x	-0.00007	-0.135	0.8929
	Soil Type	x	-0.282	-1.328	0.1870	x	-0.35	2.077	**0.0403**
	Previous year mean temperature (C)	x	1.454	1.205	0.2311				
	Previous year precipitation (mm)	x	-0.008	-0.835	0.4056				
Native Cover	Whole Model: 1998-2008: Adj R^2 = 0.141; 2008-2013: Adj R^2 = 0.122								
	Last Year of Fire					x	-0.0002	-1.431	0.1553
	Elevation	x	0.0011	2.297	**0.0237**				
	Soil type	x	0.4356	1.969	**0.0516**				
	Current year mean temperature(C)	x	1.563	1.07	0.2872				
	Number of years treated					x	0.2097	2.593	**0.0109**
	Winter current year precipitation (mm)	x	0.0365	2.39	**0.0187**				
	Current year precipitation (mm)					x	-0.1408	-3.588	**0.0005**

polygons were either clay or loam; which represents only a fraction of the soil types found throughout NROC lands.

Multivariate regression of CYCA, BRNI and native plant percent cover class change by environmental conditions, management and land use history were conducted separately for the two time frames of 1998-2008 and 2008-2013 (Table 5). During the first time period, CYCA was most strongly related to erosion and grazing and by fall precipitation 2008-2013 (Table 5; Fig. 10).

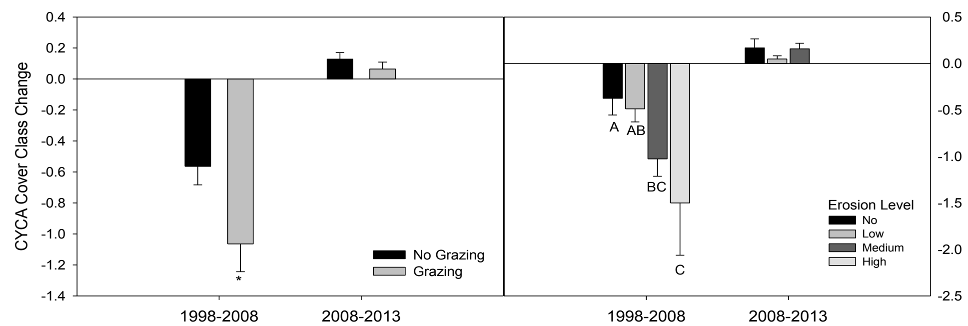


Figure 10. Disturbance history influenced CYCA 1998-2008 in that the greatest decreases in CYCA cover class were at sites with a history of grazing (left) and

The greatest reductions in CYCA cover class occurred at sites with a history of grazing and higher levels of erosion in 1998 following the El Nino event. Initial cover was also greatest at these sites (R^2 = 0.875, P <.0001) suggesting that disturbance allowed for greater levels of invasion. Additionally, weed control was equally effective regardless of whether disturbance had occurred or not, resulting in maintenance of low CYCA cover across all environmental contexts. Similarly, BRNI was associated with grazing and erosion 1998-2008, and also in 2008-2013 (Table 5; Fig. 11). BRNI was not directly controlled as a part of the NROC weed program and no individual managing agency/organization has targeted BRNI outside of active restorations (no

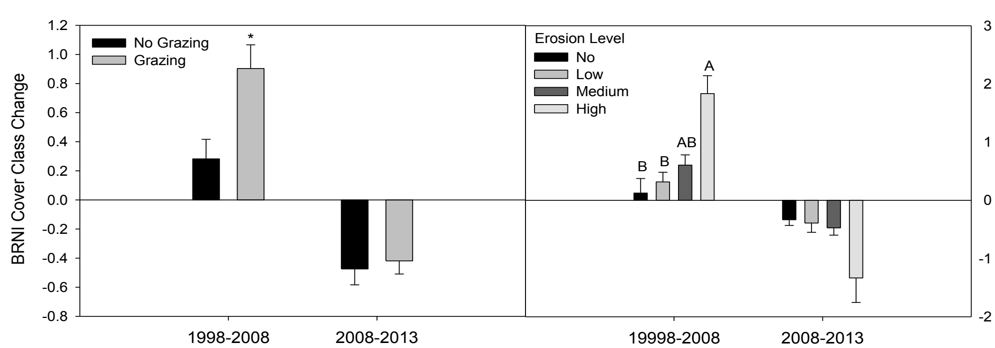


Figure 11. Disturbance history influenced BRNI in that the greatest increases in cover class occurred at sites with a history of grazing (left) or erosion (right) in 1998-2008.

control of BRNI in the weed polygons except one that was removed from our analysis for that reason).

Our study did not test the effectiveness of BRNI control, but such an assessment is advised to aid in future management planning. BRNI was more common in loamy soils than clays and was associated with lower precipitation and higher mean temperatures of the year prior to the survey year, indicating that a lag effect of climate is at play. Most likely BRNI is not as good a competitor as another species that flourishes under higher precipitation and milder temperatures leading to reduced BRNI seed rain. Climate and disturbance along with site availability provided by CYCA removal in disturbed sites facilitated the 1998-2008 BRNI pulse. Given this association with climate, we summarized annual precipitation for each survey year and found 2008 had greater rainfall than did 2013 (Fig. 12) and 2007 was a drought year with the low precipitation and higher temperatures that promote BRNI the following year. Again, indicating that increases in BRNI in 2008 were not an alternative state resulting from CYCA control, but a combination of factors providing a suitable site and climate for BRNI growth.

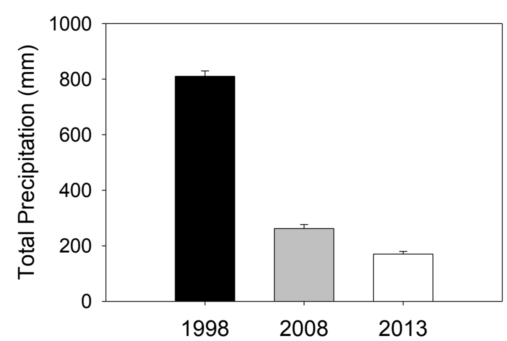


Figure 12. Total annual precipitation for the survey years of 1998,2008 and 2013.

Change in native cover class, however was not related to erosion and grazing. Instead, increases in native cover class were greater at higher elevations and in clay soils 1998-2008. Lower levels of precipitation also facilitated increased native cover class change during the full duration of the study. Natives have previously been found to persist under harsher moisture regimes and the natives of CSS are adapted to the unreliable precipitation of a semi-arid environment (Kirkpatrick & Hutchinson 1977; DeSimone & Zedler 1999). In 2008-2013, sites that had experienced more years for herbicide treatment for CYCA were those that experienced greater increases in native cover class regardless of soil texture or elevation (Table 5). It appears that natives were limited to higher elevations and clay soils initially due to competition with CYCA and the weed program has helped to reduce this limitation.

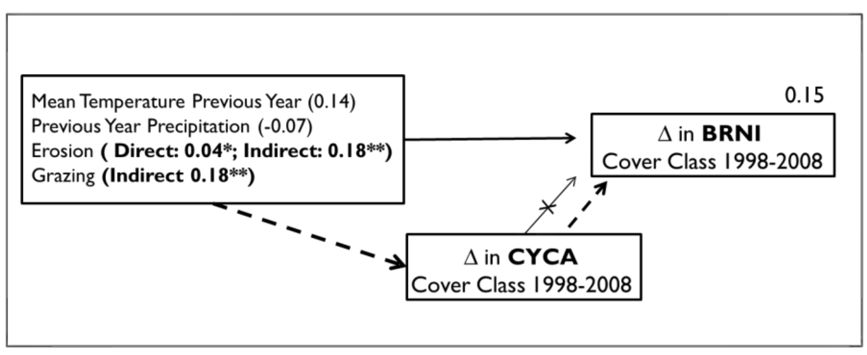


Figure 13. 1998-2008 path analysis on BRNI cover class included all environmental, management and historic land use variables initially. The best model indicated CYCA removal may have indirectly aided in the 2008 BRNI pulse, but only where disturbance was a factor. Black lines indicate significant, direct relationships, grey lines the lack of a direct relationship between CYCA and BRNI and doted lines represent an indirect relationship. Bollen Stine P = 0.404, RMEAS = 0, p = 0.478

Path anaysis was used to determine whether CYCA removal directly affected natives and BRNI and was responsible for the 1998-2008 pulse of BRNI within the environmental context (environment, management history and land use history). We ran path analysis that incorporated all the previous variables used in the multivariate analysis and added the effects of CYCA on BRNI (direct and indirect) and the effects of CYCA and BRNI on native species cover (direct and indirect) using cover class in 1998-2008 and actual cover 2008-2013. The use of actual percent cover in 2008-2013 analysis allowed for more accurate analysis that was not possible in 1998-2008 due to a lack of percent cover data of individual species in 1998. BRNI was indirectly released by the removal of CYCA 1998-2008, but only where there was a history of disturbance (grazing and erosion). At sites where erosion and grazing were not present, change in CYCA cover class was not related to change in BRNI cover class (fig. 13). The previously mentioned land manager concern that control of CYCA led to increased BRNI, therefor, was only supported for sites with an erosion and grazing history. BRNI increases were, therefor, driven by the presence of open disturbed sites and less favorable climatic conditions for plant growth the previous year. Erosion itself provided an added direct facilitation of BRNI (P = 0.418, Bollen P = 0.404, CFI = 1 RMEAS = 0, p = 0.478; Fig. 13). By the time frame of 2008-2013, effects of CYCA removal were no longer present on BRNI cover. Instead, clay soils were associated with greater losses of BRNI cover (Bollen P = 0.129, RMEAS = 0, p = 1.0; Fig. 14)

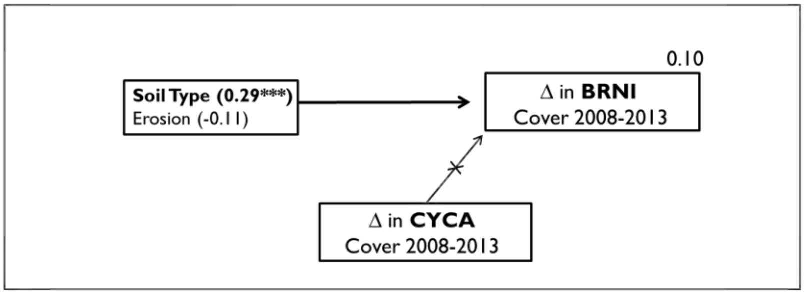


Figure 14. 2008-2013 path analysis on BRNI cover class included all environmental, management and historic land use variables initially, and the best model indicates CYCA removal no longer impacts BRNI and that loam soils support greater BRNI. Black lines indicate significant direct relationships and grey lines the lack of direct a relationship between CYCA and BRNI. Bollen Stine P = 0.129, RMEAS = 0, p = 1.0.

Path analysis of 1998-2008 native cover class data showed that increases in both CYCA and BRNI were associated with reduction of native cover class; but, the positive association of natives with higher elevation and lower precipitation had a stronger influence on native cover class (P = 0, Bollen p = 0.294, CFI = 1 RMEAS = 0, p = 1.0; Fig. 15) than did changes in CYCA or BRNI alone. Analysis of 2008-2013 data indicated that changes in CYCA and BRNI cover no longer influenced changes in native cover; and, the increasing number of years a

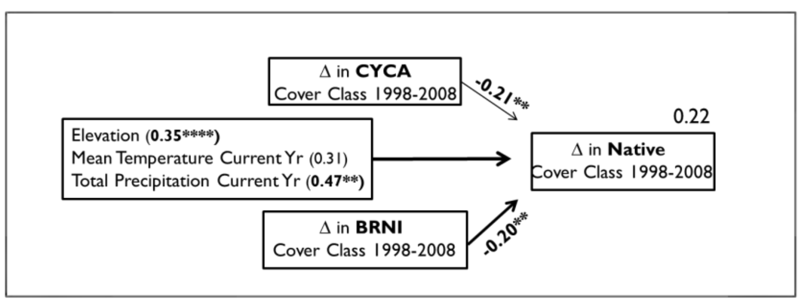


Figure 15. 1998-2008 path analysis of native cover class included all environmental, management, historic land use variables initially and the target exotic species CYCA and BRNI. The best model indicates both CYCA and BRNI have a negative influence on native cover class change, but the environment was slightly more influential. Black lines indicate significant direct relationships and grey lines the lack of direct a relationship between CYCA and BRNI and doted lines represent an indirect relationship. Bollen Stine P = 0.294, RMEAS = 0, p = 1.0

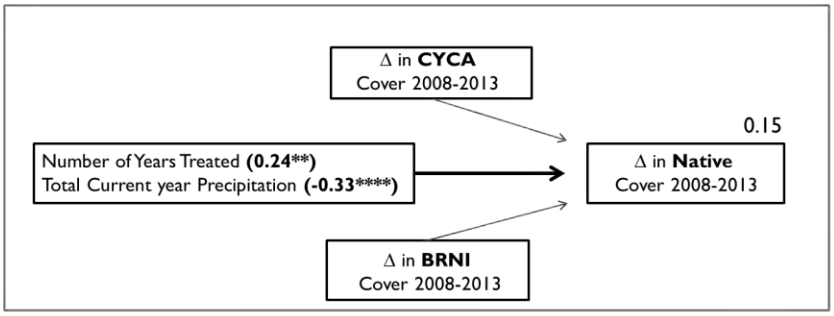


Figure 16. 2008-2013 path analysis of native cover class included all environmental, management, historic land use variables initially and the target exotic species CYCA and BRNI. The best model indicated that CYCA and BRNI no longer impact native percent cover reserve wide and that lower precipitation and a longer history of CYCA control facilitated greater increases in native cover. Black lines indicate significant direct relationships and grey lines the lack of direct a relationship between CYCA and BRNI and doted lines represent an indirect relationship. Bollen Stine P = 0.180, RMEAS = 0, p = 1.0

given site had been treated for CYCA along with lower precipitation facilitated increases in native cover (P = 1.0, Bollen p = 0.180, CFI = 1 RMEAS =0, p = 1.0; Fig 16) just as the previous multiple regression without exotic plant influences indicated. Percent cover of CYCA was maintained at a reduced level and BRNI percent cover had been substantially reduced between 2008 and 2013 resulting in a level of competition natives could tolerate. By 2013 other factors such as precipitation drove native species percent cover changes.

Stakeholders of NROC were interested in how particular native species and exotic species other than the targeted exotic species of this project were doing and where across the landscape they were either flourishing or in decline. The five most common natives in 2013 were ARCA, *Baccharis pilularis* (coyote bush), *Rhus integrifolia* (lemonade berry), *Malosma laurina* (laurel sumac) and ERFA. Shrubs were by far more common than any other native species, and, in general, were associated with higher elevation and temperature of current and previous seasons, grazing, as well as, less recent fires. Exotic forbs, native grasses and exotic grasses tended to be less prone to a particular climate, though native grasses were generally associated with steeper slopes and clay soils (Fig. 17). The focal species, S. pulchra, showed no significant associations with any environmental conditions. Subordinate native species within NROC CSS lands are mainly native forb species, the most common of which were *Ambrosia psilostachya* (western ragweed), *Gnaphalium californicum* (ladies' tobacco), *Phacelia ramosissoma* (branching phacelia), *Amsinckia menziesii* (menzie's fiddleneck) and *Deinandra fasciculata* (clustered tarweed). There was no one environmental context associated with these subordinate, native forbs, but there was a trend towards less precipitation in both current and previous season. Most CSS natives are known

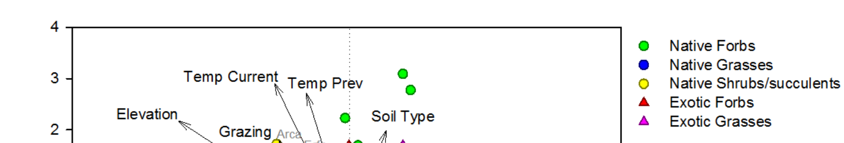


Figure 17. Individual species responses to environment, management and land use history variables from 2013. DCA 1 explained 16% and DCA2 11% of variance in native species percent cover.

to respond positively to increases in water availability (Clark et al 2005). This opposite response within the context of the plant community suggests these species are commonly limited by competition under high rainfall years supporting the idea that harsher environmental conditions are acting as refugia for natives (Desimone & Zedler 1999; Dickens et al *In Review*).

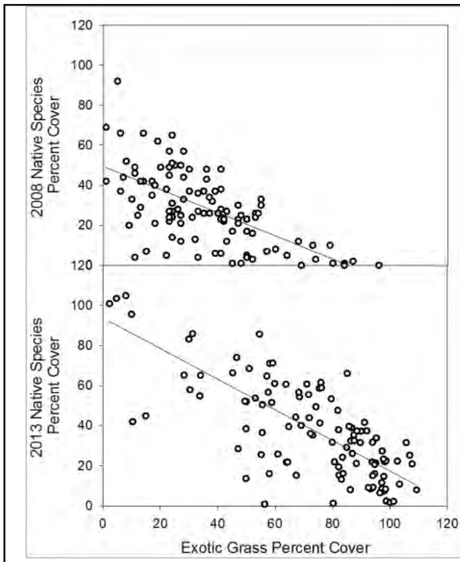


Figure 18. Exotic grass percent cover was negatively related to native species percent cover in both 2008 (R^2 = 0.392)and 2013. P<.0001

Given that environmental, land management and land use history and CYCA and BRNI cover class could only explain a limited amount of variation in native cover class change and that exotic grasses doubled between 2008-2013, we regressed 2008 and 2013 native percent cover by exotic grass cover of the same years. Exotic grass cover was negatively related to native cover in both years explaining 39 percent variation in 2008 and 56 percent 2013 (Fig. 18). Exotic grasses can negatively impact natives through preemptive water use, particularly in upper soil layers and by reducing water infiltration into deeper rooting zones where many native perennials obtain a larger proportion of their water later into the season (Seabloom et al 2003; Wood et al. 2006). Exotic grasses also reduce the availability of extractable soil nitrogen, a commonly limiting nutrient for plants (Dickens et al. 2013; Dickens & Allen 2014). Exotic grasses had a substantial impact on native species recovery in this study and, while difficult to control, will need to be addressed in some manor to allow for further native recovery.

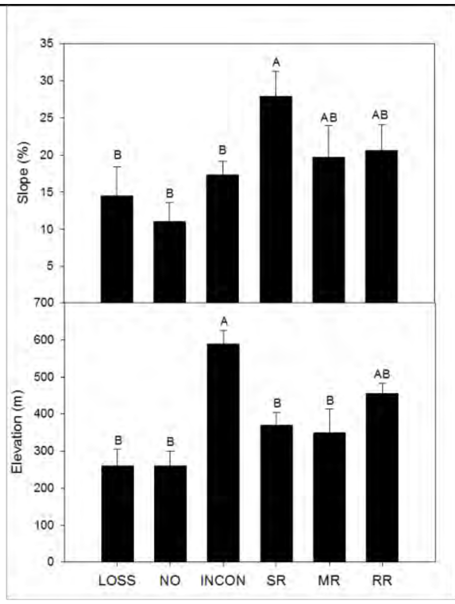


Figure 19. Analysis of variance of slope (R^2 = 0.136) and elevation (R^2 = 0.214) by native plant recovery rates, LOSS = overall loss, NO = no change, SR = slow recovery, MR = moderate recovery and RR = rapid recovery rates. P<.0001.

Task 3 and 4: Determining thresholds in both native and weed species abundance that will allow for further unassisted recovery; and, identifying areas where sites are "stuck" (i.e., not recovering) and need additional intervention (e.g., seeding, mowing, soil amendments)

Clear thresholds were not present in this study, however, we were able to identify rates of recovery that were associated with particular environmental variables. The greatest native recovery rates occurred under environmental conditions already found to support CSS and CSS recovery (Kirkpatrick & Hutchinson 1977; DeSimone & Zedler 1999). Higher percent slope was associated with native recovery at all three positive recovery rates (Fig. 19); whereas, high elevation was associated with the most rapid native recovery rate and an inconsistent recovery rate (may increase one year and decrease another but overall cover class increased; Fig. 19). Greater rates of native cover class losses occurred where exotic grass percent cover was greatest in both 2008 and 2013 (Fig. 20) further supporting competition with exotic grasses as a key limitation to native plant recovery.

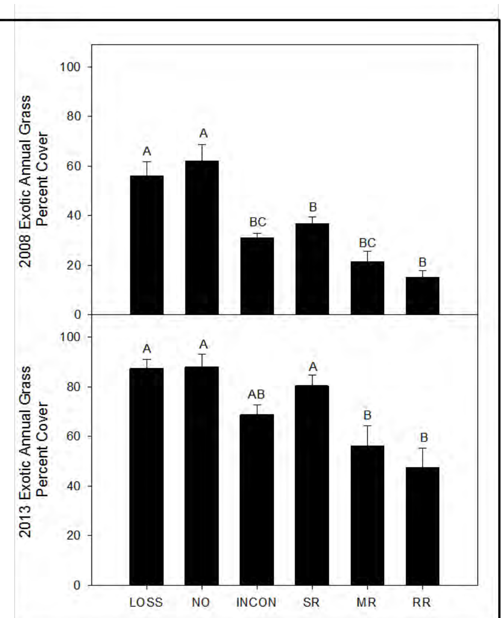


Figure 20. Analysis of variance of exotic, annual grass percent cover in 2008 (R^2 = 0.456) and 2013 (R^2 = 0.221) by native plant recovery rates, LOSS = overall loss, NO = no change, SR = slow recovery, MR = moderate recovery and RR = rapid recovery rates. P<.0001.

Identification of stuck sites can be challenging in systems of harsh or highly variable climates such as Southern California. Due to high annual and inter-annual variation in precipitation alone, the annual plant community composition can vary greatly. Given these constraints, identification of sites that have lost native plant cover or have not had increases in cover and cover classes during the period of the weed control program were used as a measure of whether a site was "stuck". Eleven to fourteen percent of sites lost native cover in each time frame and across the duration of the study (Table 6). Thirty two to thirty seven percent of sites were stuck (not changing in native cover) during the two individual time frames of 1998-2008 and 2008-2013, and 20 percent were stuck over the full duration of the study (1998-2013) (Table 6). Sites that either lost native cover or were stuck, had four features in common. They were located at lower elevations, had greater exotic grass cover, had experienced fewer years of CYCA control and more recent fires.

Table 6. Number of sites having either had losses, no change or increases in native plant species percent cover in 1998-2008, 2008-2013 and the full duration of the study 1998-2013.

Time Frame	Lost Cover	Stuck	Increased Cover
1998-2008	15	40	54
2008-2013	14	35	60
1998-2013	12	21	76

Stakeholder outreach:

On May 13, 2014, a workshop was held with key stakeholders to review preliminary results, discuss constraints of the data, changes to and new analyses to consider and facilitate conversation between stakeholders regarding goals and future directions of NROC. Fifteen stakeholders and NROC employees were in attendance (Milan Mitrovich, James Sulentich ,-NROC; William Miller-USFWS; Christine Beck-CDFW; Lana Nguyen (Meade)-Crystal Cove; Jutta Burger, Megan Lulow and Yi-Chin Fang-Irvine Ranch Conservancy; Travis Huxman, Sarah Kimball, Mike Bell – UC Irvine; Carl Bell – UC Extension Southern California; Zachary Principie – The Nature Conservancy; Margot Griswold and Travis Brooks Land IQ) were present. Topics discussed included: current analysis of the data set and potential expansions, defining recovering, defining goals/success, how to define "stuck sites" and how to measure progress.

During discussions of goals it was recognized that goals in restoration are vague and lack a means of measuring progress towards a desired trajectory or end goal (Hobbs and Norton

1996). Without this qualitative definition, it is thought restorations will not proceed as efficiently as they could (Hobbs and Norton 1996; Palmer 2005). However, NROC stakeholders bring a differing and important perspective towards goal definition. Too detailed a goal may confine managers and inhibit the use of adaptive management practices. It was agreed upon by the group that a goal of increased native cover and decreased exotic cover along with learning from management efforts to increase restoration efficiency would be more appropriate for the needs of NROC lands. A substantial barrier to adaptive management, in general, is often a lack of institutional support and fear of failure. Institutions that view adaptive management as important and embrace the inherit risks associated with trying new approaches in order to learn, provide a greater opportunity for enhancement of management strategies over time (Halbert 1993; Lassard 1998; Johnson 1999; Sabine et al 2004; Allen & Curtis 2005). NROC and its stakeholders have a unique collaborative environment that can provide such institutional and partner support.

We discussed concerns over limitations in the data such as too few weather stations to capture variation across the landscape, unclear grazing histories, that the polygons within the study do not represent all environmental conditions present on NROC lands (i.e. only clay and loam soils) and the tradeoff associated with using percent cover versus cover class data. It was decided that modeled climate data from PRISM would be a better indicator of precipitation and temperature effects on plant community composition than use of the limited weather station data. More detailed information regarding the grazing and erosion variables were obtained from the original project lead, Trish Smith of TNC, and land managers. Sampling techniques are consistently reviewed for effectiveness and cost efficiency/logistics and, at this workshop, the validity of the releve method was discussed. The releve method used in this study was conducted at two quantitative scales: cover class (1998, 2007, 2008, 2013) and actual percent cover (2007, 2008, 2013). Given the variation in plant community composition relationships with the environment and management histories, care must be used when interpreting results to avoid basing management on a single, potentially not average year. A coarse grain method such as releve using cover classes is less sensitive to annual variation and would identify real patterns and changes useful to management planning. Given how labor intensive actual percent cover is and potential differences in observer estimates, percent cover data, while informative, may not be a cost effective approach for regular monitoring. The stakeholders of NROC agreed that releve is a good method for mapping, identifying threats and prioritizing sites for future management and experiments.

When considering effects of land use legacies, constraints of the current data set became clear. Information regarding grazing stocking rates, species grazed, number of years grazed, number of years under agriculture and crop types are not readily available. These human activities have shown to impart long-term legacies on soils and vegetation that can inhibit restoration efforts (Díaz et al 2007; Standish et al 2007; Cramer et al. 2008). It was proposed by stakeholders that analysis using modeling of grazing and agriculture be conducted based on the distribution of environmental conditions know to be a result of land use and the limited data available on historic land use. Such models may aid in identifying which of the “stuck” sites may be resistant to restoration due to land use legacies that must be remediated for prior to restoration and would be conducted by NROC in the future it the method proves sound.

Conclusion and Recommendations

Overall native cover and cover class increases were associated with both the environmental context (environment, management and land use history) and changes in CYCA and BRNI cover and cover class. Fifteen years of weed control reduced CYCA and moved many sites onto a trajectory of restoration. Several sites remain stuck and thus will require active management in order for native recovery to begin. The context within which natives recover is important to predicting slow versus rapid recovery. Higher elevation sites with less recent disturbance and lower levels of CYCA, BRNI and exotic grass competition are more likely to recover and at a more rapid pace. No thresholds in management were found in this study; which, may be the result of sampling years being too far apart during years of CYCA control. It is likely we missed this point in time and the invasion of exotic grasses has led to an alternative and stable state in many sites preventing reversal of previously crossed thresholds under current management plans.

Disturbances such as grazing and erosion were associated with greater initial invasion of CYCA and therefor also the greatest reduction of CYCA following weed control. Disturbance was also, in part, responsible for the BRNI pulse event of 1998-2008. Removal of CYCA alone was not the cause of the BRNI pulse, the combination of available disturbed sites and favorable precipitation in 2008 was. Areas with a history of disturbance and new disturbance should be monitored as they are more susceptible to both CYCA and BRNI invasions. Control of CYCA is effective regardless of environment or land use history. Because CYCA and BRNI responds to disturbance, minimizing soil disturbance in areas adjacent to CYCA and BRNI populations and relatively intact CSS is advisable whenever possible (limiting walking and social trail creation during treatments). Areas with a history of erosion and grazing should be monitored more regularly as they are at higher risk of invasion. With CYCA successfully reduced to below 4% in any one weed polygon, NROC may benefit from redefining its focus towards restoration and weed control together. Instead of annual treatment of CYCA, consider biannual treatments or less for sites with no new propagule inputs and more regular (annual) control at sites adjacent to or having large CYCA populations and/or that experience regular disturbances to the soils. Remaining annual funds then could be re-allocated to increased restoration acres to promote long-term weed reduction. BRNI has persisted at percent cover similar to 1998 and is capable of pulse events under favorable precipitation conditions in a season following low precipitation and high temperature. In years following a season of low precipitation and high temperatures, greater effort may be needed to control BRNI particularly in areas that have experienced disturbance (erosion and grazing). Many exotic plant species are known to flourish in disturbed conditions (Foster et al. 2003) and BRNI is no exception. NROC has not actively controlled BRNI in any weed polygons that have not been converted to active restorations. At current BRNI percent cover across the reserve, natives are not inhibited by BRNI. But at the site level, there are sites with percent cover of BRNI capable of inhibiting native. Future experiments determining at what percent cover of BRNI natives are no longer influenced would aid in management prioritization.

Clearly, CYCA and BRNI were not the only exotics inhibiting native plant species recovery. Exotic annual grasses are increasing, especially BRDI and BRNIS and can prevent native plant establishment (D'Antonio et al. 1998; Dickens et al 2013; Kimball et al 2013). Exotic grasses had a strong negative relationship with natives, more so than other exotics. Restoration studies in CSS and grasslands have found that many native species are not able to establish unless the surrounding area is cleared of exotic grasses (DeSimone & Zedler 1980; Eliason & Allen 1997; Cox & Allen 2008). Natives struggle in wetter years which is when many exotics flourishes (exotic grasses), so weed control efforts, particularly around younger CSS stands/plants that are more susceptible to competition, will need to be greater in wetter years (Daehler 2003; Clark et al 2005). There currently is no reliable removal method for exotic annual grasses covering large areas of land. For this reason, the control of exotic grasses has been given low priority status. Logistically speaking, such large area controls may not be feasible, however, prioritizing smaller areas of exotic grass control at CSS edges or between adjacent CSS patches may allow establishment of CSS where seedbanks are most likely to persist and continued dispersal is guaranteed. It would also be advised to include a lengthy site preparation period of 1-2 years to deplete grass and other exotic seedbanks prior to seeding natives. The goal should be to manage for resilience in areas of intact and fairly intact CSS and grasslands; and, to work towards restoration in those that are heavily invaded. Managing towards resilience reduces the potential for threshold crossing and development of novel states such as the exotic annual grasslands managers now contend with (Perrings and Walker 1997; Muradian 2001).

Thresholds are difficult to identify due to the complexity of interactions that occur at the ecosystem level. Multiple thresholds often act at once and at different temporal and spatial scales and thresholds may not be unidirectional (Muradian 2001; Briske et al 2006, Goffman et al 2006). Human actions are often the cause of a threshold crossing, grazing, agriculture and altered fire regimes are just a few examples (Goffman et al 2006). Results of threshold analyses have been variable with some studies finding clear thresholds and others finding none at all (Drinnan 2005; Lindenmayer et al 2005; Lindenmayer & Luck 2005; Radford et al 2005). We did not find thresholds beyond which passive restoration would progress without further CYCA control. CYCA has been stable at a reduced cover for five

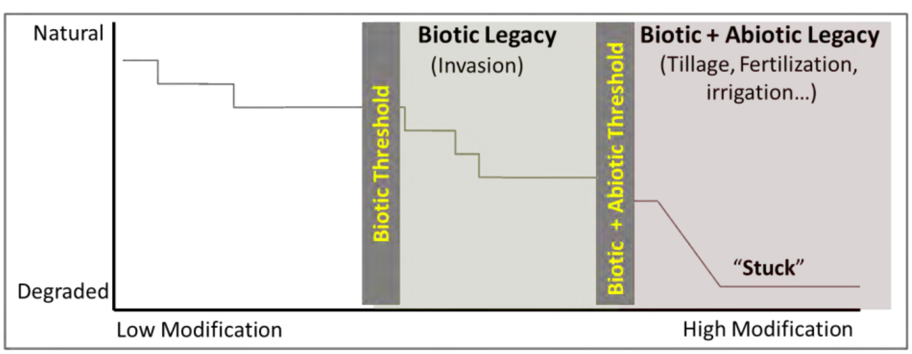


Figure 21. Thresholds can be crosses in phases and fit into two types of thresholds, biotic and abiotic. Crossing both thresholds can lead to stuck sites and a need for active intervention. Modified from Cramer et al 2008.

years and the majority of cover reduction occurred before 2008. If a threshold was present, it was likely crossed within the 1998-2008 timeframe for which there is no data. That native recovery is still limited, is a reflection that CYCA control alone cannot reverse the historic threshold crossing. Exotic grasses and their plant-soil feedbacks along with land use history such as agriculture, likely contribute to this current limitation. The thresholds that separate the native state from the invaded state of these sites were crossed long ago and likely are not the same for reversal of invasion. When both biotic and abiotic thresholds have been crossed, recovery becomes more difficult. The environmental context on which native plants rely has been modified and natives find themselves in competition with a new species (Cramer et al 2008; fig. 21). In the case of NROC lands, the threshold between the dominance of the native plant community to the alternative invaded state is likely both a biotic and, due to a long history of invasion, an abiotic threshold. The stable presence of exotic species represents the biotic threshold and their feedbacks to the soils have likely altered soil conditions representing the crossing of an abiotic threshold. The invasion of exotics such as CYCA, BRNI and exotic grasses alter microbial communities, soil nutrients and moisture availability and hydrological processes (D' Antonio & Vitousek 1992; Seabloom et al 2003; Dickens et al 2013). Such invaded induced changes to ecosystem structure and function can act as positive feedbacks that promote persistence of the alternative state (Suding et al 2004), exotic annual grasslands in the case of NROC lands. Greater changes to the biotic environment (plant community) and maybe even abiotic conditions (soils) are needed to remove the exotic plant feedbacks and move the system towards a recovery threshold. The native plant community is not as likely to recover without substantial assistance if soil nutrients and water availability have been altered (Cramer et al 2008).

Our study raises several questions with practical implications. Is there a threshold of exotic grass cover that would allow for passive native recovery and if so what is it? What methods are most effective in introducing CSS in areas highly invaded by exotic grasses? If exotic grasses are a main limiting factor for recovery at the more degraded sites and we lack effective means of controlling exotic grasses at larger scales, can some of these sites be accepted as they are? Are such alternative states on NROC lands providing functions similar to CSS and native grasslands (i.e. California gnatcatcher nesting, infrequent fires, lower erosion, habitat for herps, insects and other wildlife, raptor foraging and self-sustaining post fire recovery)? Which states are not? Assessment of the current functional values of these stuck sites may aid in prioritization of sites for active restoration, weed management only or sites that will have to remain as they are until new methods are developed. It would additionally be interesting to compare the updated vegetation descriptions within this report with the new Reserve vegetation map complied as part of another LAG.

Our models, except regression of exotic grass by native cover, had low explanatory power indicating that there are other factors that influence native cover that we did not capture. One thought is that an agricultural history reduced recovery capacity and rates. Many stuck sites occur at lower elevations. The greatest intensities of grazing and agriculture occurred at lower elevations which were susceptible to invasion and least likely to have native cover. Agricultural histories have been found to inhibit native recovery due to the high levels of disturbance and resultant less favorable soil conditions of altered nutrients and mixed upper soil horizons (Aronson et al 2003, Klimek et al. 2007). Agriculture data are not currently available in a single, useable database, but such data would be valuable for testing whether agricultural legacies limit restoration of NROC lands.

Literature Cited

Allen, C., A. Curtis. 2005. Nipped in the Bud: Why regional scale adaptive management is not blooming. Environmental Management 36: 414-425.

Aronson, J., C. Floret, E. Le Floc'h, C. Ovalle, R. Pontanier. 1993. Restorations and rehabilitation of degraded ecosystems in arid and semi-arid lands. Restoration Ecology 1:8-17.

Bossard C.C., J.M. Randall, M.C. Hoshovsky. 2000. Invasive Plants of California Wildlands. University of California Press, Berkeley, CA. pages 164-170.

Briske, D.D., S.D. Fuhlendorg, F.E. Smeins. 2006. A unified framework for assessment and application of thresholds. Rangeland Ecology and Management 59: 225-236.

Clark, P.J., P.K. Latz, D.E. Albrecht. 2005. Long-term changes in semi-arid vegetation: Invasion of an exotic perennial grass has larger effects than rainfall variability. Journal of Vegetation Science 16:237-248.

Cox, R.D., E.B. Allen. 2008. Composition of soil seed banks in southern California coastal sage scrub and adjacent exotic grassland. Plant Ecology 198:37-46.

Cramer, V.A., R.J. Hobbs, R.J. Standish (2008) What's new about old fields? Land abandonment and ecosystem assembly. Trends in Ecology and Evolution 23: 104-112.

Daehler, C.C. 2003. Performance comparisons of co-occurring native and alien invasive plants: Implications for conservation and restoration. Annual Review of Ecology Evolution and Systematics. 34:183-211.

D'Antonio, C.M., P.M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle and global change. Annual Review of Ecological and Systemics. 23: 63-87.

D'Antonio, C.M., F.L. Hughes, M. Mack, D Hitchcock, P.M. Vitousek. 1998. The response of native species to removal of invasive exotic grasses in a seasonally dry Hawaiian woodland. Journal of Vegetation Science. 9:699-712.

Denslow, J.S., C.M. D'Antonio. 2005. After biocontrol: assessing indirect effects of insect release. Biological Control 35:307-318.

DeSimone, S.A., P.H. Zedler. 1999. Shrub seedling recruitment in unburned Californian coastal sage scrub and adjacent grassland. Ecology 88:2018-2032. Días et al (2007) Global Change Biology.

Dickens, S.J.M., E.B. Allen, 2014. Soil nitrogen cycling is resilient to invasive annuals following restoration of coastal sage scrub. Journal of Arid Environments 110:12-18.

Dickens, S.J.M., S. Mangla, K.L. Preston, K.N. Suding. Embracing variability: environmental dependence and indirect effects in ecological restoration. Restoration Ecology. *In Review.*

Dickens, S.J.M., E.B. Allen, L.S. Santiago, D. Crowley. 2013. Exotic annuals reduce soil heterogeneity in coastal sage scrub soil chemical and biological characteristics. Soil Biology and Biochemistry 58:70-81.

Drinnan, I.N. 2005. The search for fragmentation thresholds in a southern Sydney Suburb. Biological Conservation 124: 339-349.

Eliason, S.A., E.B. Allen. 1997. Exotic grass competition in suppressing native shrubland reestablishment. Restoration Ecology 5:245-255.

Flory, S.L., K. Clay. 2009. Invasive plant removal method determines native plant community responses. Journal of Applied Ecology 46:434-442.Halbert, C.L. (1993) How adaptive is

adaptive management? Implementing adaptive management in Washington State and British Columbia. Reviews in Fisheries Science 1: 261-283.
Groffman, P.M., J.S. Baron, T Blett, AJ. Gold, I.Goodman. 2006. Ecological thresholds: the key to successful environmental management of an important concept with no practical application? Ecosystems 9: 1-13.
Hobbs, R.J., D. Norton. 1996. Towards a conceptual framework for restoration ecology. Restoration Ecology 4(2):93–110.
Johnson, B.L. 1999. The role of adaptive management as an operational approach for resource management agencies. Conservation Ecology 3(2): 8-18.
Kimball, S., M.E. Lulow, K.A. Mooney, Q.M. Sorenson. 2013. Establishment and management of native functional groups in restoration. Restoration Ecology 22:1-8.
Kirkpatrick, J.B., C.F. Hutchinson. 1977. The community composition of Californian coastal sage scrub. Vegetatio 35: 21-33.
Klimek, S., A. Richter gen. Kemmermann, M. Hofmann, and J. Isselstein. 2007. Plant species richness and composition in managed grasslands: The relative importance of field management and environmental factors. Biological Conservation I34:559-570.
Lassard, G. 1998. An adaptive approach to planning and decision-making. Landscape and Urban Planning 40: 81-87.
Lindenmayer, D.B.. G.Luck. 2005. Synthesis: Thresholds in conservation and management. Biological Conservation. 124: 351-354.
Lindenmayer, D.B., J Fischer, R.B. Cunningham. 2005. Native vegetation cover threshold associated with species responses. Biological Conservation. 124: 311-316.
Magness, J.R., G.M. Markle, C.C. Compton. 1971. Food and feed crops of the United States. Interregional Research Project IR-4, IR Bul. 1 (Bul. 828 New Jersey Agr. Expt. Sta.).
Muradian, R. 2001. Ecological thresholds: a survey. Ecological Economics 38: 7-24.
Palmer, M.A. 2009. Reforming watershed restoration: Science in need of application and applications in need of science. Estuaries and Coasts 32:1–17.
Perrings, D., B. Walker. 1997 Biodiversity, resilience and the control of ecological-economic systems: the case of fire driven rangelands. Ecological Economics 22: 73-83
Radford, J.Q. A.F. Benett, G.J. Cheers. 2005. Landscape-level thresholds of habitat cover for woodland-dependent birds. Biological Conservation 124: 317-337.
Sabine, E., G. Schrelber, A.R Bearlin, S.J. Nicol, C.R. Todd. 2004. Adaptive management: a synthesis of current understanding and effective application. Ecological Management and Restoration 5:177-182.
Seabloom, E.W., W.S. Harpole, O.J. Reichman, D. Tilman. 2003. Invasion, competitive dominance, and resource use by exotic and native California grassland species. PNAS 100:13384-13389.
Standish, R.J., V.A. Cramer, S.L. Wild, R.J. Hobbs. 2007. Seed dispersal and recruitment limitation are barriers to native recolonization of old-fields in Western Australia. Journal of Applied Ecology 44: 435–445.
Suding, K.N., K.L. Gross, G.R. Houseman. 2004. Alternative states and positive feedbacks in restoration ecology. Trends in Ecology and Evolution 19: 48-53.

Wood, Y.A., T. Meixner, P.J. Shouse, E.B. Allen. 2006. Altered ecohydrologic response drives native shrub loss under conditions of elevated nitrogen deposition. Journal of Environmental Quality 35: 76-92.

Appendix

Table A1. Richness and percent or richness represented by each genus.

Family	Richness	Percent	Family	Richness	Percent
Total	368	100.0	Malvaceae	5	1.4
Adoxaceae	1	0.3	Montiaceae	2	0.5
Agavaceae	1	0.3	Moraceae	1	0.3
Aizoaceae	3	0.8	Myrsinaceae	1	0.3
Amaranthaceae	2	0.5	Myrtaceae	1	0.3
Anacardiaceae	6	1.6	Nyctaginaceae	2	0.5
Apiaceae	10	2.7	Onagraceae	7	1.9
Apocynaceae	4	1.1	Orobanchaceae	1	0.3
Arecaceae	2	0.5	Oxalidaceae	2	0.5
Asteraceae	67	18.2	Papaveraceae	2	0.5
Betulaceae	1	0.3	Phrymaceae	2	0.5
Boraginaceae	15	4.1	Plantaginaceae	9	2.4
Brassicaceae	15	4.1	Platanaceae	1	0.3
Cactaceae	3	0.8	Poaceae	46	12.5
Caprifoliaceae	1	0.3	Polemoniaceae	1	0.3
Caryophyllaceae	10	2.7	Polygonaceae	12	3.3
Chenopodiaceae	7	1.9	Polypodiaceae	1	0.3
Cleomaceae	1	0.3	Pteridaceae	5	1.4
Convolvulaceae	5	1.4	Ranunculaceae	4	1.1
Crassulaceae	4	1.1	Rhamnaceae	3	0.8
Cucurbitaceae	2	0.5	Rosaceae	6	1.6
Cyperaceae	5	1.4	Rubiaceae	4	1.1
Euphorbiaceae	8	2.2	Salicaceae	5	1.4
Fabaceae	24	6.5	Saururaceae	1	0.3
Fagaceae	2	0.5	Scrophulariaceae	4	1.1
Frankeniaceae	1	0.3	Solanaceae	6	1.6
Geraniaceae	6	1.6	Tamaricaceae	1	0.3
Grossulariaceae	1	0.3	Themidaceae	1	0.3
Iridaceae	1	0.3	Typhaceae	1	0.3
Juncaceae	5	1.4	Urticaceae	4	1.1
Lamiaceae	7	1.9	Verbenaceae	1	0.3
Liliaceae	4	1.1	Violaceae	1	0.3
			Visaceae	1	0.3

Table A2. Simple regressions of common natives by environmental and land use history variables for sample years 2008 and 2013 and the change between 2008 and 2013 (change). L = Loam, C = Clay, Alpha levels are as follows: * = 0.05, ** = ** = 0.01, *** = 0.001 and **** < .0001

	AreaAcres			SoilType			Slope			Elevation			Erosion			Grazing			DrstCM			NumberYrsBurned		
	2008	2013	Change	2008	2013	Change	2008	2013	Change	2008	2013	Change	2008	2013	Change	2008	2013	Change	2008	2013	Change	2008	2013	Change
Artemisia californica											(+) 0.122 ***		0.167 ***		0.091 *									(+) 0.112 ***
Asclepias fascicularis					L 0.035 *												(+) 0.193 ****							
Ambrosia psilostachya					L 0.062 ***			(-) 0.07 **												(+) 0.101 ***				
Amsinckia menziesii		(+) 0.041 *																						
Baccaris pilularis								(+) 0.047 *									(-) 0.107 ***							
Bloomeria crocea											(+) 0.045 *													(+) 0.093 ***
Bromus carinatus																				(+) 0.067**				
Crassula connata																				(+) 0.040 *				
Cucurbita foetidissima		(+) 0.116 ***															(+) 0.088 **			(+) 0.115 ***				
Dichelostemma capitatum		(+) 0.040 *						(+) 0.061 **			(+) 0.129 ***			0.094 *										(+) 0.176 ****
Elymus condensatus								(+) 0.124 ***																
Eriogenum fasciculatum				L 0.057 *	L 0.078 **						(+) 0.064 **			0.092 *			(+) 0.048 *				(-) 0.038 *			(+) 0.054 *
Ericameria palmeri											(+) 0.099 ***						(+) 0.123 ***			(+) 0.059 **				
Gallium angustifolia		(+) 0.096 ***									(+) 0.048 *												(+) 0.062 **	
Galium porrigens		(+) 0.067 **						(+) 0.070 **			(+) 0.086 **													(+) 0.057 *
Gnaphalium bicolor														0.074 *			(+) 0.035 *							(+) 0.170 ****
Gnaphalium californicum											(+) 0.181 ****			0.086 *										(+) 0.085 ***
Heteromeles arbutifolia											(-) 0.063 **												(+) 0.116 ***	
Koeleria macrantha											(+) 0.046									(-) 0.046 *				(+) 0.041 *
Lassingia filaginafolia		(+) 0.131 ***															(+) 0.115 ***							
Lotus scoparius					L 0.048 *						(+) 0.080 **													(+) 0.172 ****
Marah macrocarpus		(+) 0.059 **									(+) 0.103 ***			0.072 *										(+) 0.096 ***
Melica imperfecta					L 0.039 *			(+) 0.094 ***																
Mimulus aurantiacus											(+) 0.081 **												(+) 0.080 **	
Nassella pulchra											(+) 0.124 ***			0.03 *			(+) 0.110 ***							
Opuntia litteralis		(+) 0.056 *									(+) 0.209 ****						(+) 0.100 ***			(-) 0.043 *				(+) 0.121 ***
Opuntia prolifera											(+) 0.063 **			0.079 *			(+) 0.123 ***							(+) 0.058 **
Phacelia ramosissoma																				(+) 0.102 ***				
Rhus integrifolia		(+) 0.053 *						(+) 0.053 *			(+) 0.221 ****									(-) 0.052 *			(+) 0.135 ****	
Salvia mellifera														0.084 *										
Sambucus mexicana					L 0.065 **			(-) 0.039 *																
Sanicula crassicaulis		(+) 0.125 ***			C 0.124 **						(+) 0.046 *													(+) 0.098 ***
Sisyrinchium bellum		(+) 0.087 **									(+) 0.134 ****			0.098 **										(+) 0.171 ****
Solanum douglasii								(+) 0.062 **						0.154 ***										
Stachys rigida					C 0.059 **			(+) 0.155 ****																

Table A3. Simple regressions of common exotics by environmental, management and land use history variables for sample years 2008 and 2013 and the change between 2008 to 2013 (change). L = Loam, C = Clay, Alpha levels are as follows: * = 0.05, ** = ** = 0.01, *** = 0.001 and **** < .0001

	# Years Treated			Area Acres			Soil Type			Slope		
	2008	2013	Change	2008	2013	Change	2008	2013	Change	2008	2013	Change
Avena Spp												
Anagallis arvensis		(-) 0.037 *			(+) 0.105 ***							
Brachypodium distachyon									C 0.043 *			
Brassica nigra											(-) 0.048 *	
Bromus diandrus				(-) 0.050 *						(-) 0.051 *		
Bromus hordeaceus		(-) 0.044 *	(-) 0.046 *						L 0.037 *			
Bromus madritensis rubens												
Carduuc pycnocephalus											(+) 0.042 *	
Centaurea melitensis								L 0.060 **				
Convolvulus arvensis					(+) 0.064 **							
Cynara cardunculus					(+) 0.076 **							
Erodium brachycarpum								L 0.038 *				
Erodium cicutarium								L 0.071 **			(-) 0.054 **	
Erodium moschatum												
Hirshfeldia incana								L 0.119 ***			(-) 0.092 ***	
Hordeum murinum					(+) 0.038 *							
Lactuca seriola												
Lolium multiflorum							C 0.070*			(+) 0.265 ****	(+) 0.111 ***	
Medicago polymorpha					(+) 0.095 ***							
Melilotus indicus					(+) 0.121 ***							
Murrubium vulgare					(+) 0.088 **							
Rumex crispus					(+) 0.068 **							
Sonchus asper					(+) 0.150 ****			C 0.042 *				
Sonchus oleraceous					(+) 0.140 ****			C 0.048 *			(+) 0.036 *	
Vulpia myuros						(+) 0.035 *		L 0.040 *				

	Elevation			Erosion			Grazing		
	2008	2013	Change	2008	2013	Change	2008	2013	Change
Avena Spp				0.131 **		0.144 ***	(+) 0.049 *		(-) 0.069 **
Anagallis arvensis					(+) 0.053 *				
Brachypodium distachyon		(+) 0.114 ***	(+) 0.056 *				(+) 0.154 ***	(+) 0.270 ****	
Brassica nigra					0.077 *				
Bromus diandrus	(-) 0.279 ****	(-) 0.048 *		(-) 0.233 ****			(-) 0.115 ***		
Bromus hordeaceus				0.091 *					
Bromus madritensis rubens		(+) 0.082 **							
Carduuc pycnocephalus		(-) 0.164 ****						(-) 0.080 **	
Centaurea melitensis									
Convolvulus arvensis		(-) 0.048 *						(+) 0.195 ****	
Cynara cardunculus		(+) 0.063 **						(+) 0.036 *	
Erodium brachycarpum									
Erodium cicutarium									
Erodium moschatum					0.076 *			(+) 0.041 *	
Hirshfeldia incana									
Hordeum murinum		(-) 0.065 **							
Lactuca seriola									
Lolium multiflorum			(-) 0.039 *	0.169 **					(-) 0.124 ***
Medicago polymorpha									
Melilotus indicus									
Murrubium vulgare		(-) 0.046 *							
Rumex crispus								(+) 0.039 *	
Sonchus asper									
Sonchus oleraceous								(-) 0.040 *	
Vulpia myuros									

	AWC			Drst			# Years Burned		
	2008	2013	Change	2008	2013	Change	2008	2013	Change
Avena Spp									
Anagallis arvensis					(+) 0.053 *				
Brachypodium distachyon							(-) 0.058 *	(+) 0.042 *	
Brassica nigra									
Bromus diandrus							(-) 0.136 ****		
Bromus hordeaceus					(+) 0.080 **	(+) 0.057 **			
Bromus madritensis rubens								(+) 0.053 *	
Carduuc pycnocephalus								(-) 0.113 ***	
Centaurea melitensis									
Convolvulus arvensis									
Cynara cardunculus									
Erodium brachycarpum					(+) 0.094 ***				
Erodium cicutarium		(+) 0.090 **			(+) 0.142 ****				
Erodium moschatum									
Hirshfeldia incana					(+) 0.143 ****			(-) 0.041 *	
Hordeum murinum		(+) 0.070 **			(+) 0.045 *			(-) 0.056 **	
Lactuca seriola		(+) 0.195 ****			(+) 0.055 *			(-) 0.044 *	
Lolium multiflorum									
Medicago polymorpha									
Melilotus indicus					(+) 0.066 **				
Murrubium vulgare								(-) 0.098 ***	
Rumex crispus									
Sonchus asper									
Sonchus oleraceous									
Vulpia myuros					(+) 0.108 ***	(+) 0.075 **			

Table #. Species list from the UC Berkeley 2013 survey. N = native plant species and E = exotic plant species.

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Acacia wattle	thorntree	E	Tree	Perennial	Fabaceae
Achiellia millefolium	common yarrow	N	Forb	Perennial	Asteraceae
Acourtia microcephala	sacapellote	N	Forb	Perennial	Asteraceae
Adiantum jordanii	california maidenhair fern	N	Fern	Perennial	Pteridaceae
Adiantum jordanii	California maiden hair	N	Fern	Perennial	Pteridaceae
Aesclepias californica	California milkweed	N	Forb	Perennial	Apocynaceae
Agoseris retrorsa	spearleaf mountain dandelion	N	Forb	Perennial	Asteraceae
Polypogon viridis	water beard grass	E	Grass	Perennial	Poaceae
Alnus sp	alder	N	Tree	Perennial	Betulaceae
Amaranthus albus	tumbleweed	E	Forb	Annual	Amaranthaceae
Ambrosia psilostachya	western ragweed	N	Forb	Perennial	Asteraceae
Amsinckia menziesii	menzie's fiddleneck	N	Forb	Annual	Boraginaceae
Anagallis arvensis	scarlet pimpernel	E	Forb	Annual	Myrsinaceae
Anemopsis californica	yerba mansa	N	Forb	Perennial	Saururaceae
Antirrhinum nuttallianum	nuttall's snapdragon	N	Forb	Annual, biennial	Plantaginaceae
Aphanes occidentalis	lady's mantle	N	Forb	Perennial	Rosaceae
Apiastrum angustifolium	wild celery	N	Forb	Annual	Apiaceae
Apium graveolens	celery	E	Forb	Annual	Apiaceae
Araujia sericifera	bladderflower	E	Forb	Perennial	Apocynaceae
Aristida adscensionis	sixweeks threeawn	N	Grass	Annual	Poaceae
Aristida purpurea	purple three awn	N	Grass	Perennial	Poaceae
Artemisia californica	California sagebrush	N	Shrub	Perennial	Asteraceae
Artemisia douglasiana	California mugwort	N	Forb	Perennial	Asteraceae
Arundo donax	giant reed	E	Grass	Perennial	Poaceae
Asclepias eriocarpa	indian milkweed	N	Forb	Perennial	Apocynaceae
Asclepias fascicularis	narrow leaf milkweed	N	Forb	Perennial	Apocynaceae
Atriplex canescens	fourwing saltbush	N	Shrub	Perennial	Chenopodiaceae
Atriplex lentiformis	big saltbush	N	Shrub	Perennial	Chenopodiaceae
Atriplex semibaccata	Australian saltbush	E	Subshrub	Perennial	Chenopodiaceae
Atriplex suberecta	peregrine saltbush	E	Forb	Annual	Chenopodiaceae
Avena spp	wild oats	E	Grass	Annual	Poaceae
Baccharis pilularis consanguinea	coyote brush	N	Shrub	Perennial	Asteraceae
Baccharis pilularis consanguinea	coyote brush	N	Shrub	Perennial	Asteraceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Baccharis salicifolia	mule fat	N	Shrub	Perennial	Asteraceae
Bloomeria crocea	common goldenstar	N	Forb	Perennial	Themidaceae
Brachypodium distachyon	purple false brome	E	Grass	Annual	Poaceae
Brassica nigra	black mustard	E	Forb	Annual	Brassicaceae
Brickellia californica	California brickelbush	N	Forb	Perennial	Asteraceae
Bromus carinatus	California bromegrass	N	Grass	Perennial	Poaceae
Bromus diandrus	ripgut brome	E	Grass	Annual	Poaceae
Bromus hordeaceus	soft chess brome	E	Grass	Annual	Poaceae
Bromus madritensis rubens	red brome	E	Grass	Annual	Poaceae
Calandrinia ciliata	redmaids	N	Forb	Annual	Montiaceae
Calochortus catalinae	Catalina mariposa lily	Rare	Forb	Perennial	Liliaceae
Calochortus plummerae	plummer's mariposa lily	N	Forb	Perennial	Liliaceae
Calochortus splendens	splendid mariposa lily	N	Forb	Perennial	Liliaceae
Calochortus superbus	yellow mariposa	N	Forb	Perennial	Liliaceae
Calystegia macrostegia	island morning glory	N	Forb	Perennial	Convolvulaceae
Calystegia sepium	hedge false bindweed	N	Forb	Perennial	Convolvulaceae
Camissonia cheiranthifolia	beach primrose	N	Forb	Perennial	Onagraceae
Camissoniopsis micrantha	Spencer primrose	N	Forb	Annual	Onagraceae
Capsella bursa-pastoris	shepherd's purse	E	Forb	Annual, biennial	Brassicaceae
Cardamine nuttallii	Nuttall's toothwort	N	Forb	Perennial	Brassicaceae
Cardamine oligosperma	bitter cress	N	Forb	Perennial	Brassicaceae
Loeflingia ramosissima	sandcarpet	N	Forb	Perennial	Caryophyllaceae
Carduus pycnocephalus pycnocephalus	Italian thistle	E	Forb	Annual	Asteraceae
Carex praegracilis	Field sedge	N	Forb	Perennial	Cyperaceae
Castilleja affinis	Indian paint brush	N	Forb	Perennial	Scrophulariaceae
Castilleja exserta	purple owl's clover	N	Forb	Annual	Orobanchaceae
Castilleja foliosa	wooly paint brush	N	Forb	Perennial	Scrophulariaceae
Castilleja purpurea	downy Indian paintbrush	N	Forb	Perennial	Scrophulariaceae
Centaurea melitensis	Maltese star thistle	E	Forb	Annual	Asteraceae
Centromadia pungens laevis	smooth tarplant	N	Forb	Annual	Asteraceae
Cerastium glomeratum	mouseear chickweed	E	Forb	Annual	Caryophyllaceae
Matricaria discoidea	pineapple weed	E	Forb	Annual	Asteraceae
Matricaria discoidea	common pineapple weed	E	Forb	Annual	Asteraceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Chenopodium californicum	California goosefoot	N	Forb	Perennial	Chenopodiaceae
Chenopodium murale	nettle leaf goosefoot	E	Forb	Annual	Chenopodiaceae
Chlorogalum pomeridianum	wavyleaf soap plant	N	Forb	Perennial	Agavaceae
Chorizanthe staticoides	turkish rugging	N	Forb	Annual	Polygonaceae
Glebionis coronaria	crown daisy	E	Forb	Annual	Asteraceae
Cirsium occidentale	cobweb thistle	N	Forb	Perennial	Asteraceae
Cirsium vulgare	bull thistle	E	Forb	Biennial	Asteraceae
Clarkia purpurea	purple clarkia	N	Forb	Annual	Onagraceae
Claytonia perfoliata	miner s lettuce	N	Forb	Annual	Montiaceae
Clematis ligusticifolia	western white clematis	N	Forb	Perennial	Ranunculaceae
Collinsia heterophylla	purple chinese houses	N	Forb	Annual	Plantaginaceae
Conium maculatum	hemlock	E	Forb	Biennial	Apiaceae
Convolvulus arvensis	field bindweed	E	Forb	Perennial	Convolvulaceae
Erigeron canadensis	horseweed	N	Forb	Annual	Asteraceae
Laennecia coulteri	Coulter's horseweed	N	Forb	Annual	Asteraceae
Erigeron sumatrensis	tropical horseweed	E	Forb	Annual	Asteraceae
Cortaderia selloana	pampas grass	E	Grass	Perennial	Poaceae
Cortaderia selloana	pampas grass	E	Grass	Perennial	Poaceae
Cotula astralius	Australian waterbuttons	E	Forb	Annual	Asteraceae
Crassula connata	sand pygmy weed	N	Succulent	Annual	Crassulaceae
Cryptantha intermedia	common cryptanth	N	Forb	Annual	Boraginaceae
Cryptantha microstachys	popcorn flower	N	Forb	Annual	Boraginaceae
Cucurbita foetidissima	stinking gourd	N	Forb	Annual, perennial	Cucurbitaceae
Cuscuta californica	California dodder	N	Forb	Annual	Convolvulaceae
Cuscuta californica	chaparral dodder	N	Vine	Annual, perennial	Convolvulaceae
Cynadon dactylon	Bermudagrass	N	Forb	Perennial	Poaceae
Cynara cardunculus	artichoke thistle	E	Forb	Perennial	Asteraceae
Cyperus eragrostis	tall cyperus	N	Forb	Perennial	Cyperaceae
Cyperus involucratus	umbrella plant	E	Forb	Perennial	Cyperaceae
Datura wrghtii	jimsonweed	N	Forb, subshrub	Annual, perennial	Solanaceae
Daucus pusillus	American wild carrot	N	Forb	Annual	Apiaceae
Daucus carota	Queen Anne's lace	E	Forb	Biennial	Apiaceae
Deinandra fasciculata	clustered tarweed	N	Forb	Annual	Asteraceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Delphinium sp.		N	Forb	Perennial	Ranunculaceae
Dichelostemma capitatum	blue dicks	N	Forb	Perennial	Themidaceae
Diplotaxis muralis	annual wallrocket	E	Forb	Annual	Brassicaceae
Disticalis spicata	inland saltgrass	N	Grass	Perennial	Poaceae
Dudleya multicaulis	many stemmed dudleya	N	Succulent	Perennial	Crassulaceae
Dudleya purverulenta	chalk dudleya	N	Succulent	Perennial	Crassulaceae
Dudliya lanceolata	southern California dudleya	N	Succulent	Perennial	Crassulaceae
Dysphania ambrosioides	Mexican tea	E	Forb	Annual	Amaranthaceae
Echium candicans	pride of Madeira	E	Shrub	Perennial	Boraginaceae
Ehrharta calycina	perennial veldtgrass	E	Grass	Perennial	Poaceae
Ehrharta erecta	upright veldt grass	E	Grass	Annual	Poaceae
Eleocharis sp		E	Grass	Perennial	Cyperaceae
Leymus condensatus	giant wild rye	N	Grass	Perennial	Poaceae
Elymus glaucus	blue wildrye	N	Grass	Perennial	Poaceae
Leymus triticoides	valley wild rye	N	Grass	Perennial	Poaceae
Encelia californica	California brittlebush	N	Shrub	Perennial	Asteraceae
Encelia farinosa	goldenhills Brittlebush	N	Shrub	Perennial	Asteraceae
Epilobium canum	California fuchsia	N	Forb	Perennial	Onagraceae
Epilobium ciliatum	northern willow herb	N	Forb	Perennial	Onagraceae
Eragrostis spp		?	Monocot	Perennial	Poaceae
Croton setigerus	dove weed	N	Forb	Annual	Euphorbiaceae
Ericameria palmeri	Palmer goldenweed	N	Shrub	Perennial	Asteraceae
Erigeron foliosus	leafy daisy	N	Forb	Perennial	Asteraceae
Eriodictyon crassifolium	felt leaved Yerba Santa	N	Shrub	Perennial	Boraginaceae
Eriogenum fasciculatum	California buckwheat	N	Shrub	Perennial	Polygonaceae
Eriogonum elongatum	longstem buckwheat	N	Shrub	Perennial	Polygonaceae
Eriogonum fasciculatum var. polifolium	Eastern Mojave buckwheat	N	Shrub	Perennial	Polygonaceae
Eriophyllum confertiflorum	golden yarrow	N	Subshrub	Perennial	Asteraceae
Erodium botrys	broad leaf filaree	E	Forb	Annual	Geraniaceae
Erodium brachycarpum	shortfruit stork's bill	E	Forb	Annual	Geraniaceae
Erodium cicutarium	redstem filaree, redstem stork's bill	E	Forb	Annual	Geraniaceae
Erodium moschatum	white stemmed filaree	E	Forb	Annual, biennial	Geraniaceae
Eschscholzia caespitosa	tufted poppy	N	Forb	Perennial	Papaveraceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Eschscholzia californica	California poppy	N	Forb	Annual, perennial	Papaveraceae
Eucalyptus globulus	blue gum	E	Tree	Perennial	Myrtaceae
Eucrypta chrysanthemafolia	common eucrypta	N	Forb	Annual	Boraginaceae
Chamaesyce albomarginata	rattlesnake weed	N	Forb	Perennial	Euphorbiaceae
Chamaesyce maculata	spotted spurge	E	Forb	Annual	Euphorbiaceae
Euphorbia peplus	pretty spurge	E	Forb	Annual	Euphorbiaceae
Euphorbia spathulata	warty spurge	N	Forb	Annual	Euphorbiaceae
Euphorbia terracina	carnation spurge	E	Forb	Annual, perennial	Euphorbiaceae
Euphorbia purpurea	purple wood spurge	N	Forb	Annual	Euphorbiaceae
Schedonorus arundinaceus	tall fescue	E	Grass	Perennial	Poaceae
Festuca microstachys	small fescue	N	Grass	Annual	Poaceae
Festuca octoflora	sixweeks grass	N	Grass	Perennial	Poaceae
Logfia filaginoides	California cottonrose	N	Forb	Annual	Asteraceae
Logfia gallica	narrowleaf cottonrose	E	Forb	Annual	Asteraceae
Foeniculum vulgare	fennel	E	Forb	Perennial	Apiaceae
Frankenia salina	yerba reuma	N	Forb	Perennial	Frankeniaceae
Galium aparine	common bedstraw	N	Forb	Annual	Rubiaceae
Galium nuttallii	climbing bedstraw	N	Forb	Perennial	Rubiaceae
Galium porrigens	graceful bedstraw	N	Forb	Perennial	Rubiaceae
Gallium angustifolia	narrowleaf bedstraw	N	Forb, subshrub	Perennial	Rubiaceae
Gastridium ventricosum	nit grass	E	Grass	Annual	Poaceae
Geranium carolinianum	Carolina geranium	N	Forb	Annual	Geraniaceae
Geranium dissectum	cutleaf geranium	E	Forb	Annual	Geraniaceae
Pseudognaphalium biolettii	two-color rabbit-tobacco	N	Forb	Perennial	Asteraceae
Pseudognaphalium californicum	ladies' tobacco	N	Forb	Annual, perennial	Asteraceae
Pseudognaphalium canescens	Wright's cudweed	N	Forb	Annual, perennial	Asteraceae
Gnaphalium palustre	lowland cudweed	N	Forb	Annual	Asteraceae
Pseudognaphalium luteoalbum	Jersey cudweed	E	Forb	Annual	Asteraceae
Pseudognaphalium stramineum	cottonbatting plant	N	Forb	Annual, biennial	Asteraceae
Grindelia camporum	common gumplant	N	Forb, subshrub	Perennial	Asteraceae
Hedypnois cretica	cretanweed	E	Forb	Annual	Asteraceae
Helianthus spp	sunflowers	N or E	Forb, subshrub	Annual, perennial	Asteraceae
Heliotropium curassavicum	Chinese parsley	N	Forb	Perennial	Boraginaceae

Botanical name 2013	**Common Name**	**N or E**	**Life form**	**Life cycle**	**Family**
Hesperocnide tenella	western stinging nettle	N	Forb	Annual	Urticaceae
Heteromeles arbutifolia	toyon	N	Shrub, Tree	Perennial	Rosaceae
Heterotheca grandiflora	telegraphweed	N	Forb	Annual, perennial	Asteraceae
Heterotheca villosa	hairy goldenaster	N	Forb	Perennial	Asteraceae
Hirshfeldia incana	short podded mustard	E	Forb, subshrub	Annual, perennial	Brassicaceae
Hordeum depressum	dwarf barley	N	Grass	Annual	Poaceae
Hordeum murinum	foxtail barley	E	Grass	Annual	Poaceae
Hordeum vulgare	common barley	E	Grass	Annual	Poaceae
Hypochaeris glabra	smooth cats ear	E	Forb	Annual	Asteraceae
Hypochaeris glabra	smooth cat's ear	E	Forb	Annual, perennial	Asteraceae
Isocoma menziesii	Menzies' goldenbush	N	Shrub	Perennial	Asteraceae
Peritoma arborea	bladderpod	N	Shrub	Perennial	Cleomaceae
Juncus balticus	baltic rush	N	Forb	Perennial	Juncaceae
Juncus bufonius	common toad rush	N	Forb	Annual	Juncaceae
Juncus mexicanus	Mexican rush	N	Forb	Perennial	Juncaceae
Juncus rugulosus	wrinkled rush	N	Monocot	Perennial	Juncaceae
Juncus textilis	basket rush	N	Forb	Perennial	Juncaceae
Keckiella cordifolia	climbing penstemon	N	Shrub	Perennial	Plantaginaceae
Koeleria macrantha	prairie junegrass	N	Grass	Perennial	Poaceae
Lactuca seriola	prickly wild lettuce	E	Forb	Annual	Asteraceae
Lamarckia aurea	goldentop grass	E	Grass	Annual	Poaceae
Corethrogyne filaginifolia	common sandaster	N	Forb, subshrub	Perennial	Asteraceae
Lasthenia californica	California goldfields	N	Forb	Annual	Asteraceae
Lasthenia grasilus	needle goldfields	N	Forb	Annual	Asteraceae
Lathyrus latifolius	perennial pea	E	Forb	Perennial	Fabaceae
Lathyrus vestitus	Bolander's Pea	N	Forb	Perennial	Fabaceae
Lavatera cretica	Cornish mallow	E	Forb	Annual	Malvaceae
Layia platyglossa	tidy tips	N	Forb	Annual	Asteraceae
Lepidium lasiocarpum	desert pepper grass	N	Forb	Annual	Brassicaceae
Lepidium nitidum	peppergrass	N	Forb	Annual	Brassicaceae
Lepidium verginicum	peppergrass	N	Forb	Annual	Brassicaceae
Lianthus dianthafolris	fringed linanthus	N	Forb	Annual	Polemoniaceae
Nuttallanthus texanus	blue toadflax	N	Forb	Annual, biennial	Plantaginaceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Lobularia maritima	sweet alyssum	E	Forb	Annual, perennial	Brassicaceae
Loeflingia squarrosa	spreading pygmyleaf	N	Forb	Annual	Caryophyllaceae
Festuca perennis	Italian rye grass	E	Grass	Annual, perennial	Poaceae
Acmispon micranthus	small flowered lotus	N	Forb	Annual	Fabaceae
Lotus heermannii	Heermann's bird's foot trefoil	N	Forb	Perennial	Fabaceae
Acmispon americanus americanus	spanish clover	N	Forb	Annual	Fabaceae
Acmispon glaber	deerweed	N	Forb, subshrub	Perennial	Fabaceae
Acmispon strigosus	strigose lotus	N	Forb	Annual	Fabaceae
Lupinus bicolor	bicolored lupine	N	Forb	Annual	Fabaceae
Lupinus excubitus	adonis lupine	N	Shrub	Perennial	Fabaceae
Lupinus microcarpa	chick lupine	N	Forb	Annual	Fabaceae
Lupinus sparsiflorus	Coulter's lupine	N	Forb	Annual	Fabaceae
Lupinus succulentus	arroyo lupine	N	Forb	Annual	Fabaceae
Lupinus truncatus	truncate leaf lupine	N	Forb	Annual	Fabaceae
Malacothamnus fasciculatus	chaparral mallow	N	Shrub	Perennial	Malvaceae
Malacothrix saxatilis	cliff aster	N	Forb, subshrub	Perennial	Asteraceae
Malosma laurina	laurel sumac	N	Shrub	Perennial	Anacardiaceae
Malva nicaeensis	bull mallow	E	Forb	Annual	Malvaceae
Malva parvaflora	cheeseweed mallow	E	Forb	Annual	Malvaceae
Malvella leprosa	alkali mallow	N	Forb	Annual	Malvaceae
Marah macrocarpus	wild cucumber	N	Vine	Perennial	Cucurbitaceae
Marrubium vulgare	Common horehound	E	Forb, subshrub	Perennial	Lamiaceae
Medicago lupulina	black medick	E	Forb	Annual	Fabaceae
Medicago polymorpha	California burclover	E	Forb	Annual	Fabaceae
Melica imperfecta	California melic	N	Grass	Perennial	Poaceae
Melilotus indicus	annual yellow sweetclover	E	Forb	Annual	Fabaceae
Mesembryanthemum crystallinum	crystalline ice plant	E	Succulent	Annual, biennial	Aizoaceae
Microseris bigelovii	coast microseris	N	Forb	Annual	Asteraceae
Uropappus lindleyi	silver puffs	N	Forb	Annual	Asteraceae
Mimulus aurantiacus	bush monkey flower	N	Subshrub	Perennial	Phrymaceae
Mimulus guttatus	seep monkey flower	N	Forb	Perennial	Phrymaceae
Minuartia douglasii	Douglas' sandwort	N	Forb	Annual	Caryophyllaceae
Mirabilis laevis crassifolia	California four o'clock	N	Forb, subshrub	Perennial	Nyctaginaceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Mirabilis laevis	desert wishbone bush	N	Shrub	Perennial	Nyctaginaceae
Morus alba	white mulberry	N	Shrub	Perennial	Moraceae
Muhlenbergia microsperma	annual muhly	N	Grass	Annual	Poaceae
Stipa lepida		N	Grass	Perennial	Poaceae
Stipa pulchra	purple needle grass	N	Grass	Perennial	Poaceae
Nasturtium officinale	watercress	N	Aquatic	Perennial	Brassicaceae
Nicotiana glauca	tree tabacco	E	Shrub, Tree	Perennial	Solanaceae
Oenothera sinuosa	wavy-leaved gaura	E	Forb	Perennial	Onagraceae
Oenothera speciosa	Mexican evening primrose	E	Forb	Perennial	Onagraceae
Opuntia littoralis	western prickly pear	N	Succulent	Perennial	Cactaceae
Opuntia oricola	chaparral pricklypear	N	Succulent	Perennial	Cactaceae
Cylindropuntia prolifera	coastal cholla	N	Succulent	Perennial	Cactaceae
Dimorphotheca fruticosa	trailing african daisy	E	Forb, subshrub	Perennial	Asteraceae
Oxalis corniculata	creeping woodsorrel	E	Forb	Perennial	Oxalidaceae
Oxalis pes-caprae	Bermuda buttercup	E	Forb	Perennial	Oxalidaceae
Pectocarya linearis	sagebrush combseed	N	Forb	Annual	Boraginaceae
Pellaea andromedifolia	coffee cliffbrake	N	Fern	Perennial	Pteridaceae
Pellaea mucronata	birdfoot fern	N	Fern	Perennial	Pteridaceae
Penecetum setaceum	purple fountain grass	E	Grass	Annual, perennial	Poaceae
Pentagramma triangularis	goldenback fern	N	Fern	Perennial	Pteridaceae
Phacelia cicutaria hispida	caterpillar phacelia	N	Forb	Annual	Boraginaceae
Phacelia distans	common phacelia	N	Forb	Annual	Boraginaceae
Phacelia parryi	Parry's phacelia	N	Forb	Annual	Boraginaceae
Phacelia ramosissoma	branching phacelia	N	Forb	Perennial	Boraginaceae
Phalaris minor	Mediterranean canarygrass	E	Grass	Annual	Poaceae
Phoenix canariensis	Canary Island date palm	E	Tree	Perennial	Arecaceae
Pholistoma auritum	blue fiestaflower	N	Forb	Annual	Boraginaceae
Phoradendron serotinum ssp. macrophyllum	big leaf mistletoe	N	Shrub	Perennial	Visaceae
Helminthotheca echioides	bristly ox-tongue	E	Forb	Annual, biennial	Asteraceae
Piptatherum miliaceum	millet mountain rice	E	Monocot	Perennial	Poaceae
Plagiobothrys collinus	Cooper's popcornflower	N	Forb	Annual	Boraginaceae
Plagiobothrys tenellus	Pacific popcornflower	N	Forb	Annual	Boraginaceae
Plantago erecta	California plantain	N	Forb	Annual	Plantaginaceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Plantago ovata insularis	woolly plantain	N	Forb	Annual	Plantaginaceae
Plantago lanceolata	English plantain	E	Forb	Perennial	Plantaginaceae
Plantago major	common plantain	E	Forb	Perennial	Plantaginaceae
Platanus racemosa	California sycamore	N	Tree	Perennial	Platanaceae
Poa annua	annual blue grass	E	Grass	Annual	Poaceae
Poa secunda	pine bluegrass	N	Grass	Perennial	Poaceae
Polycarpon tetraphyllum tetraphyllum	four leaved polycarp	E	Forb	Annual	Caryophyllaceae
Polygonum arenastrum	common knotweed	E	Forb	Perennial	Polygonaceae
Polygonum aviculare	prostrate knotweed	E	Forb	Annual	Polygonaceae
Polygonum aviculare	prostrate knotweed	E	Forb	Perennial	Polygonaceae
Polypodium californicum	California polypody	N	Fern	Perennial	Polypodiaceae
Polypogon monspeliensis	rabbitsfoot grass	E	Grass	Annual	Poaceae
Polypogon viridis	water beard grass	E	Grass	Perennial	Poaceae
Populus fremontii fremontii	fremont cottonwood	N	Tree	Perennial	Salicaceae
Potentilla glandulosa	common cinquefoil	N	Forb	Perennial	Rosaceae
Prunus ilicifolia	hollyleaf cherry	N	Shrub, Tree	Perennial	Rosaceae
Pterostegia drymarioides	woodland pterostegia	N	Forb	Annual	Polygonaceae
Quercus agrifolia	coast live oak	N	Tree	Perennial	Fagaceae
Quercus berberdifolia	scrub oak	N	Shrub, Tree	Perennial	Fagaceae
Rafinesquia californica	California chicory	N	Forb	Annual	Asteraceae
Ranunculus californicus	California buttercup	N	Forb	Perennial	Ranunculaceae
Ranunculus hebecarpus	pubescent fruited Buttercup	N	Forb	Annual	Ranunculaceae
Raphanus sativa	wild radish	E	Forb	Annual, biennial	Brassicaceae
Rhamnus californica	California coffeeberry	N	Shrub	Perennial	Rhamnaceae
Rhamnus crocea	redberry buckthorn	N	Shrub	Perennial	Rhamnaceae
Rhamnus ilicifolia	evergreen buckthorn	N	Shrub	Perennial	Rhamnaceae
Rhus integrifolia	lemonade berry	N	Shrub, Tree	Perennial	Anacardiaceae
Rhus ovata	sugar sumac	N	Shrub	Perennial	Anacardiaceae
Ribes speciosum	fuchsia flowered gooseberry	N	Shrub	Perennial	Grossulariaceae
Ricinus communis	castorbean	E	Shrub, Tree	Perennial	Euphorbiaceae
Rosa californica	California wild rose	N	Shrub	Perennial	Rosaceae
Rubus ursinus	California blackberry	N	Shrub	Perennial	Rosaceae
Rumex conglomeratus	clustered dock	E	Forb	Perennial	Polygonaceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Rumex crispus	curly leaved dock	E	Forb	Perennial	Polygonaceae
Rumex hymenosepalus	canaigre dock	N	Forb	Perennial	Polygonaceae
Rumex salicifolius	willow leaved dock	N	Forb	Perennial	Polygonaceae
Salix exigua	narrow leaved willow	N	Tree	Perennial	Salicaceae
Salix gooddingii	Goodding's black willow	N	Tree	Perennial	Salicaceae
Salix laevigata	polished Willow	N	Tree	Perennial	Salicaceae
Salix lasiolepis	arroyo willow	N	Tree	Perennial	Salicaceae
Salsola tragus	Russian thistle	E	Forb	Annual	Chenopodiaceae
Salvia apiana	white sage	N	Subshrub	Perennial	Lamiaceae
Salvia leucophylla	purple sage	N	Shrub	Perennial	Lamiaceae
Salvia mellifera	black sage	N	Shrub	Perennial	Lamiaceae
Sambucus nigra caerulea	blue elderberry	N	Tree	Perennial	Adoxaceae
Sanicula arguta	sharp toothed sanicle	N	Forb	Biennial, perennial	Apiaceae
Sanicula bipinnatifida	purple sanicle	N	Forb	Biennial, perennial	Apiaceae
Sanicula crassicaulis	Pacific sanicle	N	Forb	Biennial, perennial	Apiaceae
Schinus molle	Peruvian pepper tree	E	Tree	Perennial	Anacardiaceae
Schinus terebinthifolius	Brazilian pepper tree	E	Tree	Perennial	Anacardiaceae
Schismus barbatus	old han schismus	E	Grass	Annual	Poaceae
Schoenoplectus americanus	chairmaker's bulrush	N	Forb	Perennial	Cyperaceae
Scrophularia californica	California bee plant	N	Forb, subshrub	Perennial	Scrophulariaceae
Senecio californicus	California butterweed	N	Forb	Annual	Asteraceae
Senecio vulgare	common groundsel	E	Forb	Annual	Asteraceae
Sesuvium verrucosum	western sea purslane	N	Succulent	Perennial	Aizoaceae
Silene antirrhina	Sleepy Catch fly	N	Forb	Annual	Caryophyllaceae
Silene galica	common catchfly	E	Forb	Annual	Caryophyllaceae
Silybum marianum	milk thistle	E	Forb	Annual, biennial	Asteraceae
Sisymbrium altissimum	tumbling mustard	E	Forb	Annual	Brassicaceae
Sisymbrium orientale	Indian hedge mustard	E	Forb	Annual	Brassicaceae
Sisymbrium orio	london rocket	E	Forb	Annual	Brassicaceae
Sisyrinchium bellum	blue eyed grass	N	Forb	Perennial	Iridaceae
Solanum americanum	American black nightshade	N	Forb, subshrub	Annual, perennial	Solanaceae
Solanum douglasii	Douglas' nightshade	N	Forb, subshrub	Perennial	Solanaceae
Solanum elaeagnifolium	silverleaf nightshade	E	Forb	Perennial	Solanaceae

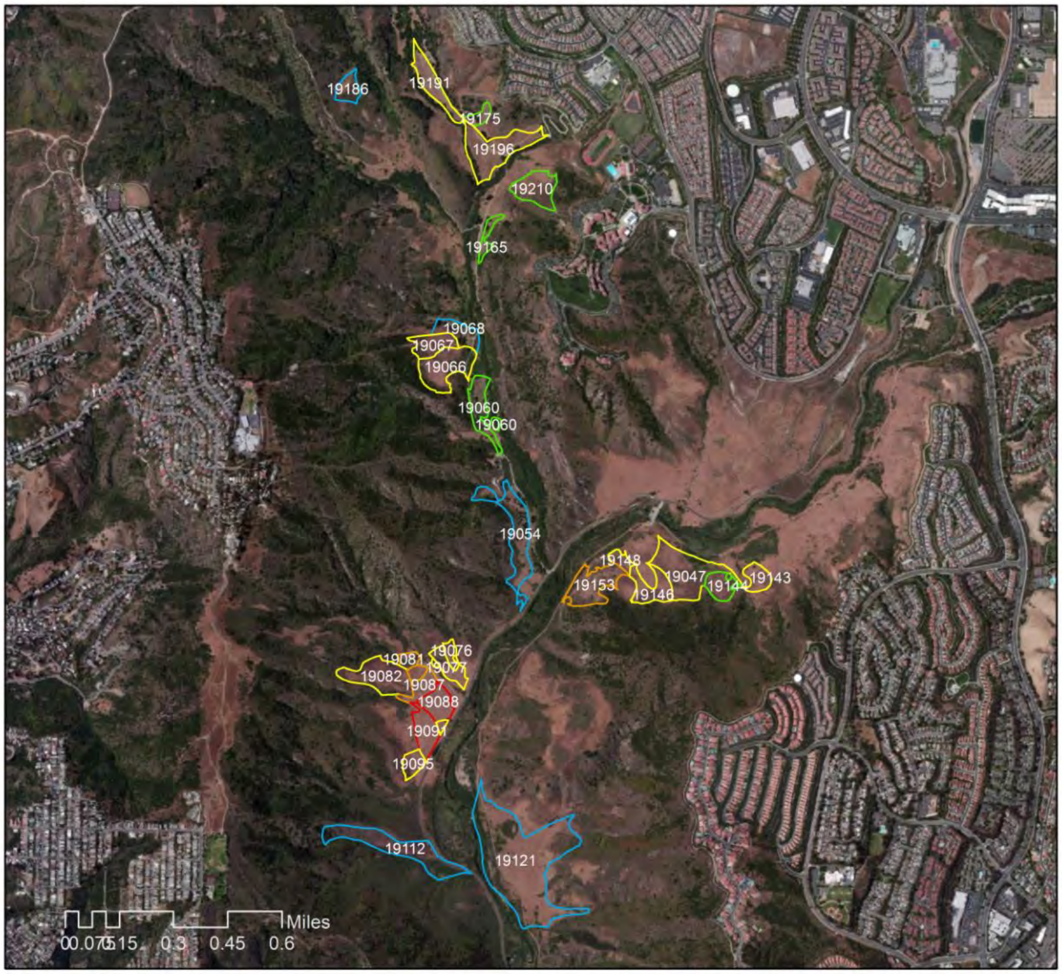
Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Solanum xanti	purple nightshade	N	Forb, subshrub	Perennial	Solanaceae
Soleirolia soleirolii	baby's tears	E	Forb	Annual	Urticaceae
Solidago velutina californica	threenerve goldenrod	N	Forb	Perennial	Asteraceae
Sonchus asper asper	prickly sow thistle	E	Forb	Annual	Asteraceae
Sonchus oleraceous	sonchus oleraceous	E	Forb	Annual	Asteraceae
Spergularia arvensis	corn spurry	N	Forb	Annual	Caryophyllaceae
Spergularia spp		?	Forb	Annual	Caryophyllaceae
Stachys bullata	California hedge nettle	N	Forb	Perennial	Lamiaceae
Stachys rigida	rough hedgenettle	N	Forb	Perennial	Lamiaceae
Stebbinsoseris heterocarpa	grassland stebbinsoseris	N	Forb	Annual	Asteraceae
Stellaria media	common chickweed	E	Forb	Annual, biennial	Caryophyllaceae
Stephanomeria		N	Forb	Annual	Asteraceae
Stephanomeria virgata	tall stephanomeria	N	Forb	Annual	Asteraceae
Stipa miliacea	smilo grass	E	Grass	Perennial	Poaceae
Stipa speciosa	desert needle grass	N	Grass	Perennial	Poaceae
Stipa tenuissima	Mexican feather grass	E	Grass	Perennial	Poaceae
Symphoricarpos mollis	trailing snowberry	N	Tree	Perennial	Caprifoliaceae
Tamarix ramosissima	tamarisk	E	Tree	Perennial	Tamaricaceae
Taraxacum officinale	dandelion	E	Forb	Annual	Asteraceae
Torilis nodosa	hedge Parsley	E	Forb	Annual	Apiaceae
Toxicodendron diversilobum	poison oak	N	Shrub	Perennial	Anacardiaceae
Trianthema portulacastrum	horse purslanes	N	Forb	Annual	Aizoaceae
Trichostema lanceolatum	vinegarweed	N	Forb	Annual	Lamiaceae
Trifolium hirtum	rose clover	E	Forb	Annual	Fabaceae
Trifolium microcephalum	maiden clover	N	Forb	Annual	Fabaceae
Trifolium repens	white clover	E	Forb	Annual	Fabaceae
Trifolium willdenovii	tomcat clover	N	Forb	Annual	Fabaceae
Trifolium depauperatum	dwarf sack clover	N	Forb	Annual	Fabaceae
Typha latifolia	common cattail	N	Forb	Perennial	Typhaceae
Urtica dioica	stinging nettle	N	Forb	Perennial	Urticaceae
Urtica urens	annual stinging nettle	E	Forb	Annual	Urticaceae
Verbena lasiostachys	common verbena	N	Forb	Perennial	Verbenaceae
Veronica peregrina L. ssp. xalapensis	purslane speedwell	N	Forb	Annual	Plantaginaceae

Botanical name 2013	Common Name	N or E	Life form	Life cycle	Family
Vicia sativa	common vetch	E	Forb	Annual	Fabaceae
Vicia valosa	winter vetch	E	Forb	Annual	Fabaceae
Viola pedunculata	California golden violet	N	Forb	Perennial	Violaceae
Festuca myuros	rattail sixweeks grass	E	Grass	Annual	Poaceae
Washingtonia robusta	Mexican fan palm	E	Tree	Perennial	Arecaceae
Xanthium strumarium	rough cockleburr	N	Forb	Annual	Asteraceae

Appendix A: Cover Class Change Maps

Native Cover

Aliso and Wood Canyons
Native Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

N
W E
S

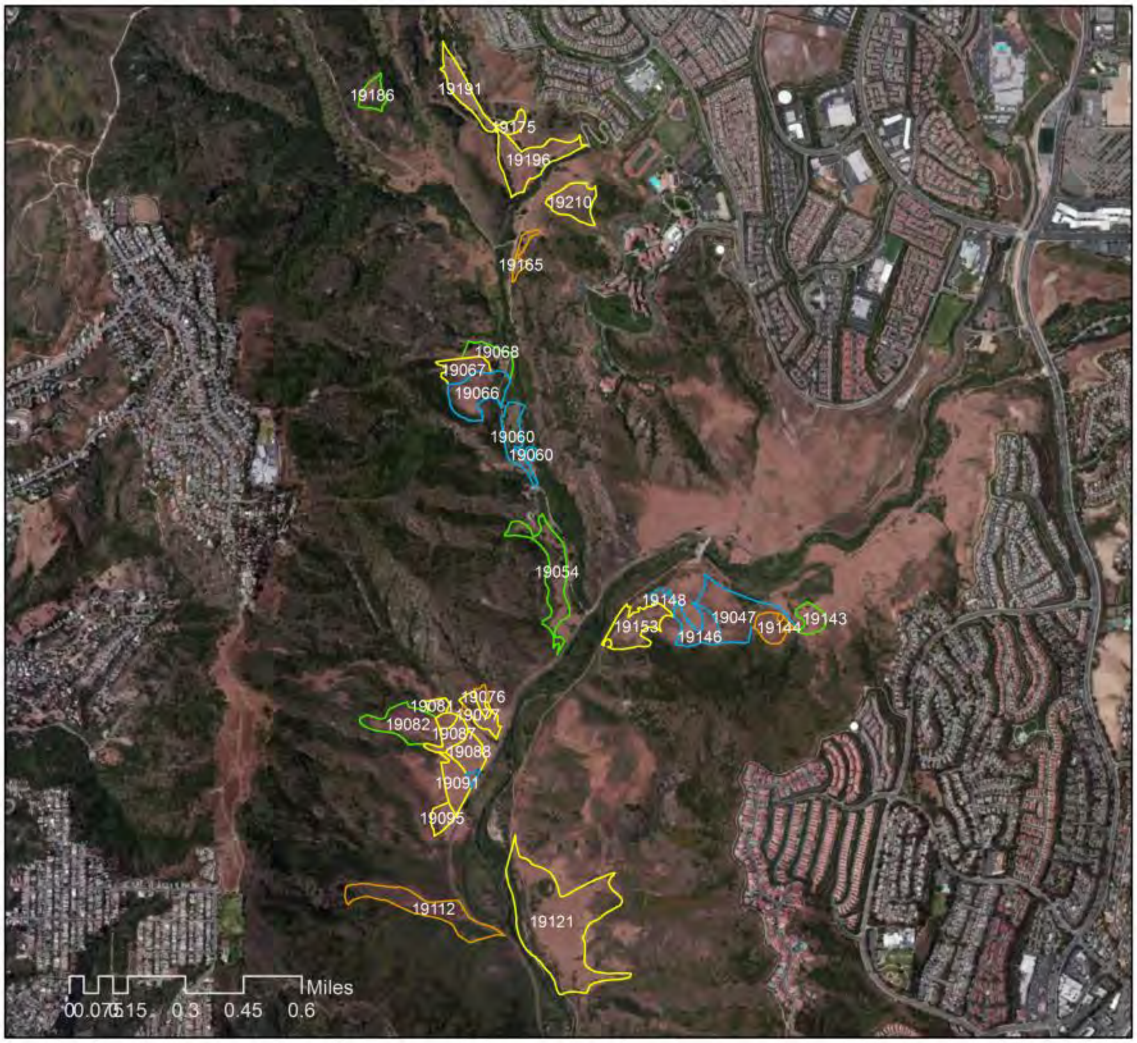
Native Cover

Cover Class Change 1998-2008

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Aliso and Wood Canyons
Native Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
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Native Cover
Cover Class Change 2008-2013

- -2.0
- -1.9 - -1.0
- -0.9- 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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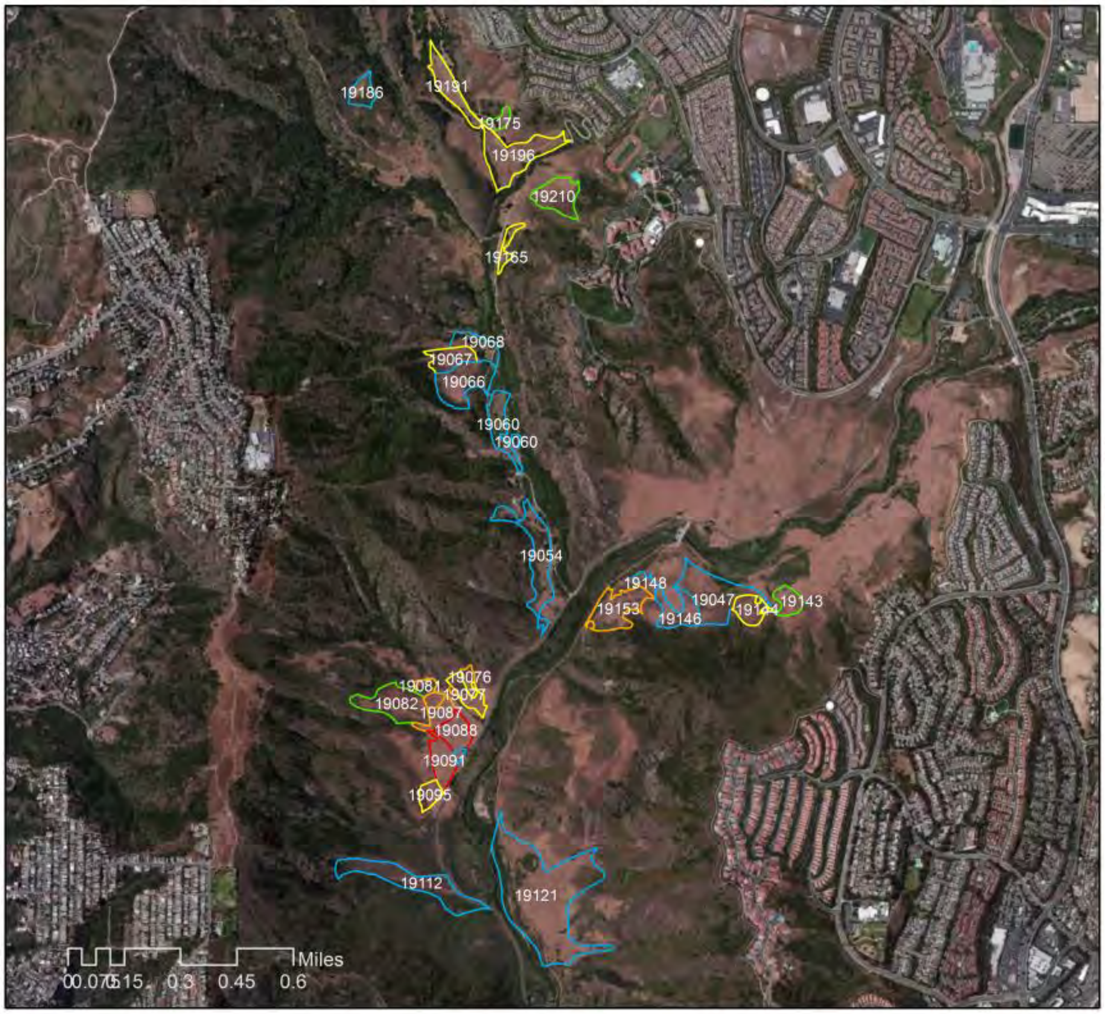
Aliso and Wood Canyons
Native Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
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Native Cover

Cover Class Change 1998-2013

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- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

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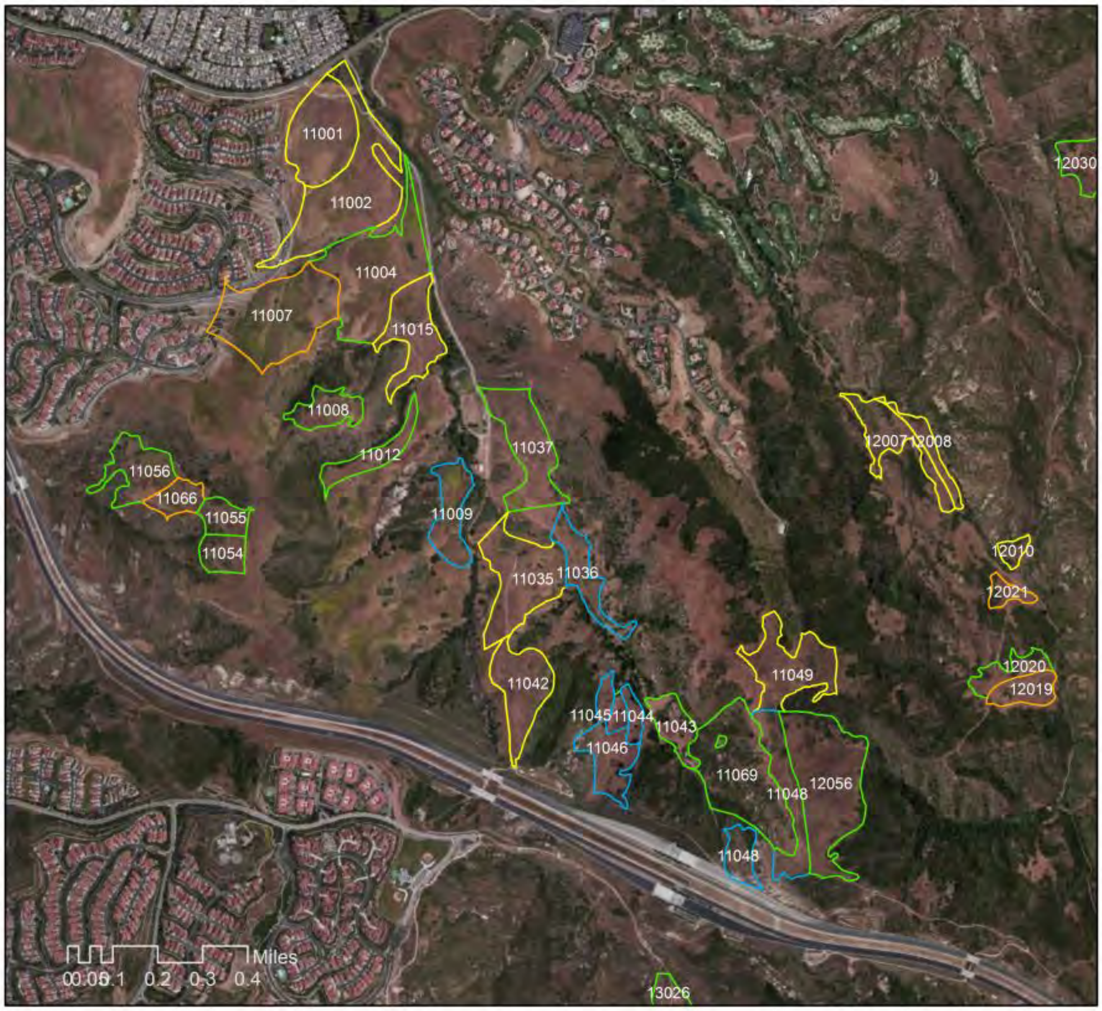
Bommer Canyon and Butterfly Valley
Native Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

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Native Cover
Cover Class Change 1998-2008
-3.0 - -2.0
-1.9 - -1.0
-0.9 - 0.0
0.1 - 1.0
1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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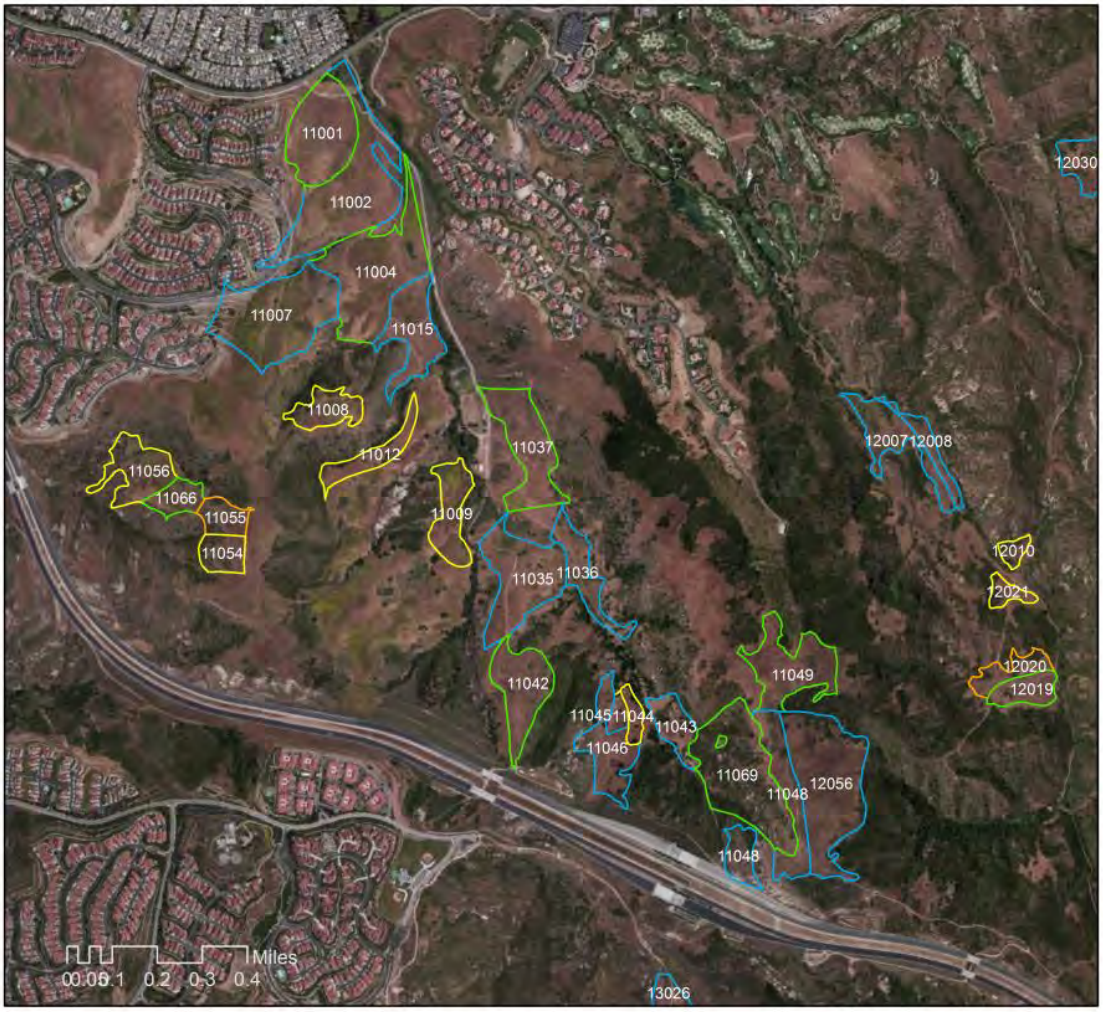
Bommer Canyon and Butterfly Valley
Native Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

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Native Cover

Cover Class Change 2008-2013

- -2.0 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
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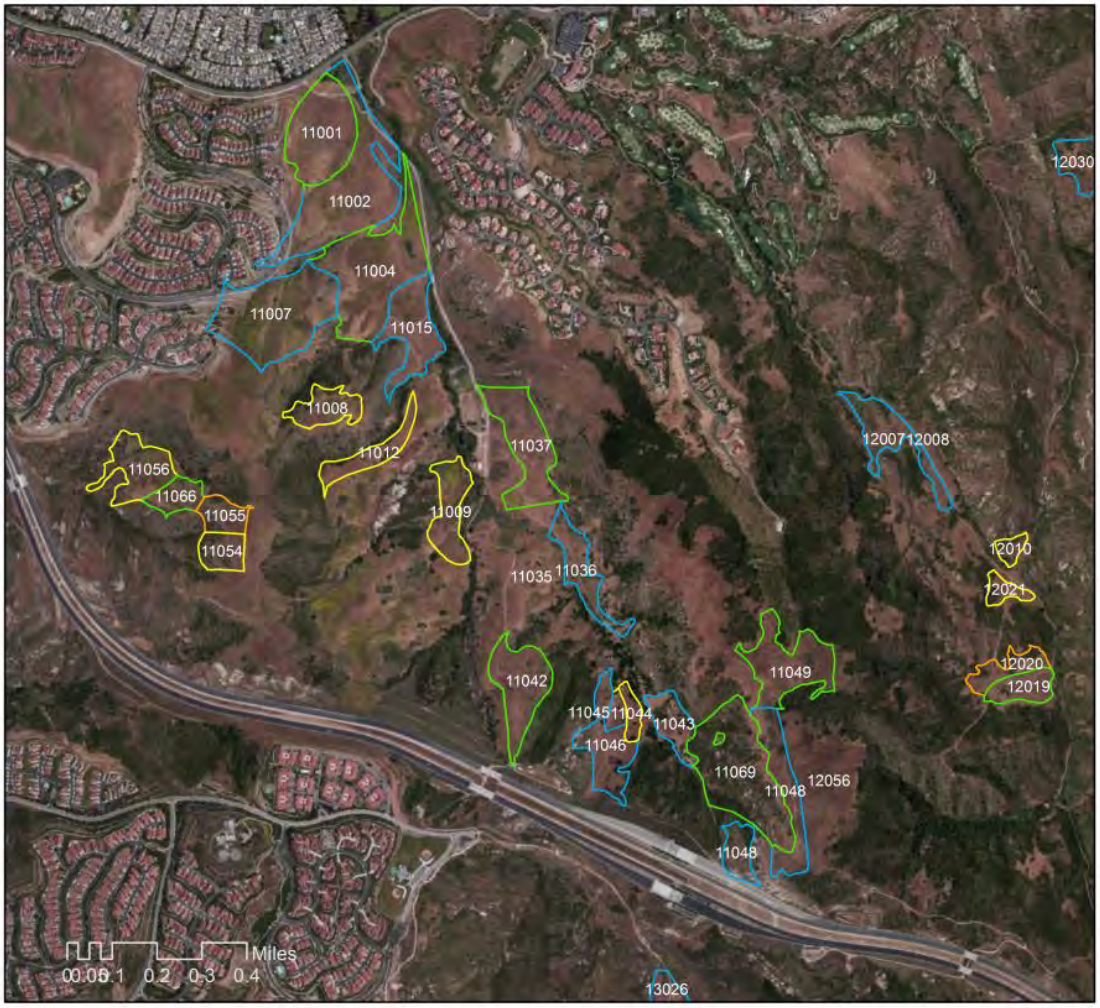
Bommer Canyon and Butterfly Valley
Native Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

N
W E
S

Native Cover

Cover Class Change 1998-2013

- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 2.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Crystal Cove State Park
Native Cover Class Change 1998-2008

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

N
W E
S

Native Vegetation Cover Class Change 1998-2008

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Crystal Cove State Park
Native Cover Class Change 2008-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Native Vegetation
Cover Class Change 2008-2013

- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Crystal Cove State Park
Native Cover Class Change 1998-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

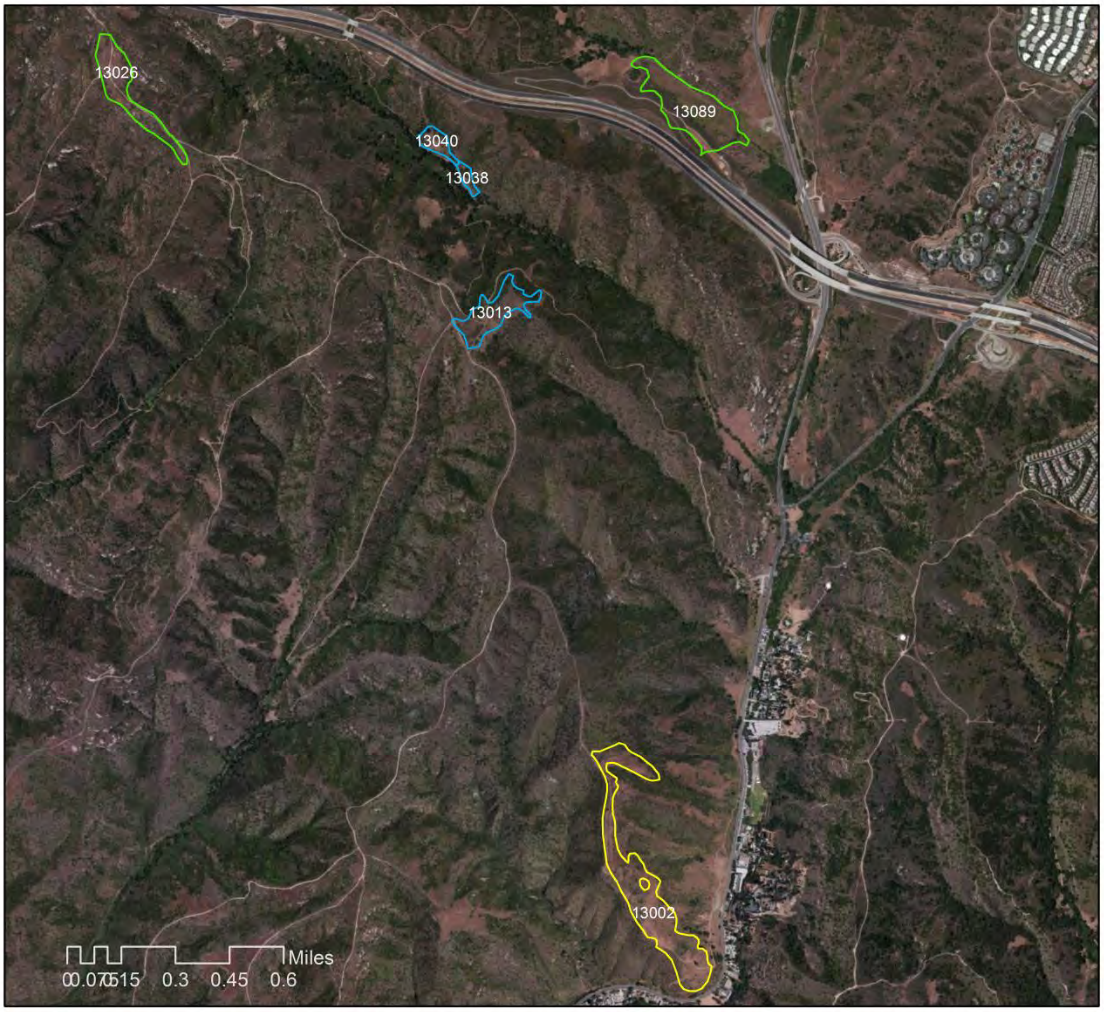
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Native Vegetation Cover Class Change 1998-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Laguna Canyon Wilderness
Native Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Native Vegetation
Cover Class Change 1998-2008

- -3.0- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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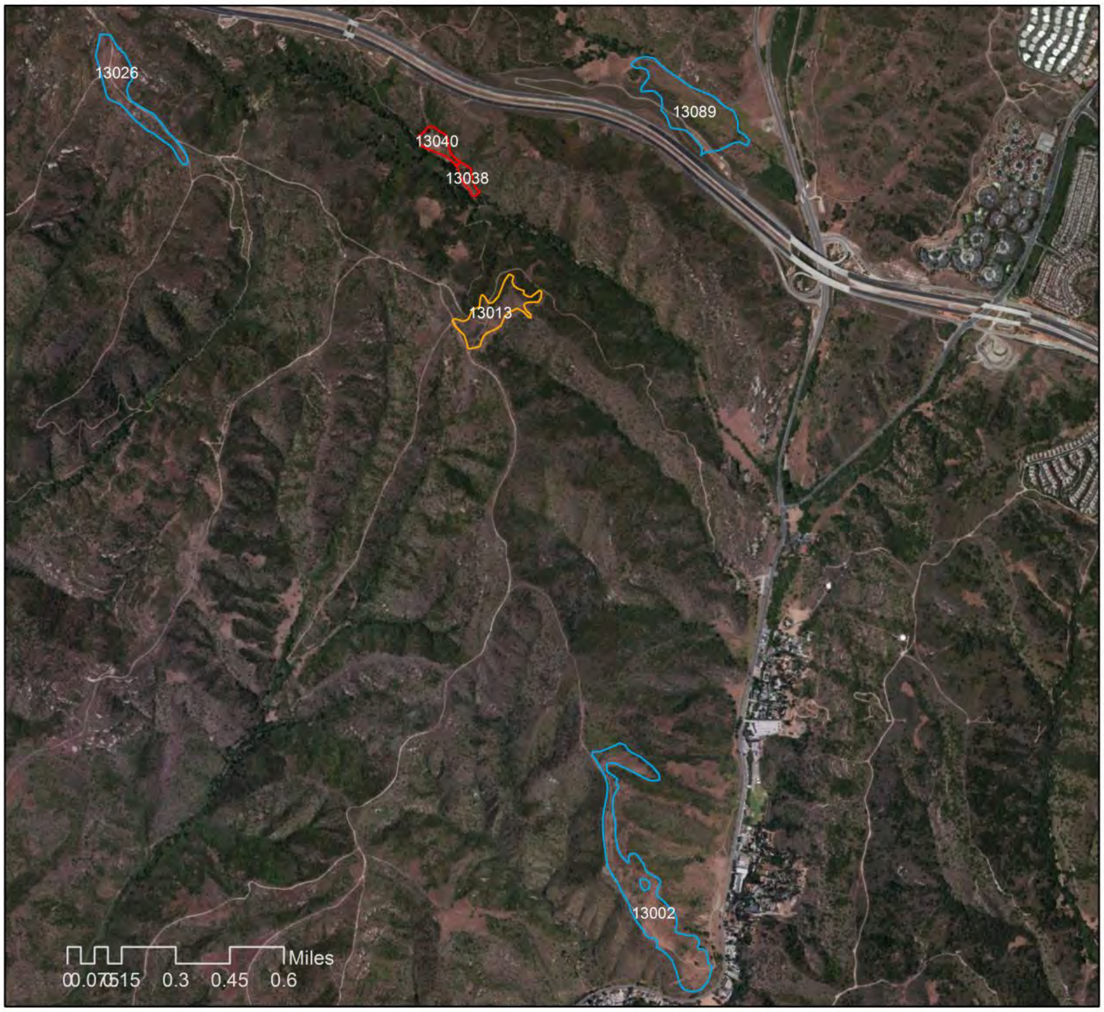
Laguna Canyon Wilderness
Native Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Native Vegetation Cover Class Change 2008-2013

- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.01 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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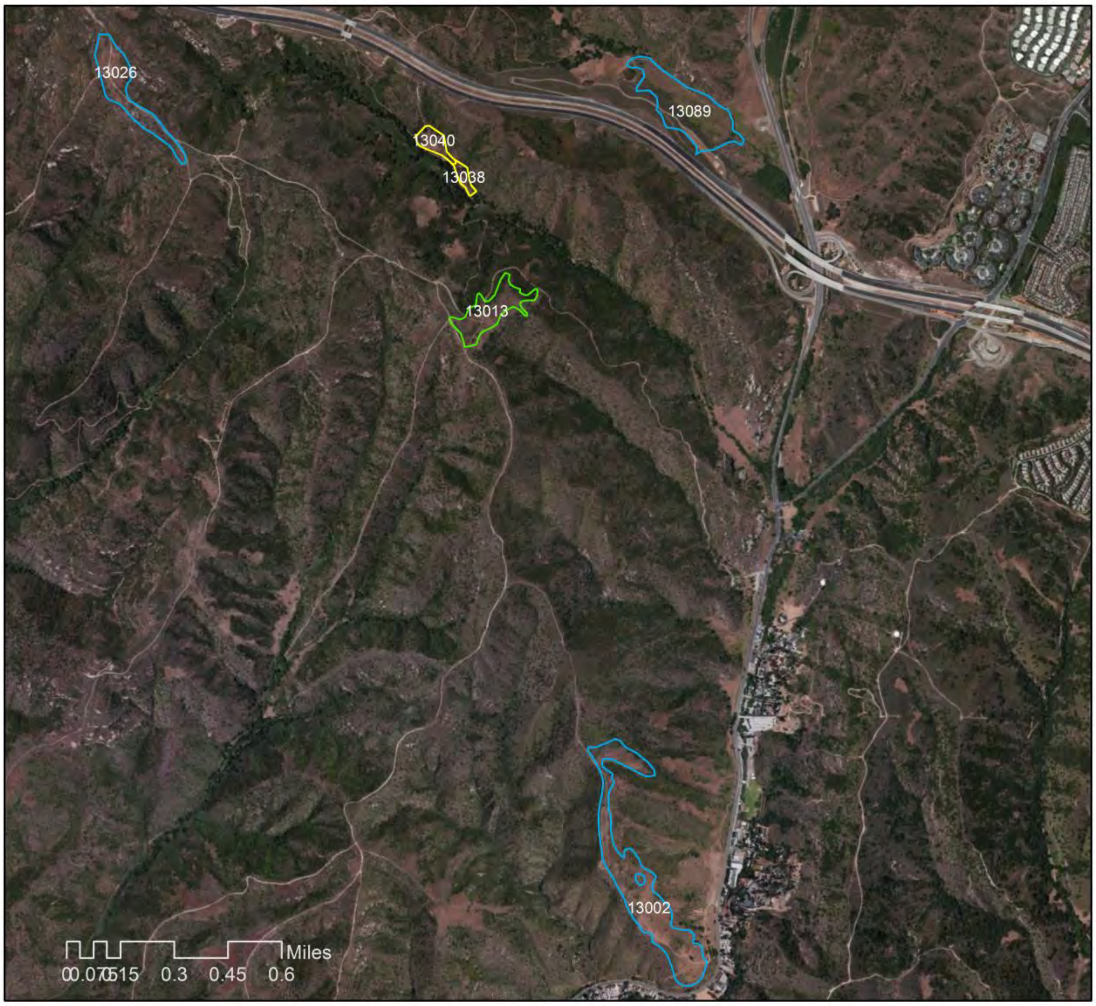
Laguna Canyon Wilderness
Native Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

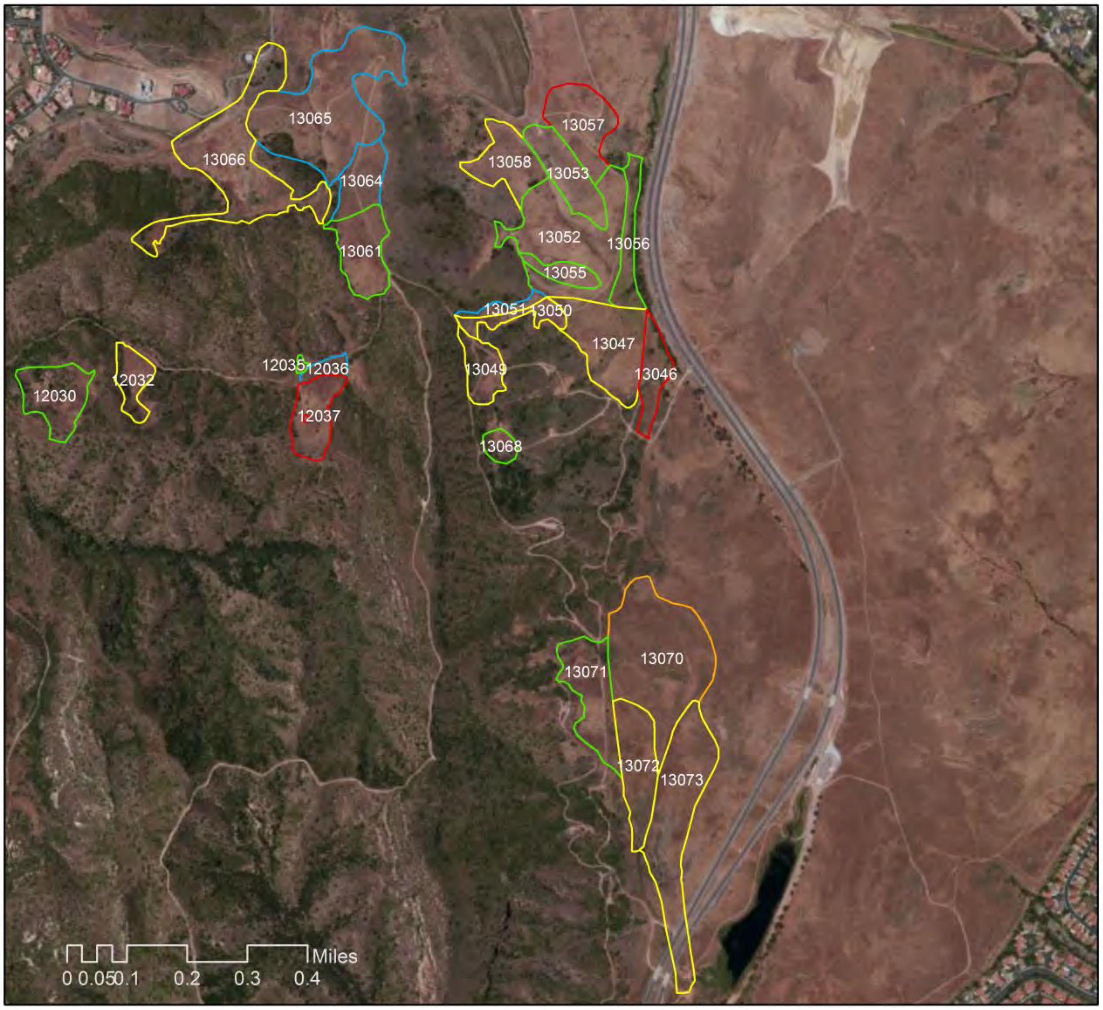
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Native Vegetation Cover Class Change 1998-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Mule Deer ans Serrano Ridge
Native Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

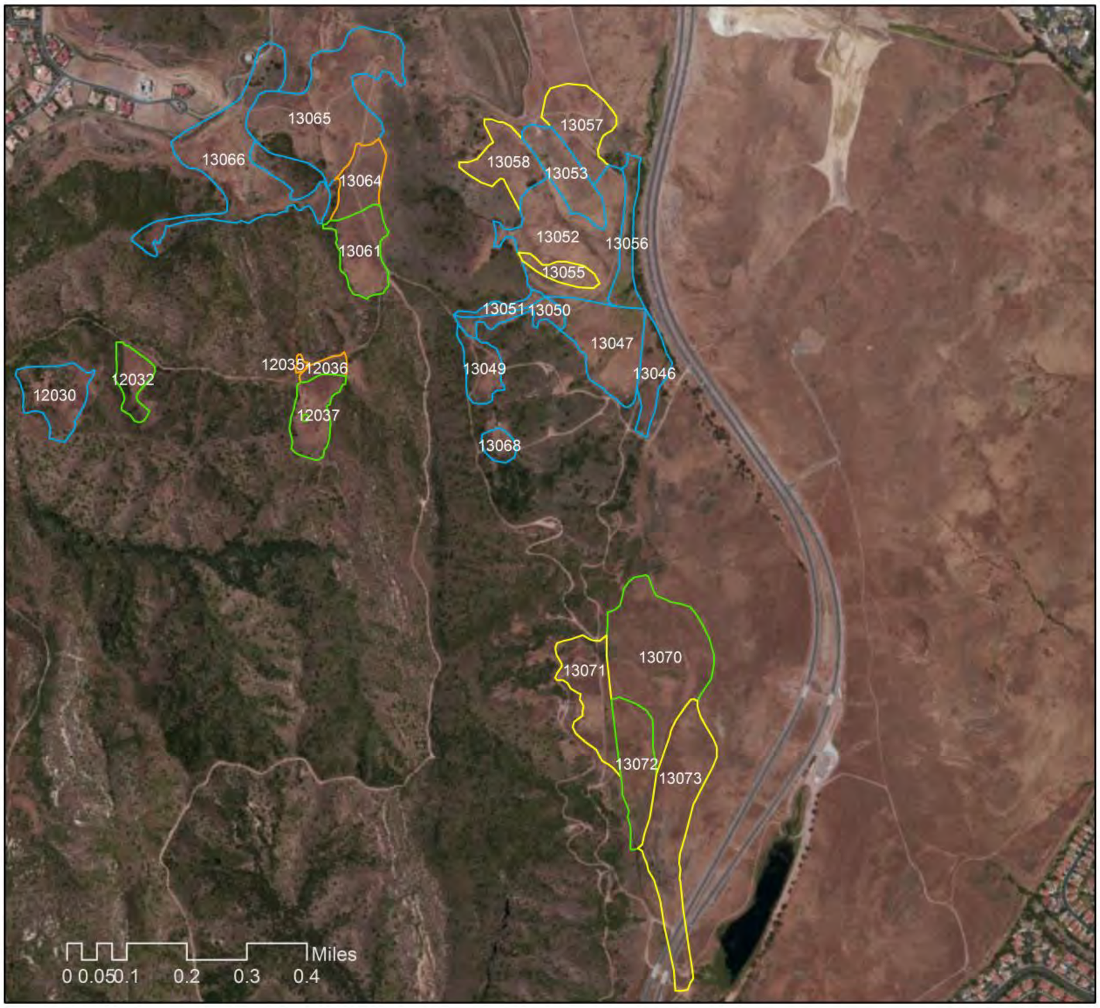
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Native Vegetation
Cover Class Change 1998-2008

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Mule Deer ans Serrano Ridge
Native Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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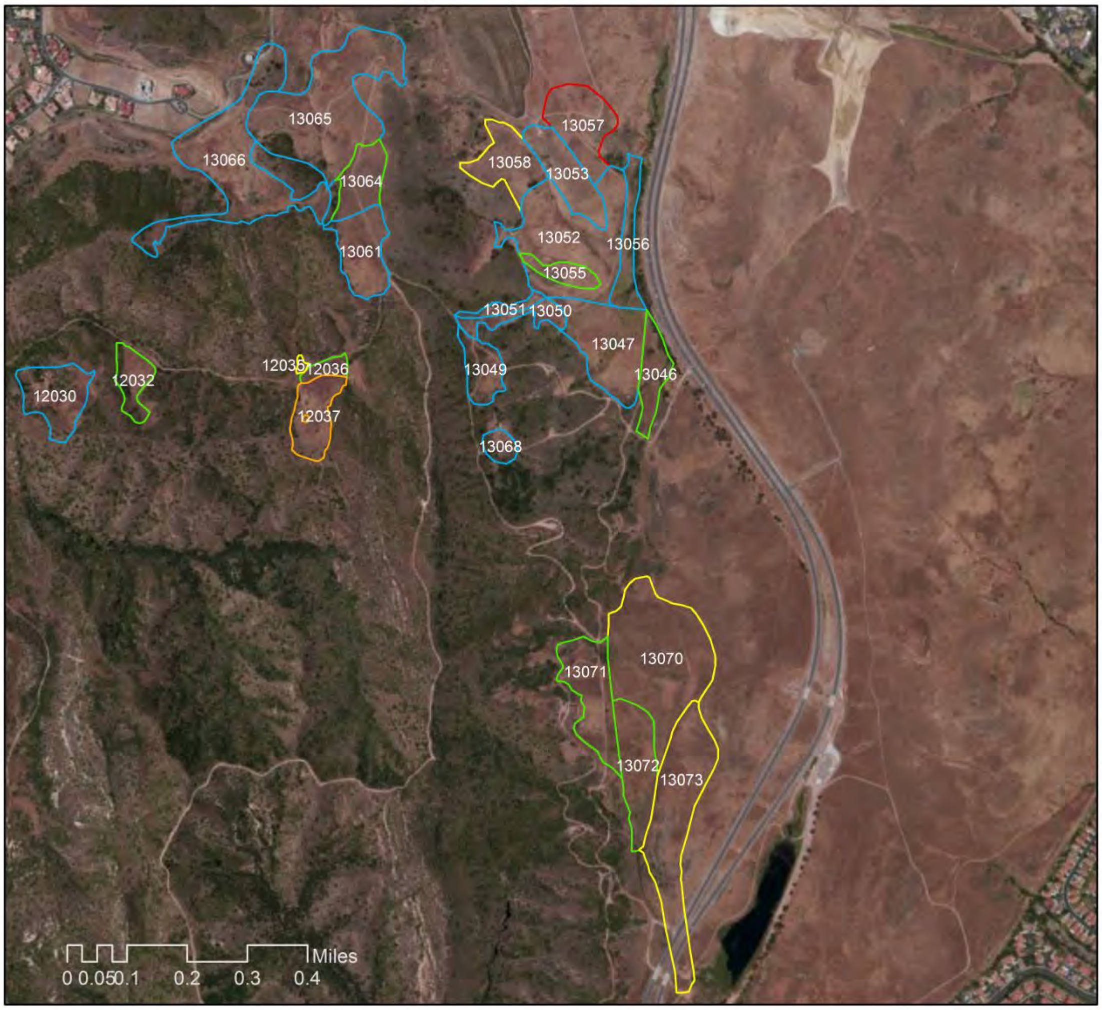
Mule Deer ans Serrano Ridge
Native Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Native Vegetation Cover Class Change 1998-2013

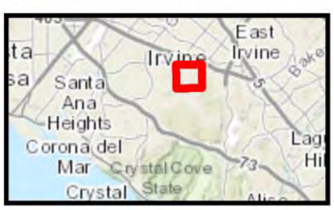
- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Quail Hill
Native Cover Class Change 1998-2008

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley



Native Vegetation Cover Class Change 1998-2008

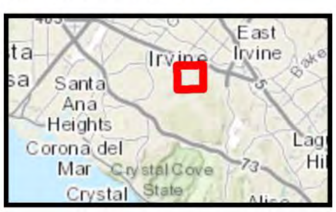
- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Quail Hill
Native Cover Class Change 2008-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley



Native Vegetation Cover Class Change 2008-2013

- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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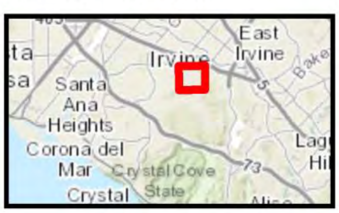
Quail Hill
Native Cover Class Change 1998-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

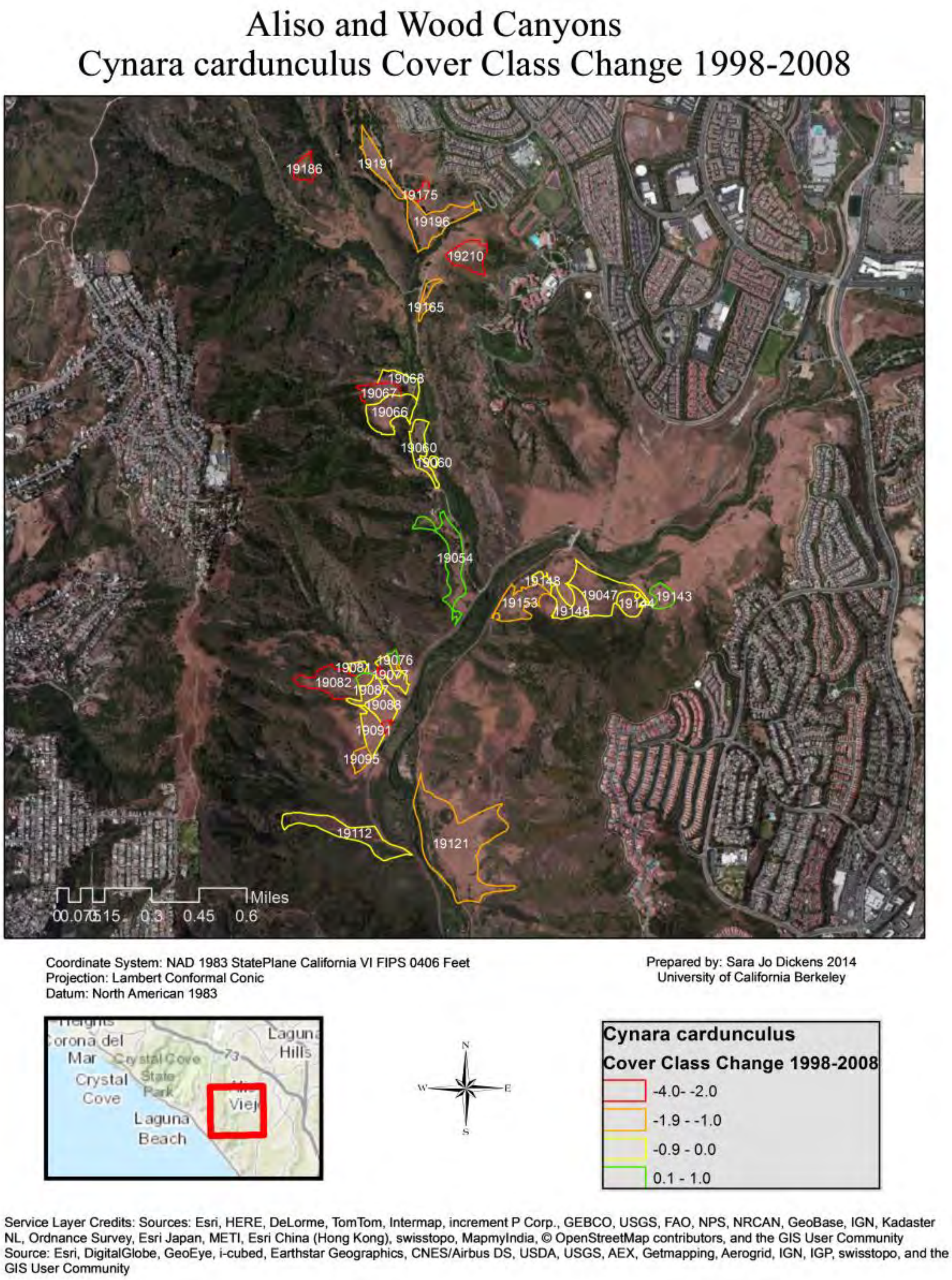


Native Vegetation
Cover Class Change 1998-2013

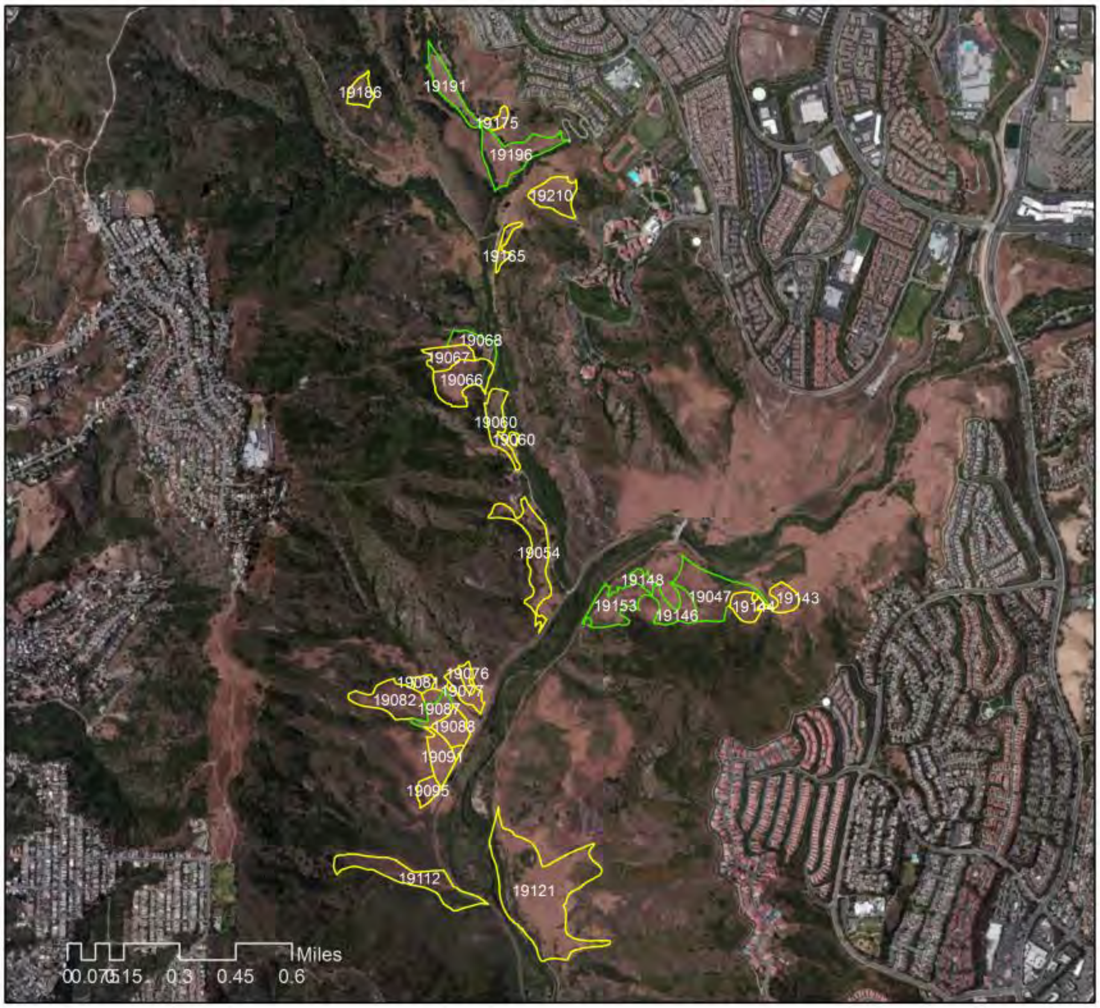
- -3.0- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Cynara cardunculus

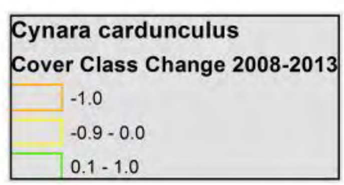


Aliso and Wood Canyons
Cynara cardunculus Cover Class Change 2008-2013



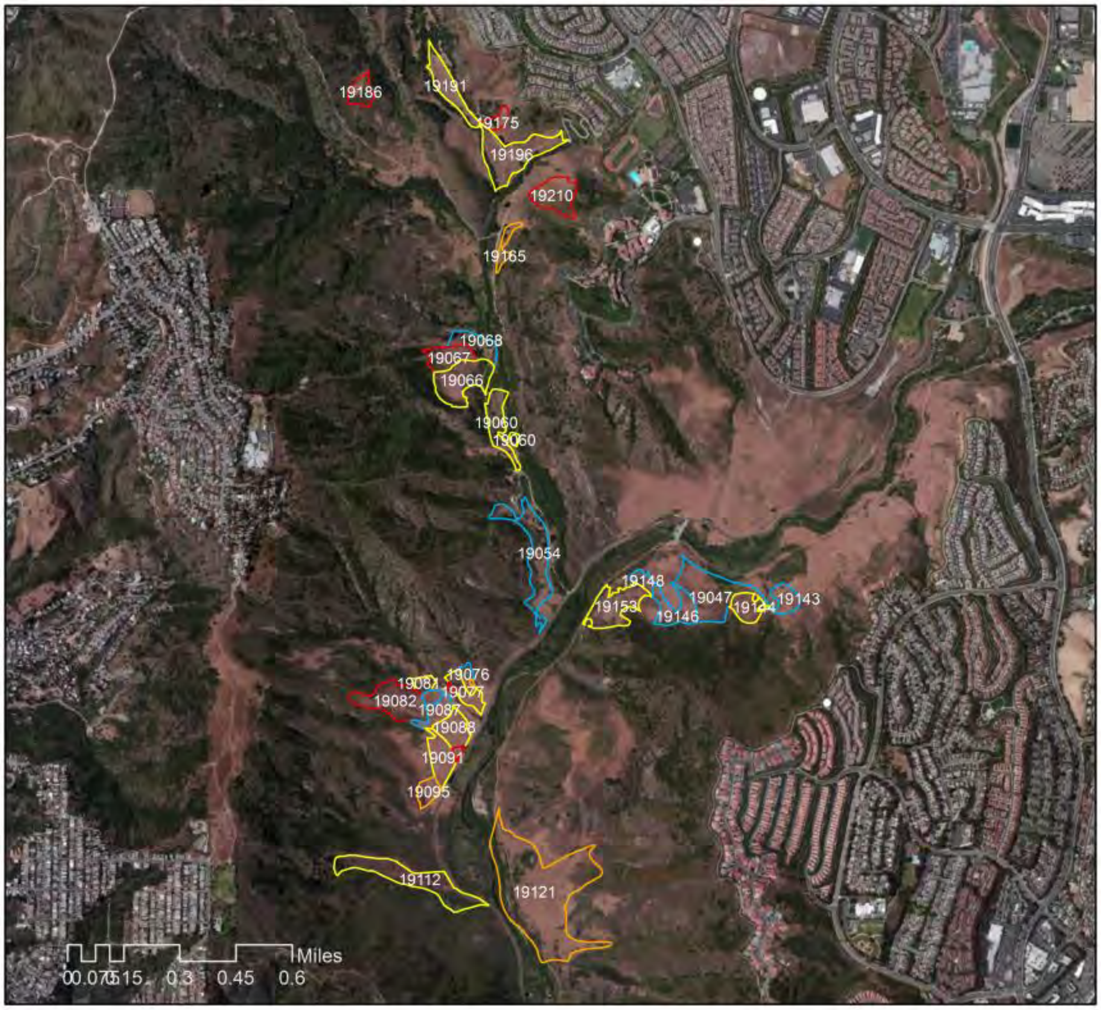
Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley



Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Aliso and Wood Canyons
Cynara cardunculus Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

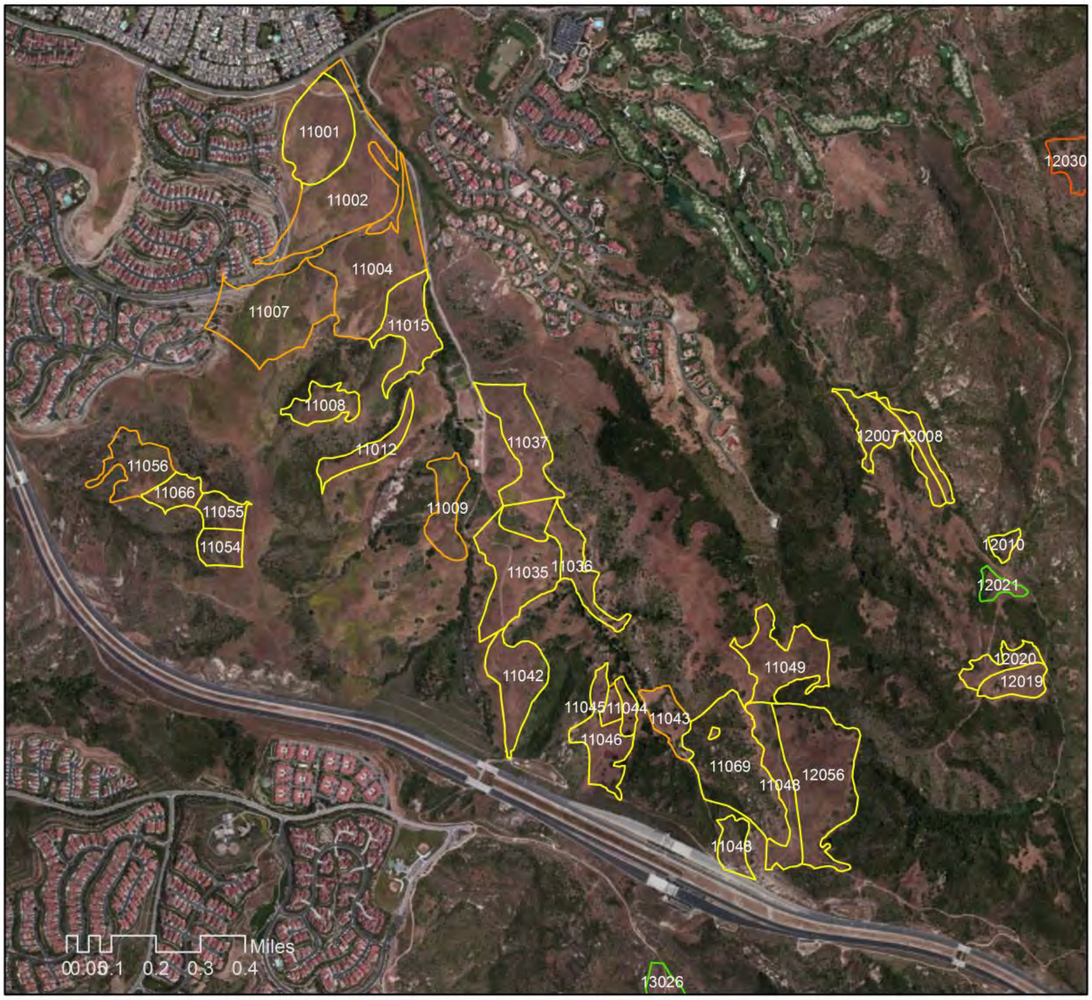
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus
Cover Class Change 1998-2013

- -4.0- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Bommer Canyon and Butterfly Valley
Cynara cardunculus Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

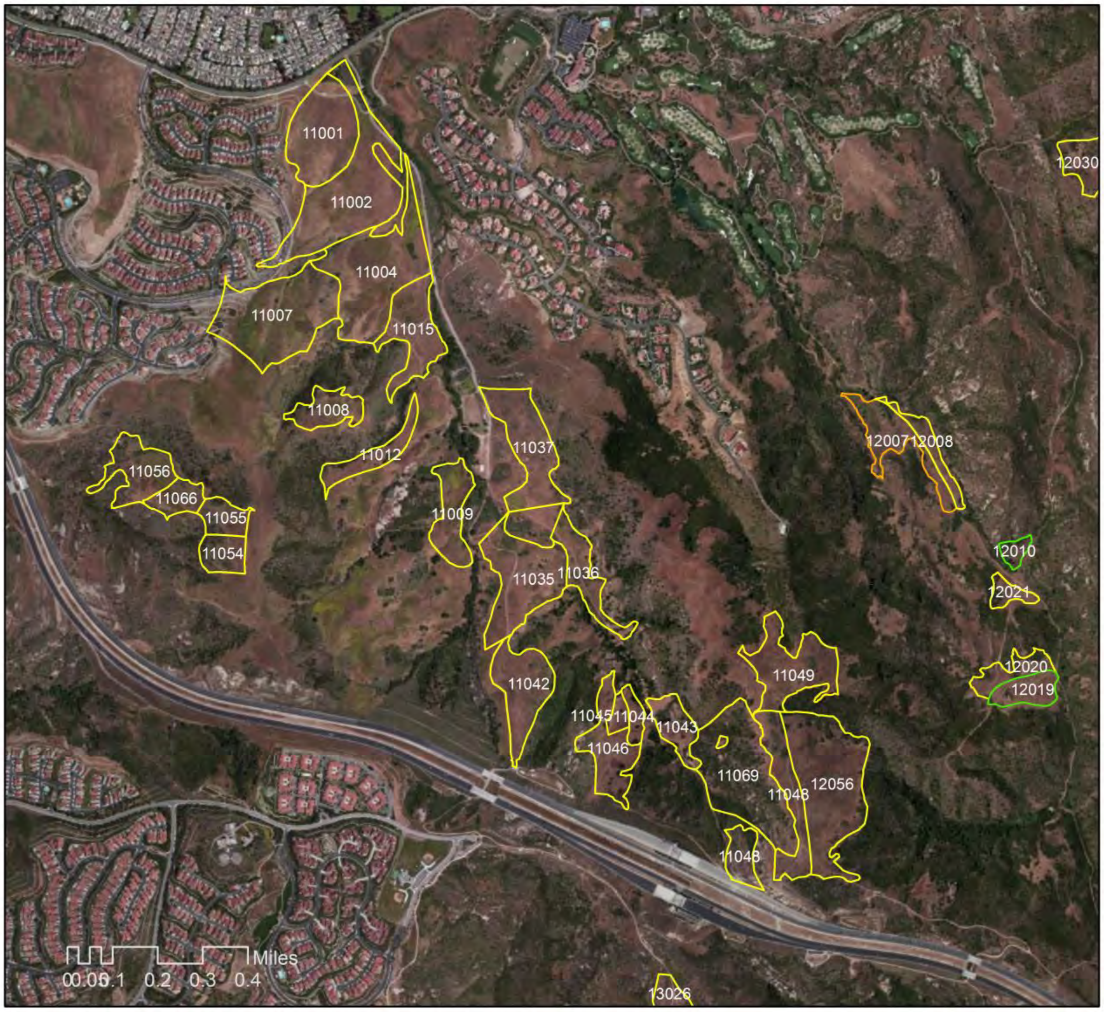
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus
Cover Class Change 1998-2008

- -4.0- -2.0
- -2.1 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Bommer Canyon and Butterfly Valley
Cynara cardunculus Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

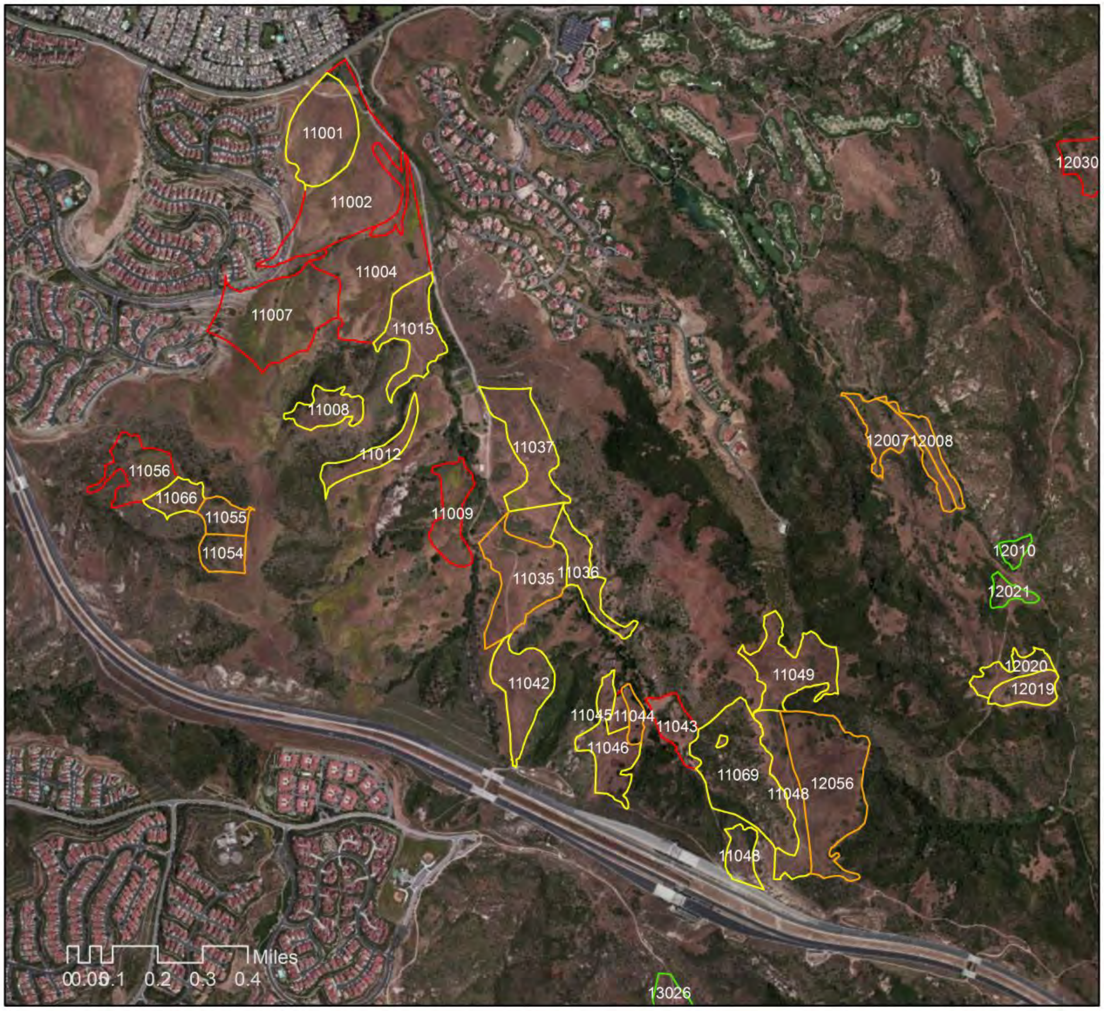
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus
Cover Class Change 2008-2013

- -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Bommer Canyon and Butterfly Valley
Cynara cardunculus Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus
Cover Class Change 1998-2013

- -4.0 - -2.0
- -1.9- -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Crystal Cove State Park
Cynara cardunculus Cover Class Change 1998-2008

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus
Cover Class Change 1998-2008

- -4.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Crystal Cove State Park
Cynara cardunculus Cover Class Change 2008-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus Cover Class Change 2008-2013

- -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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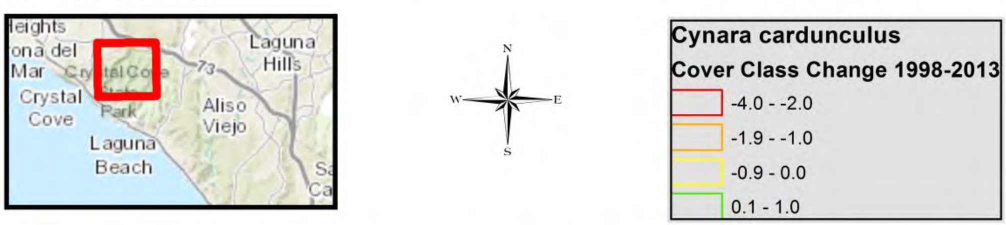
Crystal Cove State Park
Cynara cardunculus Cover Class Change 1998-2013

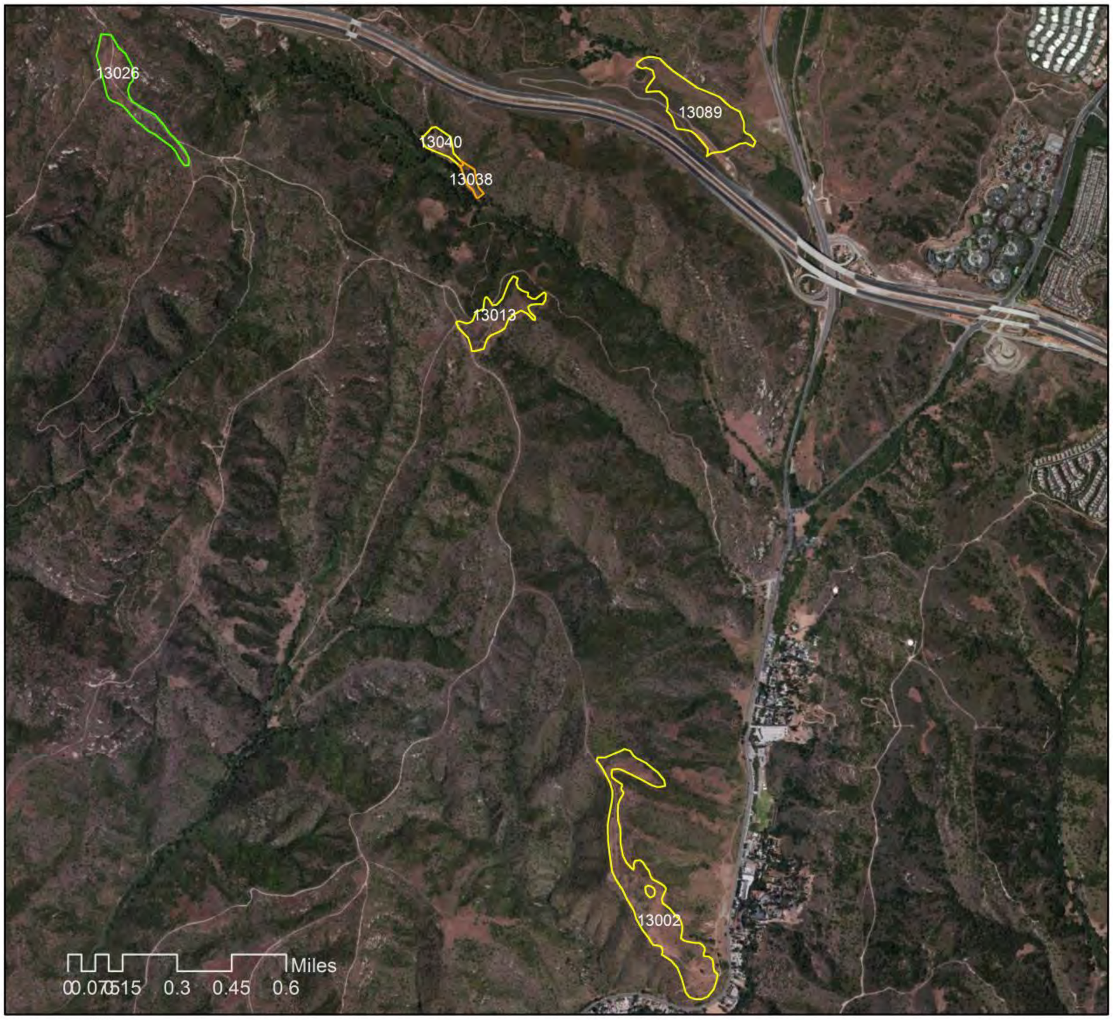
Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley



Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Laguna Canyon Wilderness
Cynara cardunculus Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus
Cover Class Change 1998-2008
- -4.0 - -2.0
- -1.9 - -1.0
- -0.9- 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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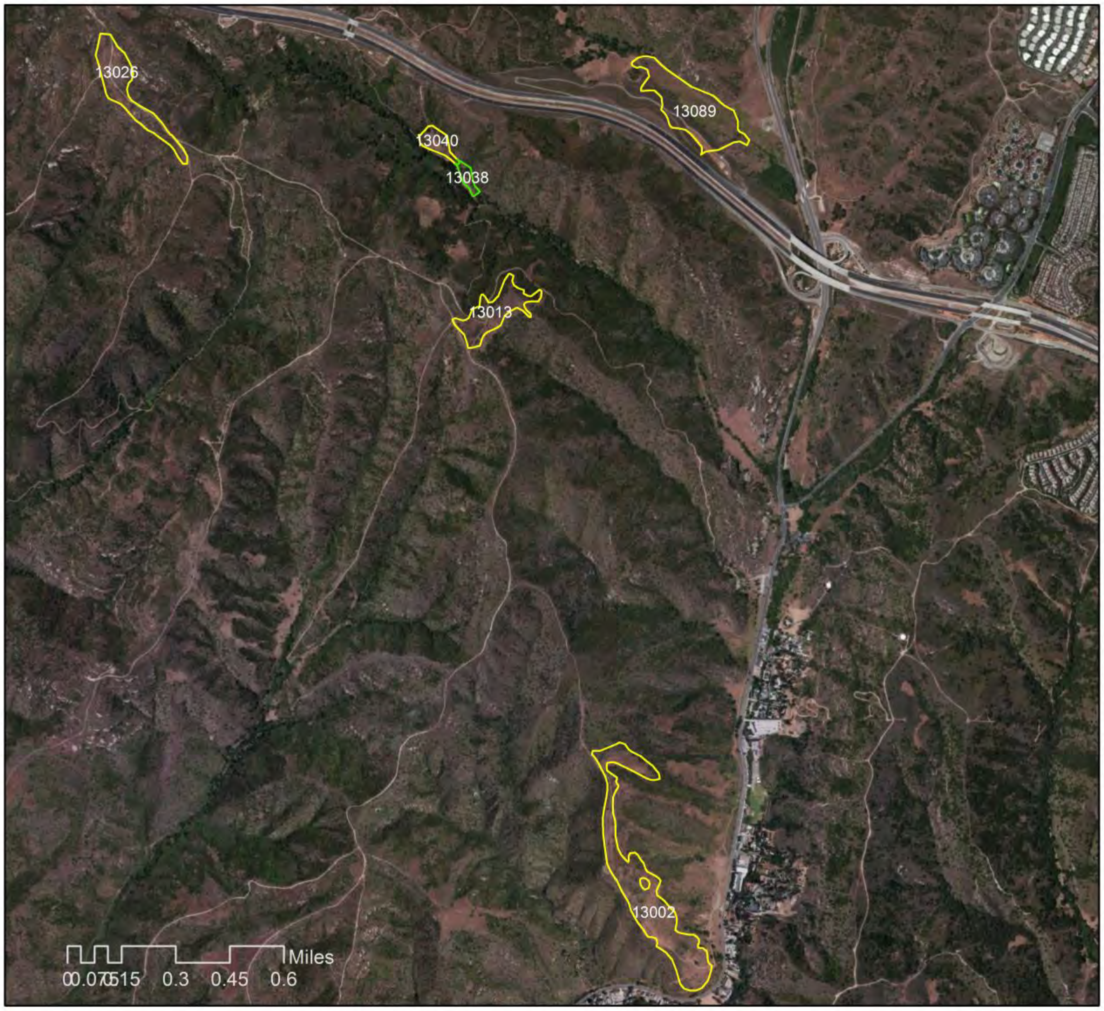
Laguna Canyon Wilderness
Cynara carduncululus Cover Class Change 2008-2013



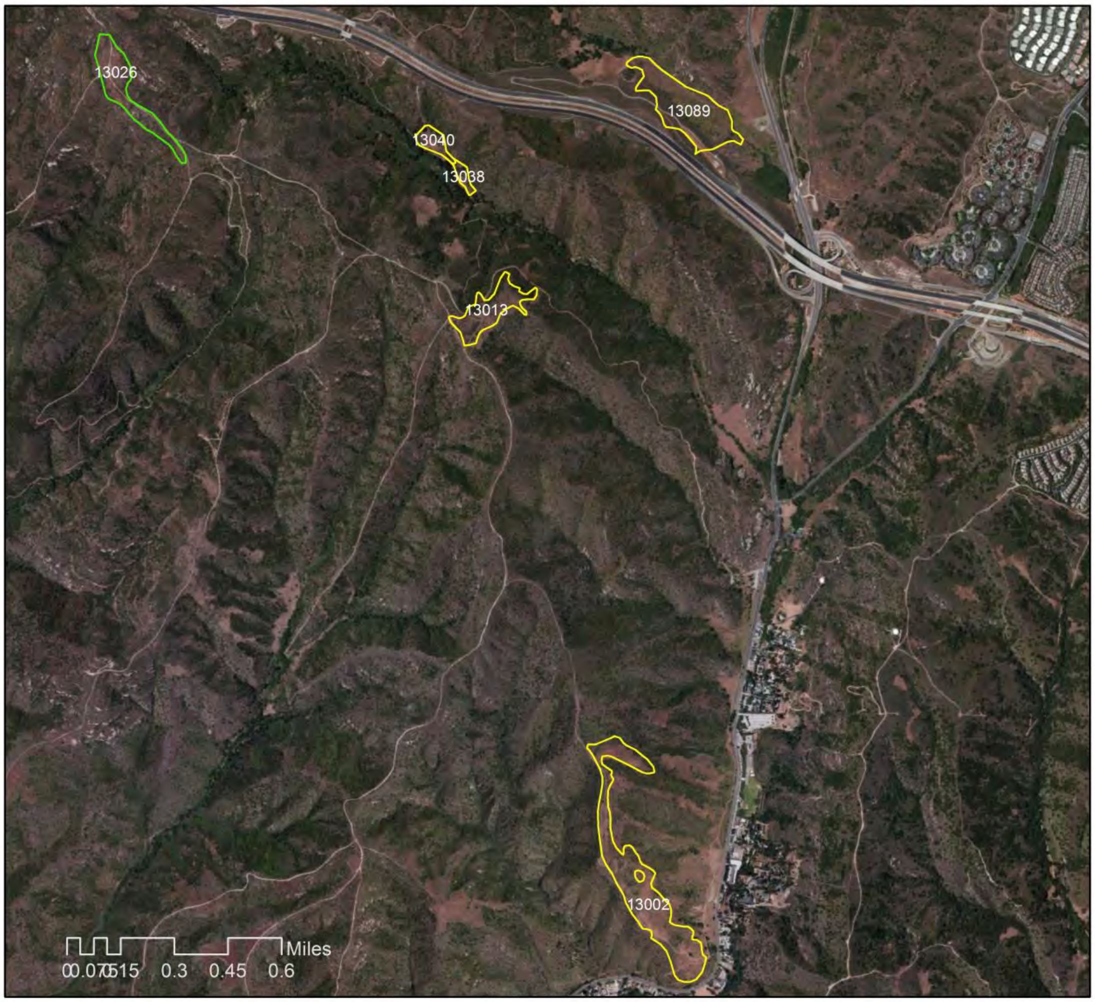
Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara carduncululus
Cover Class Change 2008-2013
- -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Laguna Canyon Wilderness
Cynara carduncululus Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

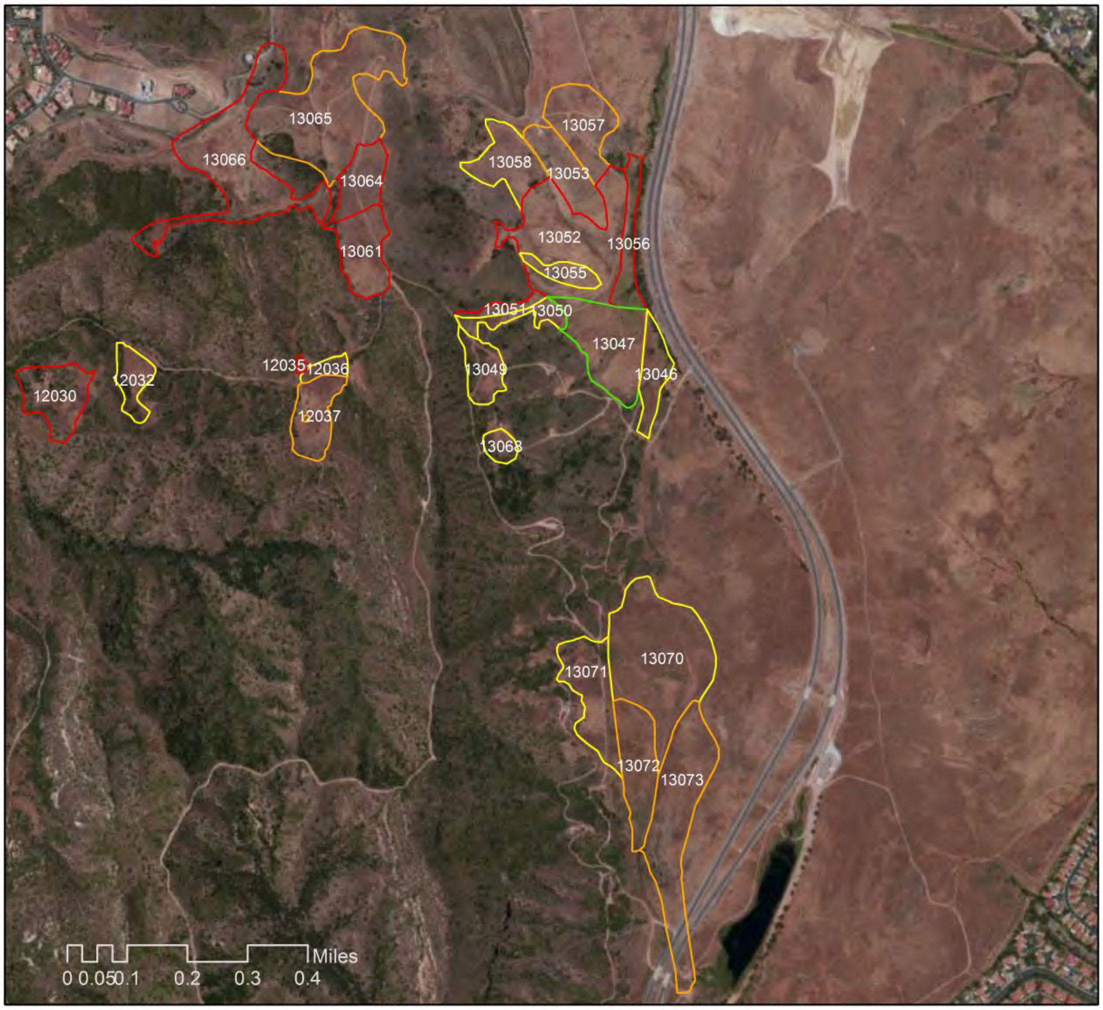
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara carduncululus
Cover Class Change 1998-2013

- -4.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Mule Deer ans Serrano Ridge
Cynara cardunculus Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus
Cover Class Change 1998-2008
- -4.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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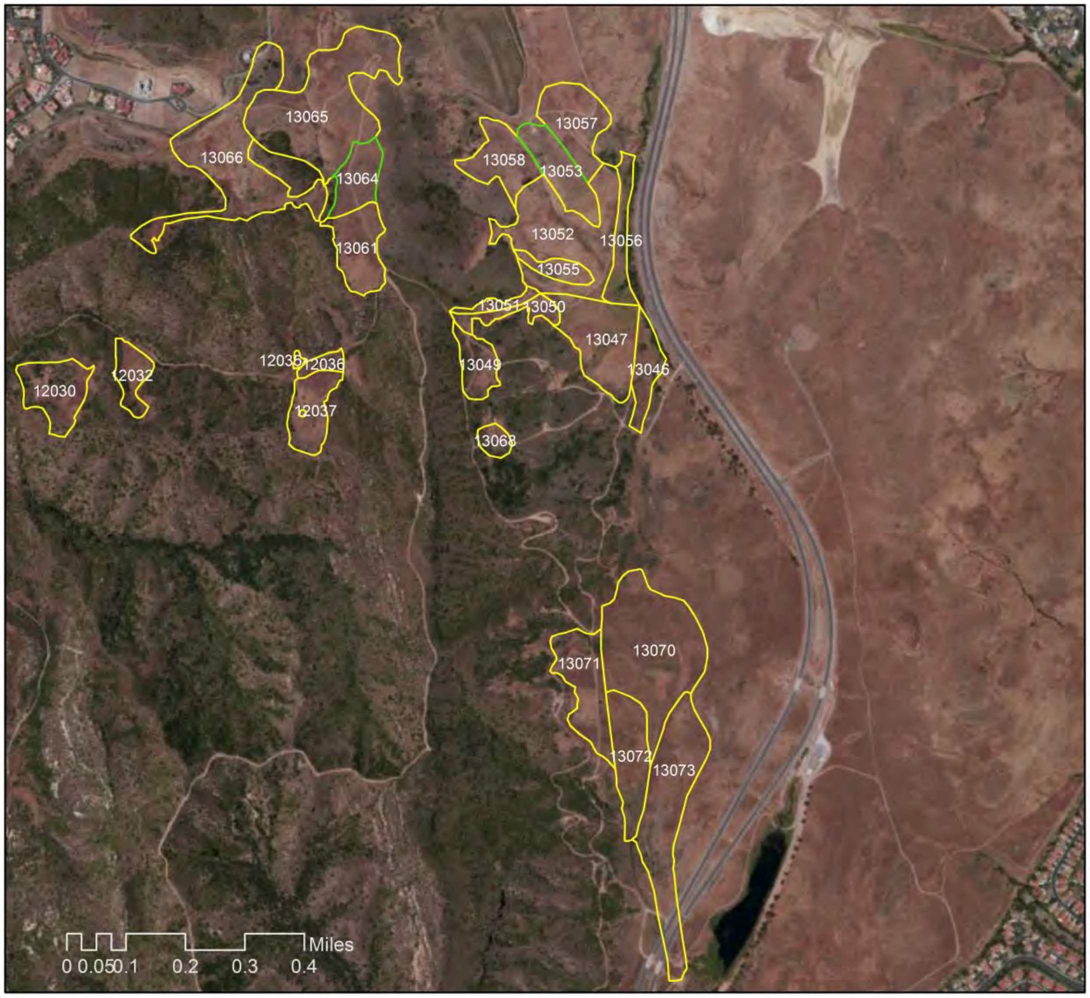
Mule Deer ans Serrano Ridge
Cynara cardunculus Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

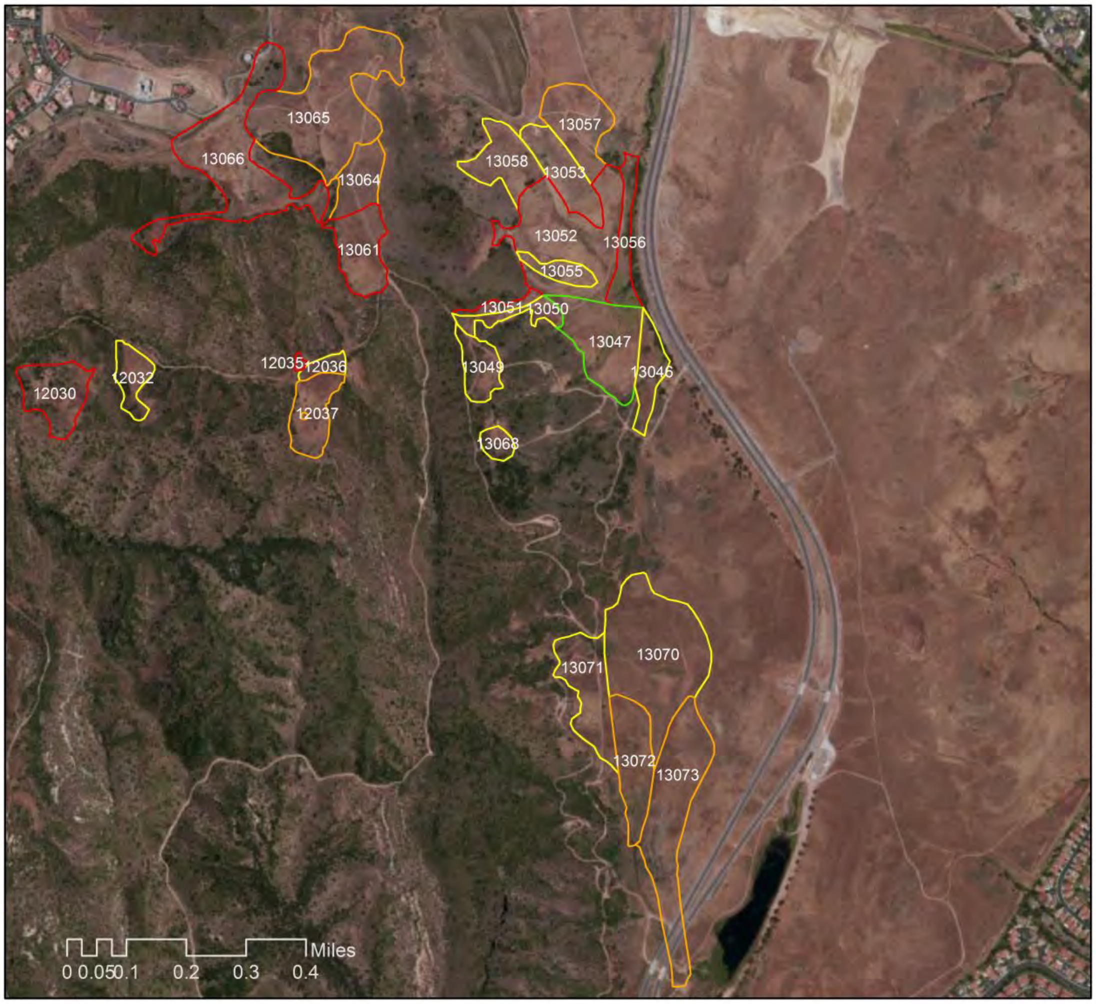
N
W E
S

Cynara cardunculus
Cover Class Change 2008-2013

- -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Mule Deer ans Serrano Ridge
Cynara carduncullus Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara carduncullus
Cover Class Change 1998-2013

- -4.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Quail Hill
Cynara cardunculus Class Change 1998-2008

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Cynara cardunculus
Cover Class Change 1998-2008

- -4.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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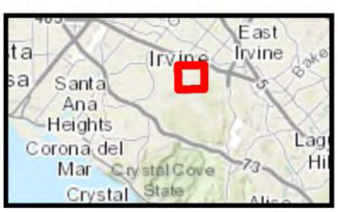
Quail Hill
Cynara cardunculus Class Change 2008-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley



Cynara cardunculus
Cover Class Change 2008-2013

- -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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Quail Hill
Cynara carduncululus Class Change 1998-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
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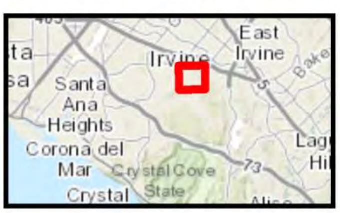
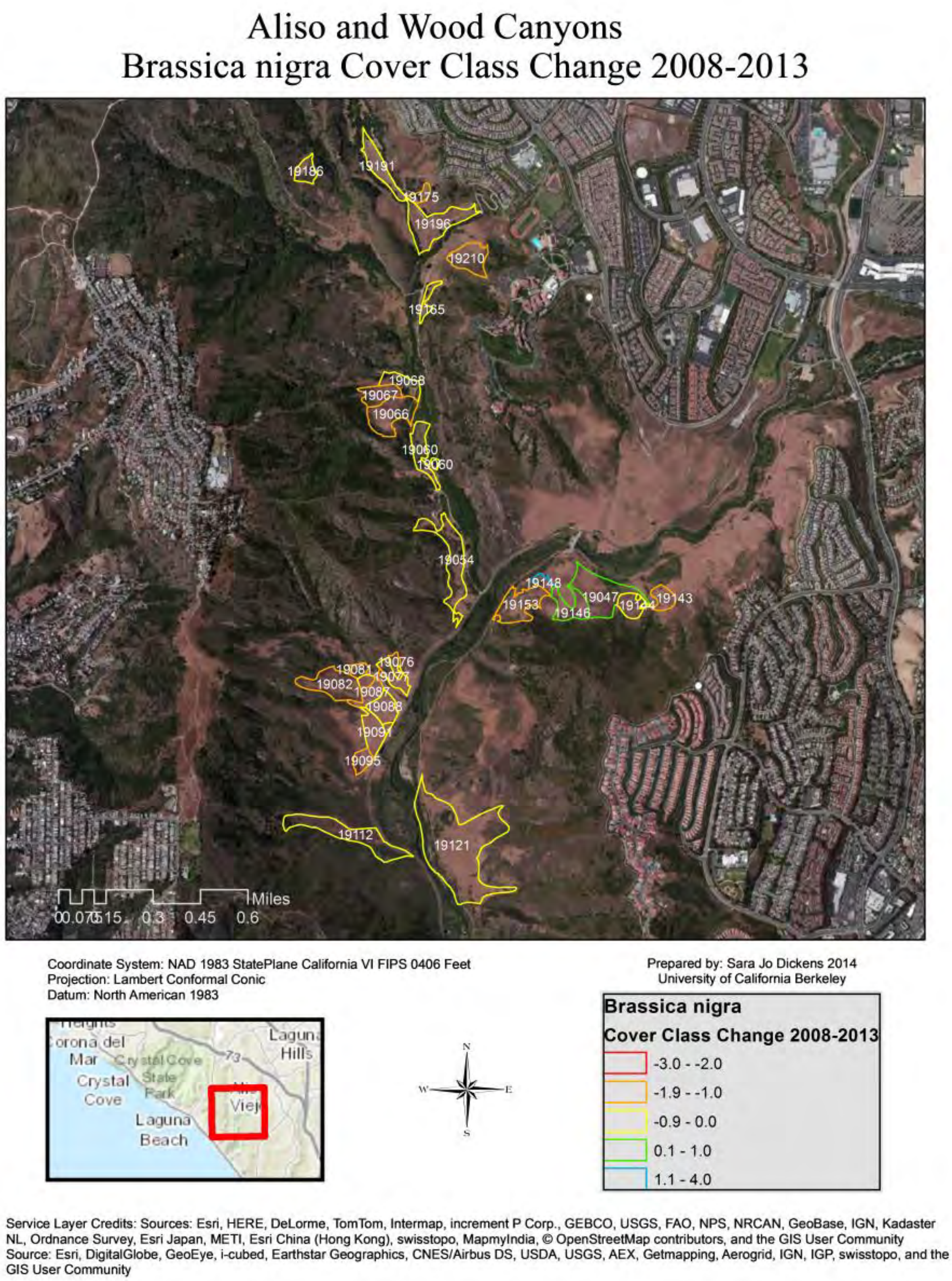


Cynara carduncululus
Cover Class Change 1998-2013

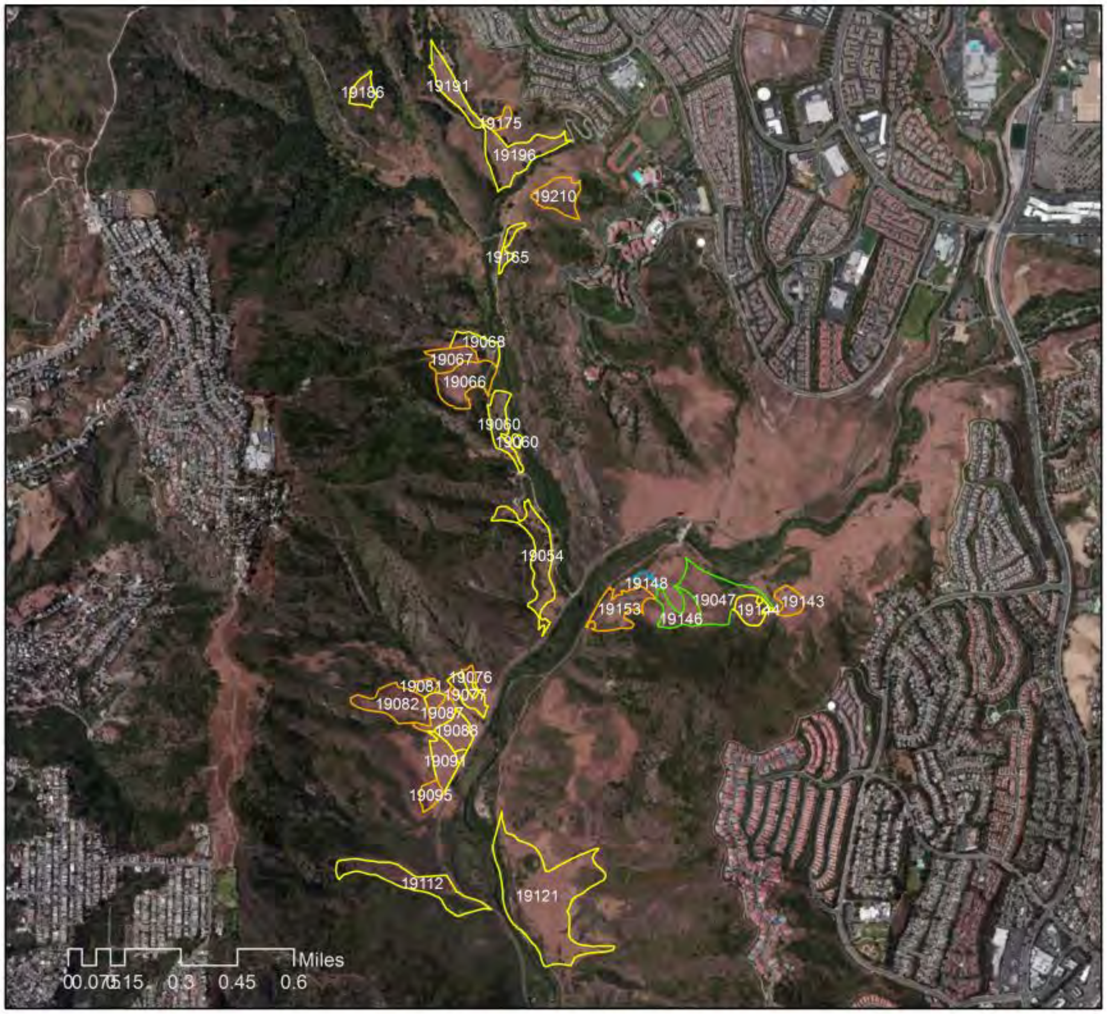
- -4.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Brassica nigra



Aliso and Wood Canyons
Brassica nigra Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

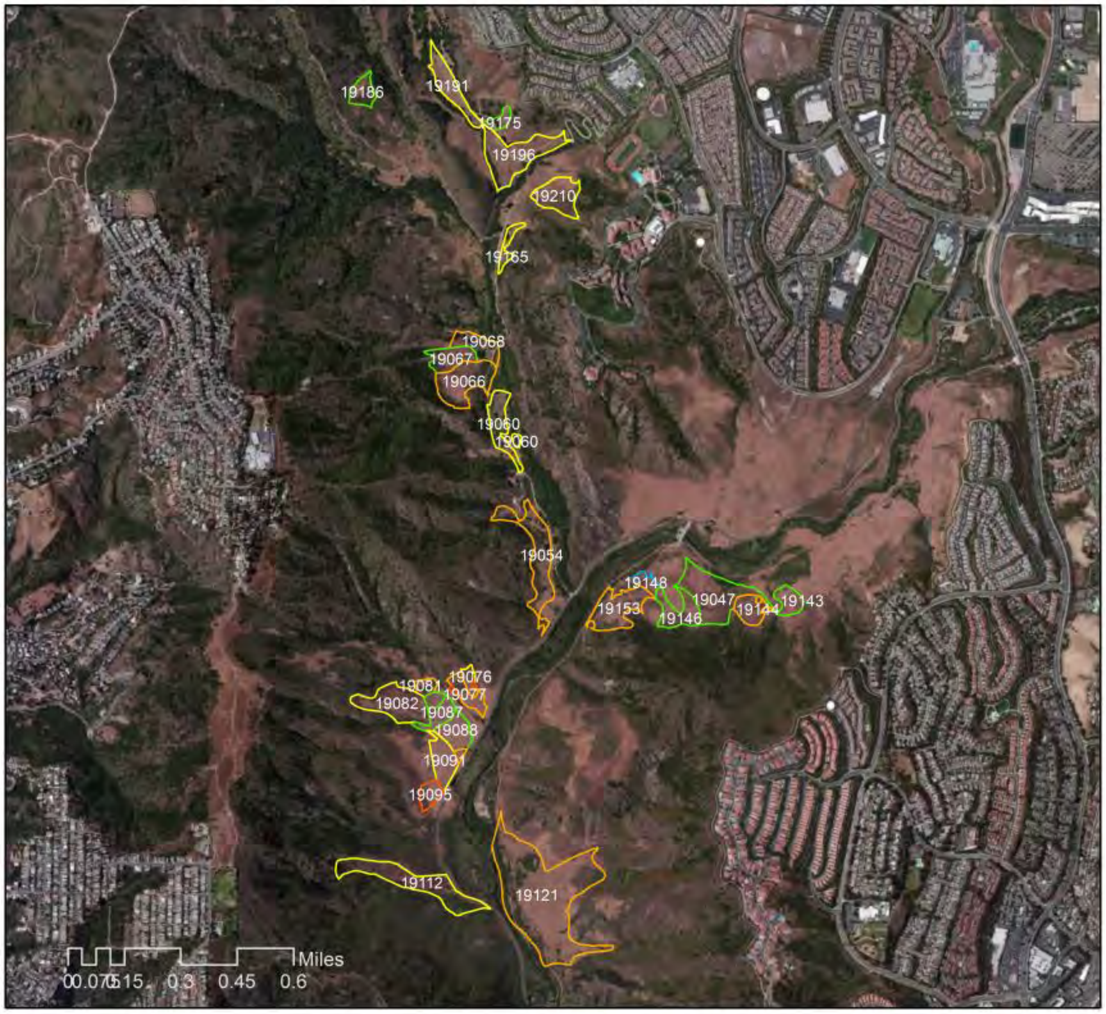
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 2008-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Aliso and Wood Canyons
Brassica nigra Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

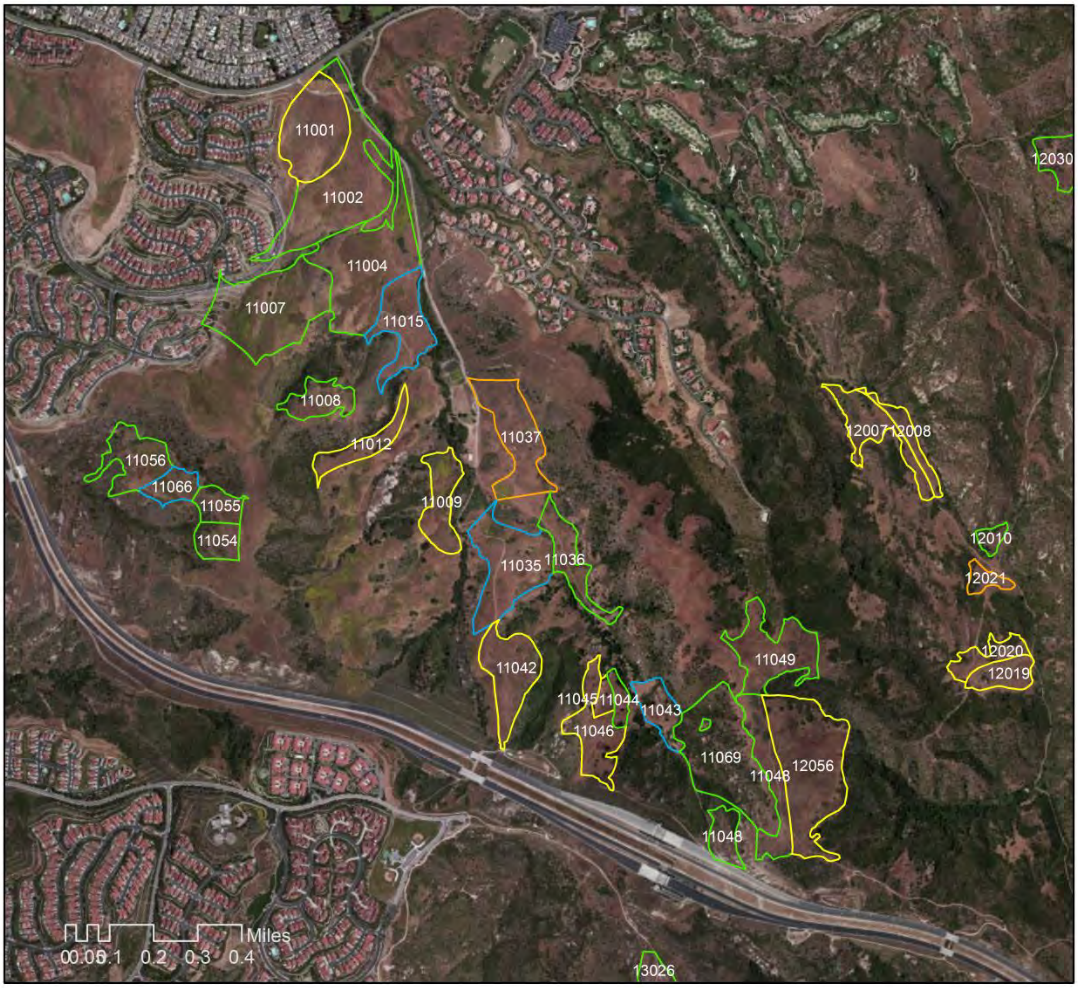
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 1998-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 5.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Bommer Canyon and Butterfly Valley
Brassica nigra Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

N
W E
S

Brassica nigra
Cover Class Change 1998-2008

- -2.0
- -1.9- -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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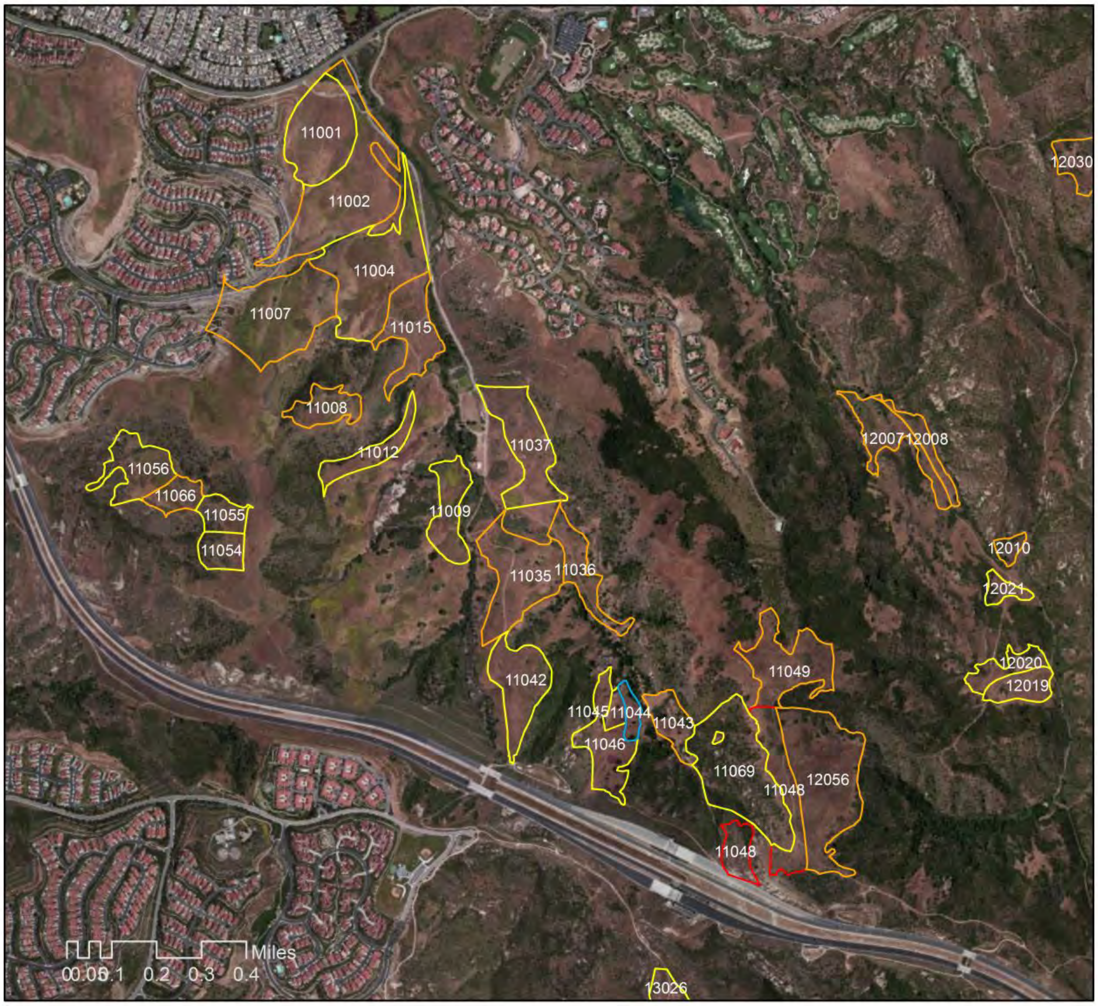
Bommer Canyon and Butterfly Valley
Brassica nigra Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 2008-2013

- -3.0 - -2.0
- -1.9- -1.0
- -0.9- 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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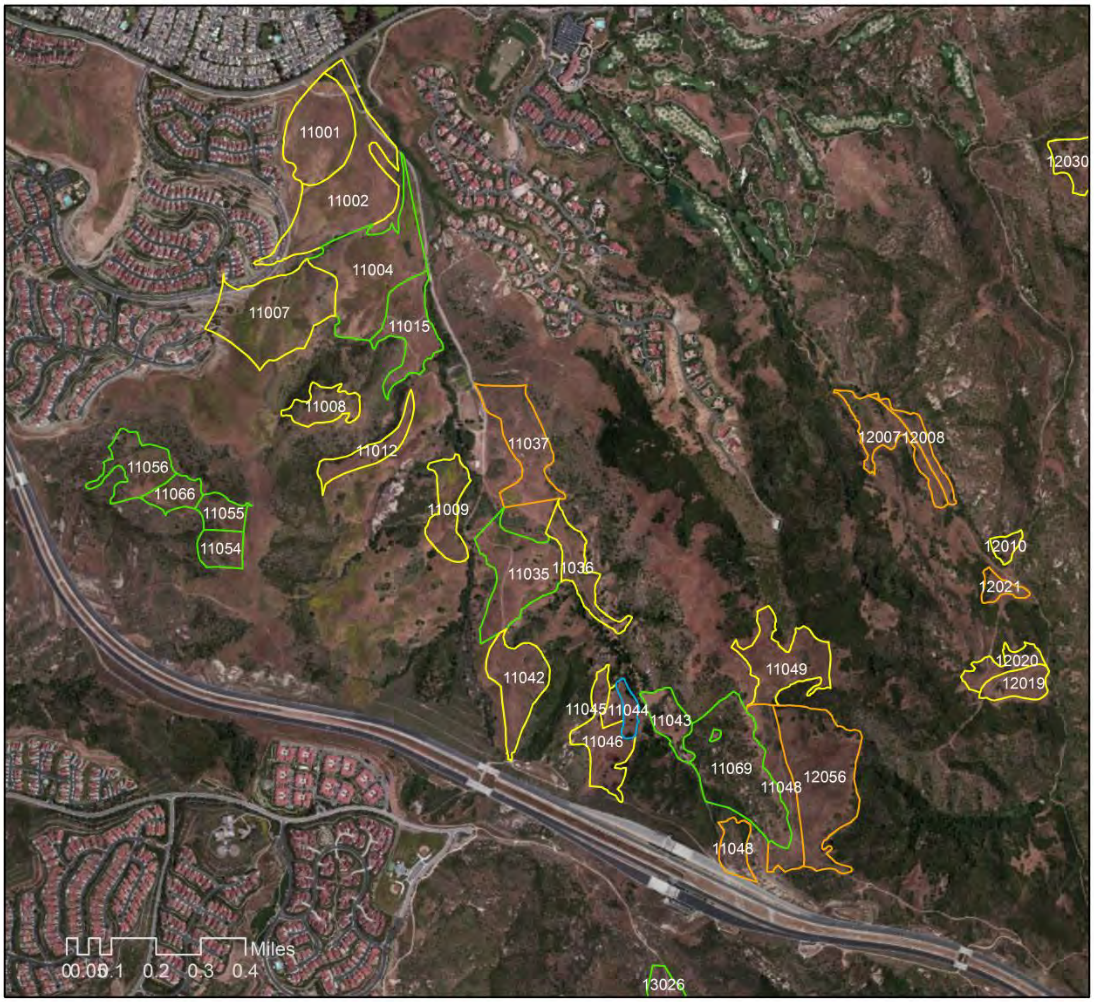
Bommer Canyon and Butterfly Valley
Brassica nigra Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 1998-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 5.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Crystal Cove State Park
Brassica nigra Cover Class Change 1998-2008

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassic nigra
Cover Class Change 1998-2008

- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Crystal Cove State Park
Brassica nigra Cover Class Change 2008-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassic nigra
Cover Class Change 2008-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Crystal Cove State Park
Brassica nigra Cover Class Change 1998-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassic nigra
Cover Class Change 1998-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 5.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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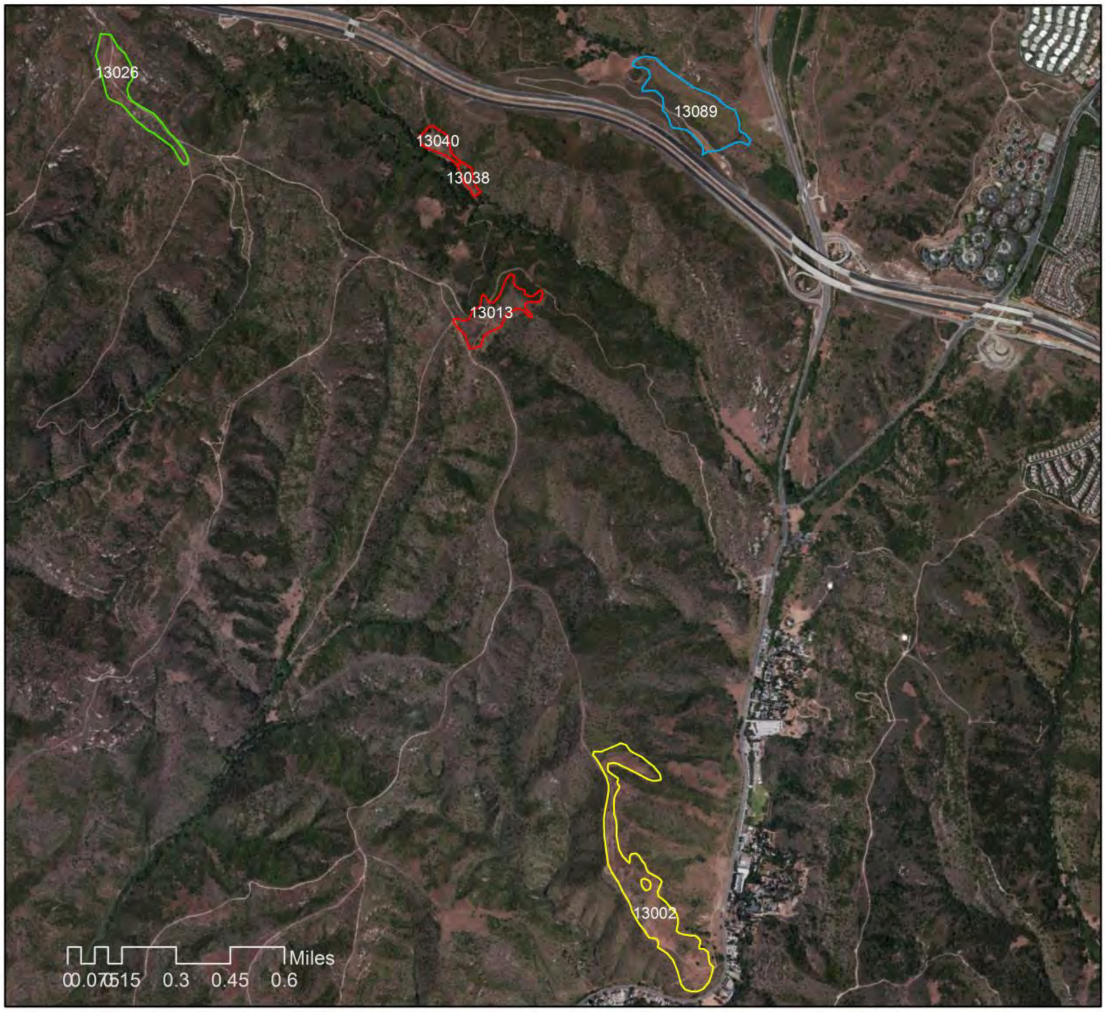
Laguna Canyon Wilderness
Brassica nigra Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 1998-2008

- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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Laguna Canyon Wilderness
Brassica nigra Cover Class Change 2008-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

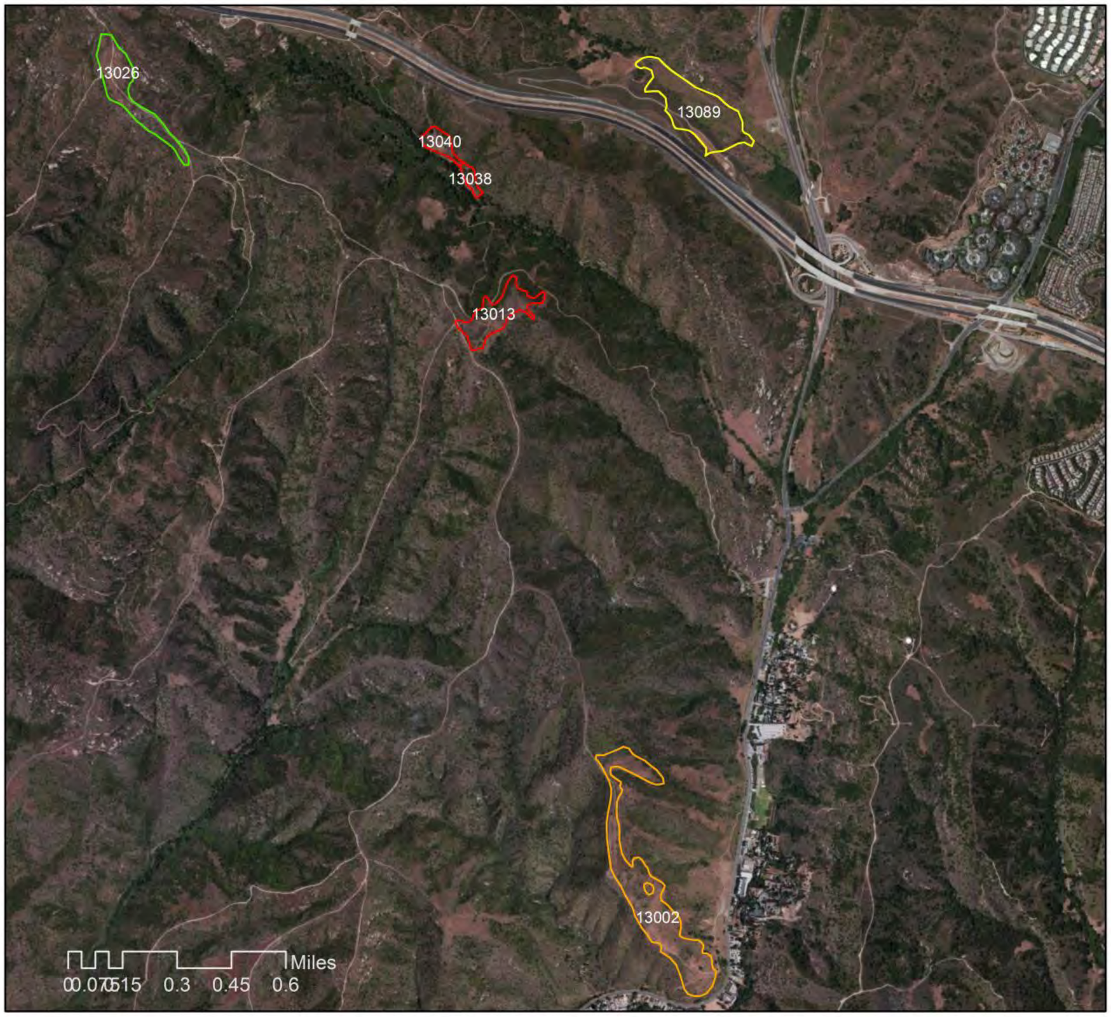
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 2008-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Laguna Canyon Wilderness
Brassica nigra Cover Class Change 1998-2013



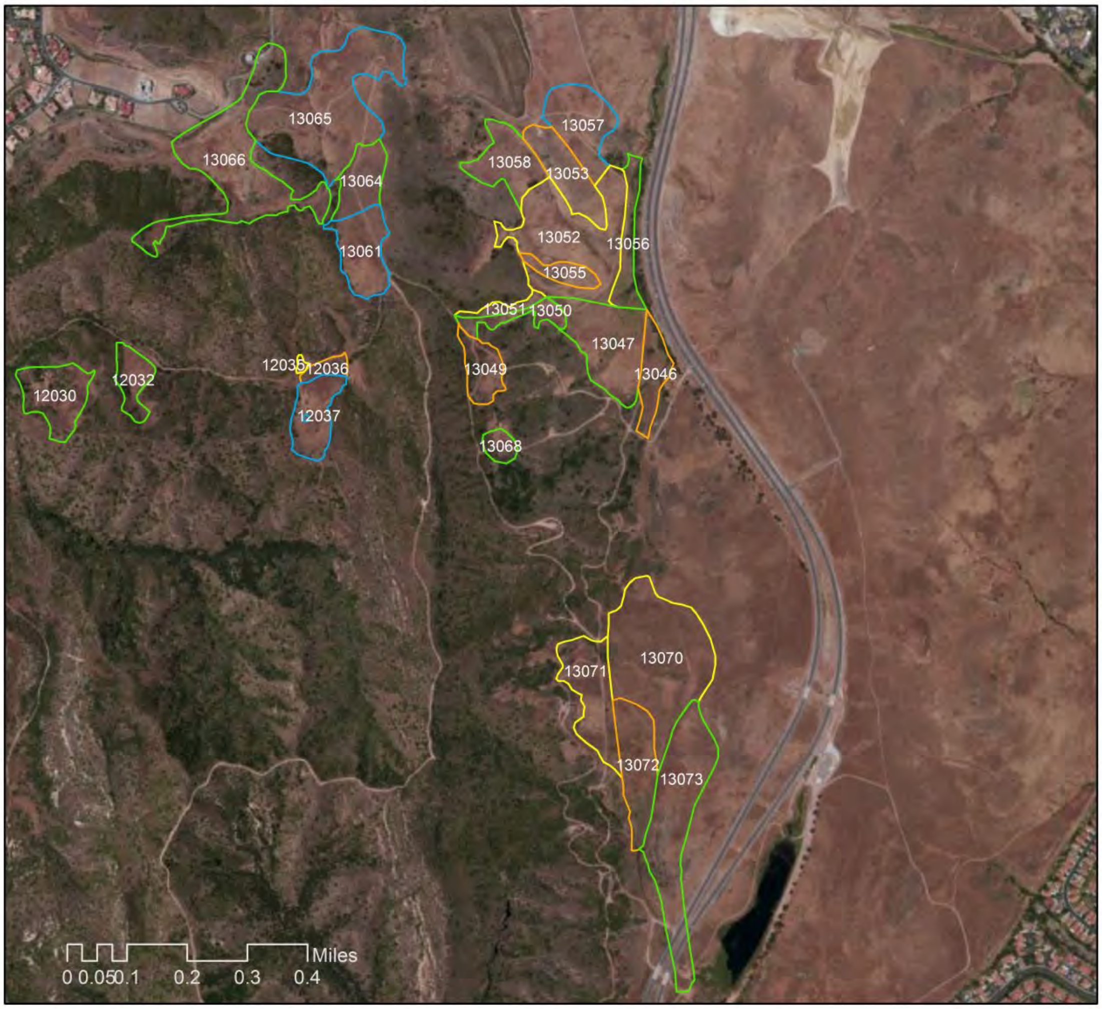
Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 1998-2013
- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 5.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Mule Deer ans Serrano Ridge
Brassica nigra Cover Class Change 1998-2008



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

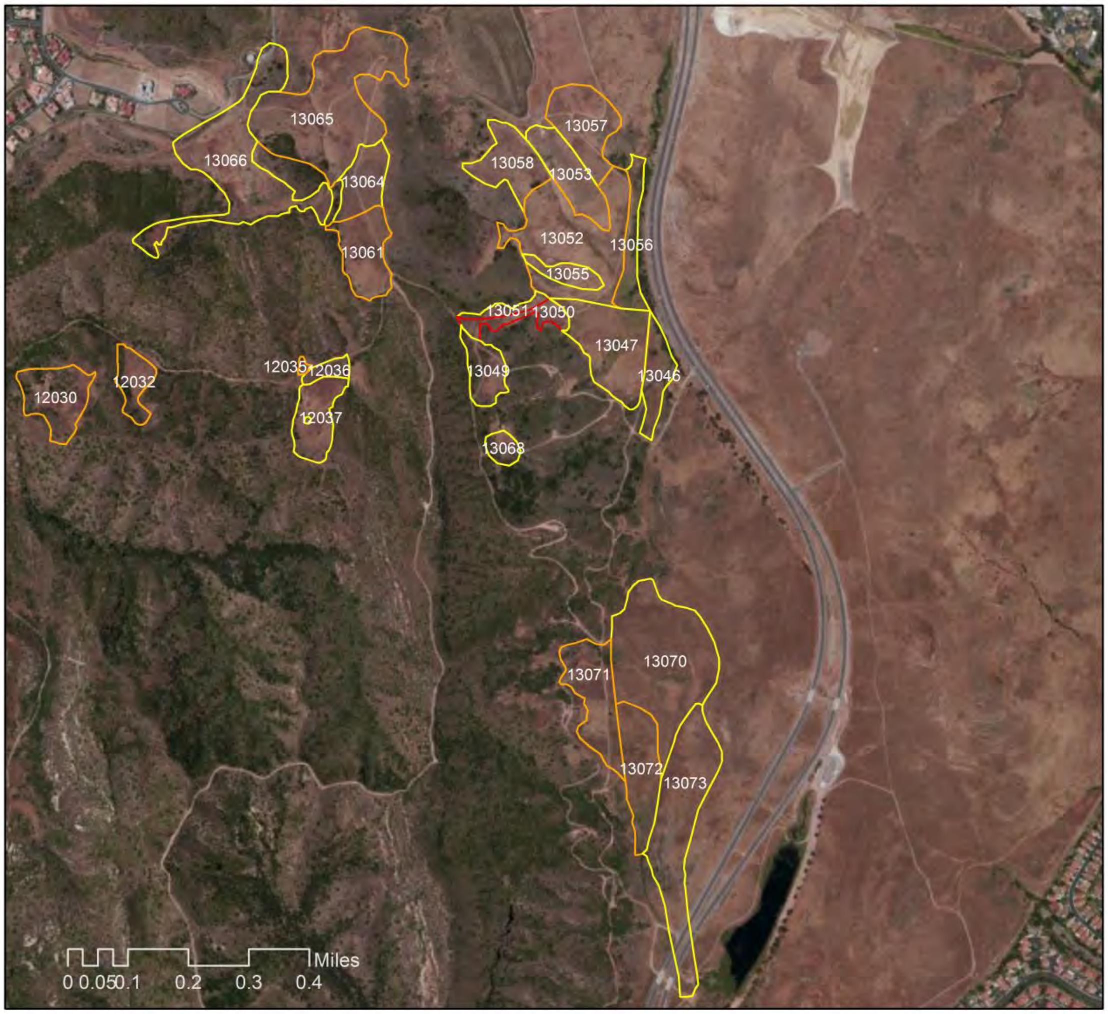
Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 1998-2008

- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Mule Deer ans Serrano Ridge
Brassica nigra Cover Class Change 2008-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 2008-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 2.0
- 2.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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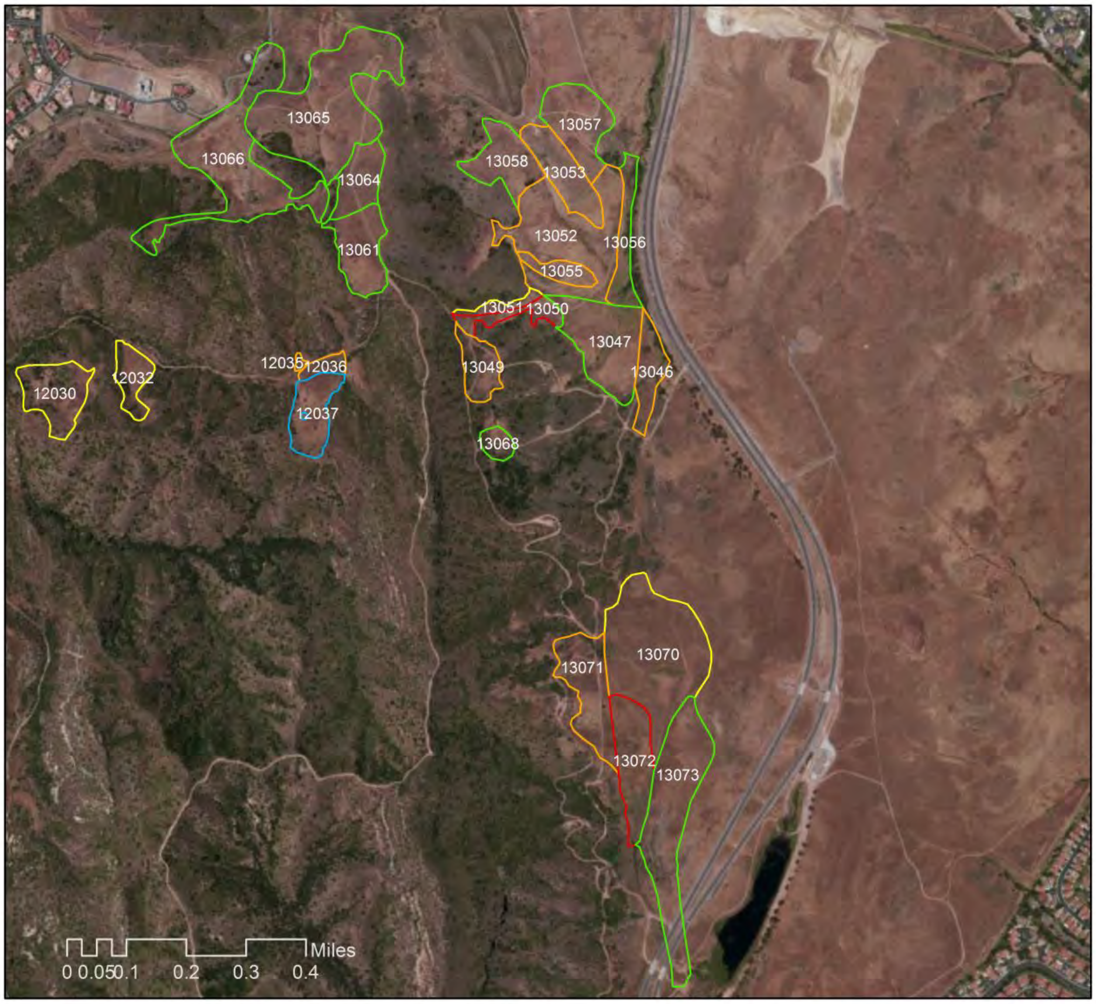
Mule Deer ans Serrano Ridge
Brassica nigra Cover Class Change 1998-2013



Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra
Cover Class Change 1998-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 5.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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Quail Hill
Brassica nigra Class Change 1998-2008

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley

Brassica nigra

Cover Class Change 1998-2008

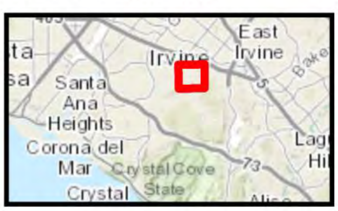
- -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 3.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Quail Hill
Brassica nigra Class Change 2008-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley



Brassica nigra
Cover Class Change 2008-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 4.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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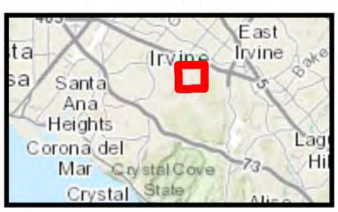
Quail Hill
Brassica nigra Class Change 1998-2013

Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Prepared by: Sara Jo Dickens 2014
University of California Berkeley



Brassica nigra
Cover Class Change 1998-2013

- -3.0 - -2.0
- -1.9 - -1.0
- -0.9 - 0.0
- 0.1 - 1.0
- 1.1 - 5.0

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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