Palos Verdes Peninsula
Land Conservancy

January -- December 2014

PALOS VERDES NATURE PRESERVE
REPORT

FOR THE

RANCHO PALOS VERDES
NATURAL COMMUNITY CONSERVATION PLAN

October 2015

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Restoration

In 2014, Palos Verdes Peninsula Land Conservancy (PVPLC) installed plants on 5 acres (Phase 4) at Portuguese Bend Reserve NCCP site, in accordance with the Portuguese Bend Habitat Restoration Plan. An additional 2 acres of restoration at Abalone Cove Reserve was installed, following the installation of 3 acres in 2013, with funds from the National Fish and Wildlife Foundation, California Trails and Greenways Foundation, Santa Monica Bay Restoration Commission and Coastal Conservancy.

Monitoring

At Alta Vicente, Phase 1 (Year 5), native plant cover in coastal sage scrub (CSS) ranged from 26% to 41%, not yet meeting the goal of 50%; Palos Verdes Blue butterfly (PVB) habitat ranged from 26% to 32%, but host plants did not appear in the survey, not meeting the goal of 10%, most likely due to low rainfall. PVPLC will seed in Phase 1 in the fall to compensate for low seed germination rates in the CSS and PVB habitat.

At Alta Vicente, Phase 2 (Year 4) native plant cover in CSS ranged from 26% to 29%, not yet meeting the goal of 50% by Year 5. Native plant cover in the PVB habitat ranged from 4% to 17%, with 2% host plant cover, not yet meeting the goal of 10% host plant cover. Restoration in fall 2015 will focus on seeding the area, with the expectation that plants germinating from seed may be more successful at this site. The restoration site will require more time for plants to fill in and for native plants to germinate and fill in the gaps. In the cactus scrub habitat, both native plant cover (32% to 38%) and cactus plant cover (4% to 11%) were above the three-year goal.

At Portuguese Bend, Phase 1 and 2 were installed the same year, to allow for an additional year of weed control at the site prior to planting. Therefore, they both represent Year 2 after plant installation. The native cover in the CSS ranged from 21% to 26%. Native plant cover in the cactus scrub was 20%. Plants were healthy, and recruitment from seed was observed at the site. The site is on track for meeting success criteria. At Portuguese Bend, Phase 3, native plant cover in Year 1 was 19%, and some recruitment from seed was observed, which is on track for meeting success criteria.

Targeted Exotic Removal Program for Plants (TERPP)

In 2014, PVPLC met the objectives for the TERPP program by treating 28 populations of invasive plants. PVPLC treated 24 populations of the highly invasive *Euphorbia terracina.* Euphorbia seeds can persist in the soil for 3 to 5 years, and treatment needs to be repeated for several years to successfully control this species on the Preserve. Euphorbia is a very serious invasive, and PVPLC thinks its expansion in the Preserve must be controlled. Therefore, many of the TERPP sites are the same as in the previous years.

PVPLC treated two populations of *Acacia cyclops.* At Portuguese Bend, acacia that was encroaching into cactus scrub were removed. At Vicente Bluffs, an acacia population adjacent to coastal sage scrub was removed.

At Vicente bluffs, a population of *Cortaderia selloana* located along the edge of coastal sage scrub was removed.

At Portuguese Bend, staff is controlling new shoots in a *Eucalyptus globulus* population damaged by the 2009 fire.

Trail Management and Monitoring

PVPLC continues to update maps and place maps at major trailheads, and post them on PVPLC's website. PVPLC has placed QR codes at major trailheads for people to access maps via smart phones. In 2014, PVPLC completed the replacement of all decals on carsonite signs in the Preserve to better delineate trails. Per the direction of City Council, "Walk Bike" signs were placed at multi-use canyon crossings at Filiorum and Portuguese Bend. In March 2014 PVPLC hired a part-time field operations technician, and in October this position was increased to full-time. The technician focuses on unauthorized trail closure, trail delineation and graffiti removal.

PVPLC continued to work on closing unauthorized trails throughout the Preserve. Many unauthorized trails represent trails that were used for many years but were not included in the Preserve Trails Plan. PVPLC's primary focus is to close newly created unauthorized trails before they become established and damage habitat. This is very intensive work, that requires continuously closing down the trail as signage, branches, and plants are removed. Rapid Response Team volunteers assist in maintaining closures by reclosing sections on a regular basis. However, new unauthorized trails have also developed. PVPLC prioritizes closure of newly developed unauthorized trails. In 2014, focal areas were Portuguese Bend, Forrestal, and Abalone Cove Reserves.

In 2014 PVPLC installed five "Area closed" signs, 583 decals, 27 carsonite signs for trail delineation, and 20 post and cable closures. Two signs describing difficult trail conditions were installed on either side of the Rim trail to dissuade the creation of new unauthorized trails by people not prepared to travel on a difficult trail.

The PVPLC and City initiated the Volunteer Trail Watch Program in 2013 to help educate trail users about appropriate trail use and monitor preserve misuse. The mission of the Palos Verdes Nature Preserve Volunteer Trail Watch Program is to serve as eyes and ears of the City and the Palos Verdes Peninsula Land Conservancy with a view to 1) protect the natural resources of the Palos Verdes Nature Preserve, including the flora and fauna as well as the geology, topography and scenic landscape, and 2) enhance the safety of, and promote an enjoyable experience for all Preserve visitors. Volunteers educate the public about Preserve rules and etiquette; and enter observations of infractions into a web portal (i.e. dogs off leash, off-trail activity, user on non-designated trail, etc.) to allow rangers and Preserve managers to track time and location of these activities. Fourteen volunteers completed the second training workshop for the Volunteer Trail Watch took place in March 2014. In 2014, 28 volunteers spent a total of 1246 hours in the Preserve, observing and educating visitors.

Ability to Accomplish Resource Management Goals

PVPLC has been successful at completing restoration under the NCCP, and meeting the goals for targeted invasive plant removal. However, because *Euphorbia terracina* has been difficult to eradicate, and has required treatment over several years, many of the same areas have been treated since 2009.

Concerns about habitat management in the future include the ability to successfully close unauthorized trails, and to prevent new trails from being created. Closing these trails is time consuming and expensive because of continuous vandalism. PVPLC has been collaborating with the City-provided rangers to help determine which areas need more ranger attention.

There is also a need to ensure that utilities and contractors accessing the Preserve follow guidelines to remain on permitted trails and avoid damaging the habitat. In 2014 a contractor hired by the City incorrectly graded and widened a portion of Toyon and Peppertree Trails in Portuguese Bend, in violation of the conservation easement on the property. The City is creating a restoration plan for this site. Since then, PVPLC and the City have created a protocol for ensuring oversight of projects within the Preserve.

Funding Needs

PVPLC would benefit from continued funding to control highly invasive species on the Preserve. PVPLC continues to apply for funding to increase the amount of acreage restored for the species listed under the plan. Preserve habitat and trails could also benefit from additional funding for on-the-ground enforcement.

1.0 INTRODUCTION

The 2014 Palos Verdes Nature Preserve Report for the Rancho Palos Verdes Natural Community Conservation Plan provides annual submittal requirements by the Palos Verdes Peninsula Land Conservancy (PVPLC) on the status of the Palos Verdes Nature Preserve (Preserve). Additionally this report details stewardship activities, research, funding, and community involvement in the Preserve during the period January 1, 2014 through December 31, 2014.

PVPLC provides habitat management for the Palos Verdes Nature Preserve (Preserve) for the City of Rancho Palos Verdes (RPV). The Preserve encompasses approximately 1,400 acres and is located on the southern side of the Palos Verdes Peninsula in the City of Rancho Palos Verdes, California. The Preserve was formed under a Draft Natural Community Conservation Plan (NCCP) to "maximize benefits to wildlife and vegetation communities while accommodating appropriate economic development within the City and region pursuant to the requirements of the NCCP Act and Section 10(a) of the ESA (URS 2004a)." As a primary component of the NCCP, a Preserve design was proposed to conserve regionally important habitat areas and provide habitat linkages in order to benefit sensitive plants and wildlife. PVPLC manages the habitat in the Preserve under a management agreement with the City.

The primary focus of management for the Preserve is to maintain or restore habitat for the covered plant and animal species listed in the draft NCCP. A Habitat Management Plan was adopted in 2007 that outlines the restoration of 5 acres per year for a total of 15 acres over a 3-year period. This plan also outlined the methodology for removal of exotic plant species, a predator control plan, and the monitoring of covered plant and animal species. The plan outlined restoration of 15 acres at Alta Vicente Reserve. However, after the 2009 fire at Portuguese Bend, restoration focused on this reserve, and a restoration plan was developed for 15 acres at Portuguese Bend Reserve. PVPLC attempts to seek additional funding when possible, to perform restoration on more than the minimum 5 acres per year required in the NCCP. Several opportunities of this nature occurred during the reporting period that enabled PVPLC to conduct additional restoration.

PVPLC also facilitates scientific research and trail maintenance projects in the Preserve. Volunteers make up a large component of the management strategies for the Preserve. They assist in monitoring the properties, wildlife, and habitat as well as help restore habitat and maintain trails. Partnering with regional high schools and colleges allows for scientific research that expands our understanding of the Preserve.

The Management Agreement with RPV requires that PVPLC submit an annual report to the RPV City Council describing management activities with respect to habitat enhancement and restoration, property maintenance and monitoring, vegetation and wildlife monitoring, and efforts on targeted exotic plant removals. This report provides annual submittal requirements on the status of the Preserve for the period of January 1, 2014-December 31, 2014. It is accompanied by a status report for the Targeted Exotic Removal Program for Plants (TERPP). Volunteer involvement and support and student-based scientific research are also described in this report.

The NCCP Implementing Agreement has not been signed by the regulatory agencies, and therefore, the NCCP is technically not officially executed. However, because it is anticipated that this agreement and federal/state permits will be signed in the near future, this annual report is intended function as the framework management and monitoring plan for the upcoming federal/state NCCP and has been provided to satisfy the requirements the Management Agreement between PVPLC and the City. Annual reporting requirements for the Draft NCCP are detailed below and will be updated once the final NCCP is approved. Additionally, once every three years, a Comprehensive Report is required under the NCCP. To date, two Comprehensive Reports have been completed, covering the periods 2007 through 2009, and 2010 through 2012.

Annual Submittals (Included in This Report)

1. A monitoring report on habitat restoration areas using standard monitoring protocol as detailed in the Preserve Habitat Restoration Plan
2. Report on Targeted Exotic Plant Removal Efforts
3. Report on trail maintenance projects.

Site Description

The Preserve is located on the southern side of the Palos Verdes Peninsula in the City of Rancho Palos Verdes, California (Figure 1). The approximately 1,400-acre Preserve has been divided into ten areas referred to as Reserves (Figure 1).

The topography of the Preserve is diverse, ranging from relatively flat lowland areas above steep coastal bluffs in the south, to very steep slopes, ridgelines and gullies on the slopes to the north. Elevations range from approximately sea level along the coastal edges of Vicente Bluffs, Abalone Cove, and Ocean Trails to approximately 1,300 feet above mean sea level at the northern most parcel, vista del Norte. Adjacent land uses include single-family residences on most sides, open space associated with neutral lands on the Peninsula, the Pacific Ocean to the south and west, and the Los Verdes and Trump National golf courses near the western and eastern ends of the Preserve area.

Table 1
Reserve Names of the Palos Verdes Nature Preserve. See Figure 1 for locations.

Abalone Cove Reserve	Portuguese Bend Reserve
Agua Amarga Reserve	San Ramon Reserve
Alta Vicente Reserve	Three Sisters Reserve
Filiorum Reserve	Vicente Bluffs Reserve
Forrestal Reserve	Vista del Norte Reserve
Ocean Trails Reserve*	
*Not managed by PVPLC	

2.0 FIRES IN THE PRESERVE

2012 Three Sisters Fire Status

On January 9, 2012, the Crest Fire burned approximately 12.7 acres of the 99-acre Three Sisters Reserve, as well as some habitat in McCarrell's canyon, outside of the Preserve. The wildfire burned native and non-native vegetation and known habitat of the threatened coastal California gnatcatcher (*Polioptila californica californica*) and the special status cactus wren (*Campylorhynchus brunneicapillus*). PVPLC wrote a Fire Report and Restoration Plan for the site. The report recommends cactus planting in key areas, weed control and monitoring. The burn area weeded and large cactus was planted in 2012. Surveys in 2014 showed that burned cactus and other native vegetation were recovering; weed cover was low; and there remains a high amount of bare ground. Monitoring results from 2014 are located in the Monitoring report (Appendix A1).

2014 Vista del Norte Fire Status

On June 17, 2014, the Vista del Norte fire burned approximately 6.7 acres of the 14-acre Vista del Norte Reserve. The wildfire burned native and non-native vegetation. No coastal California gnatcatchers or cactus wrens were identified at the Reserve in recent surveys. PVPLC wrote a Fire Report and Restoration Plan for the site (Appendix A2). The report recommends targeted invasive species removal, erosion control and native seeding of the burned area.

3.0 HABITAT RESTORATION PLAN

The initial Preserve Habitat Management Plan (PHMP) for the Draft NCCP was created in 2007. A component of the PHMP was the Habitat Restoration Plan for 5 acres per year for a total of

15 acres over the first three-year period. This plan was completed in April 2007 and concluded that Alta Vicente Reserve in the Preserve ranked the highest in terms of site suitability for an immediate restoration project. The Habitat Restoration Plan for Alta Vicente Reserve outlines appropriate revegetation locations and methodology to adequately comply with the Preserve Management requirements of the Rancho Palos Verdes NCCP.

The Habitat Restoration Plan for Alta Vicente Reserve provides guidelines for the establishment of coastal sage scrub (CSS), coastal cactus scrub (CCS), and PVB butterfly habitat on a total of 15 acres during 3 consecutive years at the Alta Vicente Reserve. However, since a fire occurred at Portuguese Bend Reserve in August 2009, plans were adapted to focus immediate restoration at Portuguese Bend, and only Phase 1 and 2 (10 acres) were implemented at Alta Vicente.

The Restoration Plan for Portuguese Bend covers restoration of 25 acres over 5 years (2010 to 2015) (*in* 2010-2012 Comprehensive Report). This report contains an updated plant palette based on wildlife agency recommendations (Appendix B). The following provides a brief description of work done to fulfill the NCCP during the reporting period. Table 2 provides the implementation schedule for Phases 1 and 2 at Alta Vicente and Phase 1 through 5 at Portuguese Bend.

Figure 1. Map of the Palos Verdes Nature Preserve with associated Reserves locations.

*Ocean Trails Reserve is not managed by PVPLC

3.1 ALTA VICENTE RESERVE RESTORATION

The habitat restoration at the Alta Vicente Reserve consists of two 5-acre phases, with one phase initiated each year. The first 5 acres of restoration (Phase 1) began with site preparation during the fall of 2007 and 2008 to minimize weeds after planting (as per the timeline in the Alta Vicente Restoration Plan, Table 5). Phase 1 plants were installed and hydroseeded during the winter of 2009/2010. Site preparation for Phase 2 began in Fall 2008. In December 2010, staff removed *Acacia cyclops* and completed planting and seeding in the Phase 2 area. Staff weeded and maintained Phase 1 and 2. Additional container plants were installed from 2012 to 2014 to fill in areas with low native cover.

Draft NCCP annual reporting requirements include a monitoring report on habitat restoration areas using a standard monitoring protocol for years 1, 2, 3 and 5 during the 5-year maintenance and monitoring period that follows plant installation. Monitoring at Alta Vicente began in 2010.

Table 2

Restoration Project Schedule for Alta Vicente Reserve Phases 1 and 2. This table has been modified from its original content in the 2007 Habitat Restoration Plan to reflect activities only in Phase 1 and 2.

	Task	Date
PHASE 1	Site clearing and soil preparation	Fall 2007, Fall 2008
	Installation of temporary irrigation system	Fall 2008
	Weed/exotic removal and grow-kill cycles	Fall 2008-Spring 2009
	Planting container stock	Early Winter 2009/2010
	Hydroseed application	Winter 2009/2010 (following planting)
	Completion of installation/assessment of site installation	Following completion of installation and seeding and 120 day maintenance period
	5-year biological monitoring and maintenance	Spring 2010-Spring 2014
	Phase one completion	2014, end of Year 5
PHASE 2	Site clearing and soil preparation	Fall 2008, Fall 2009
	Installation of temporary irrigation system	Fall 2008, Fall 2009
	Weed/exotic removal and grow-kill cycles	Fall 2008, Fall 2009,-Spring 2010
	Planting container stock	Winter 2010/2011
	Seed application	Winter 2010/2011 (following planting)
	Completion of installation/assessment of site installation	Following completion of installation and seeding and 120 day maintenance period
	5-year biological monitoring and maintenance	Spring 2011-Spring 2015
	Phase two completion	2015, end of Year 5

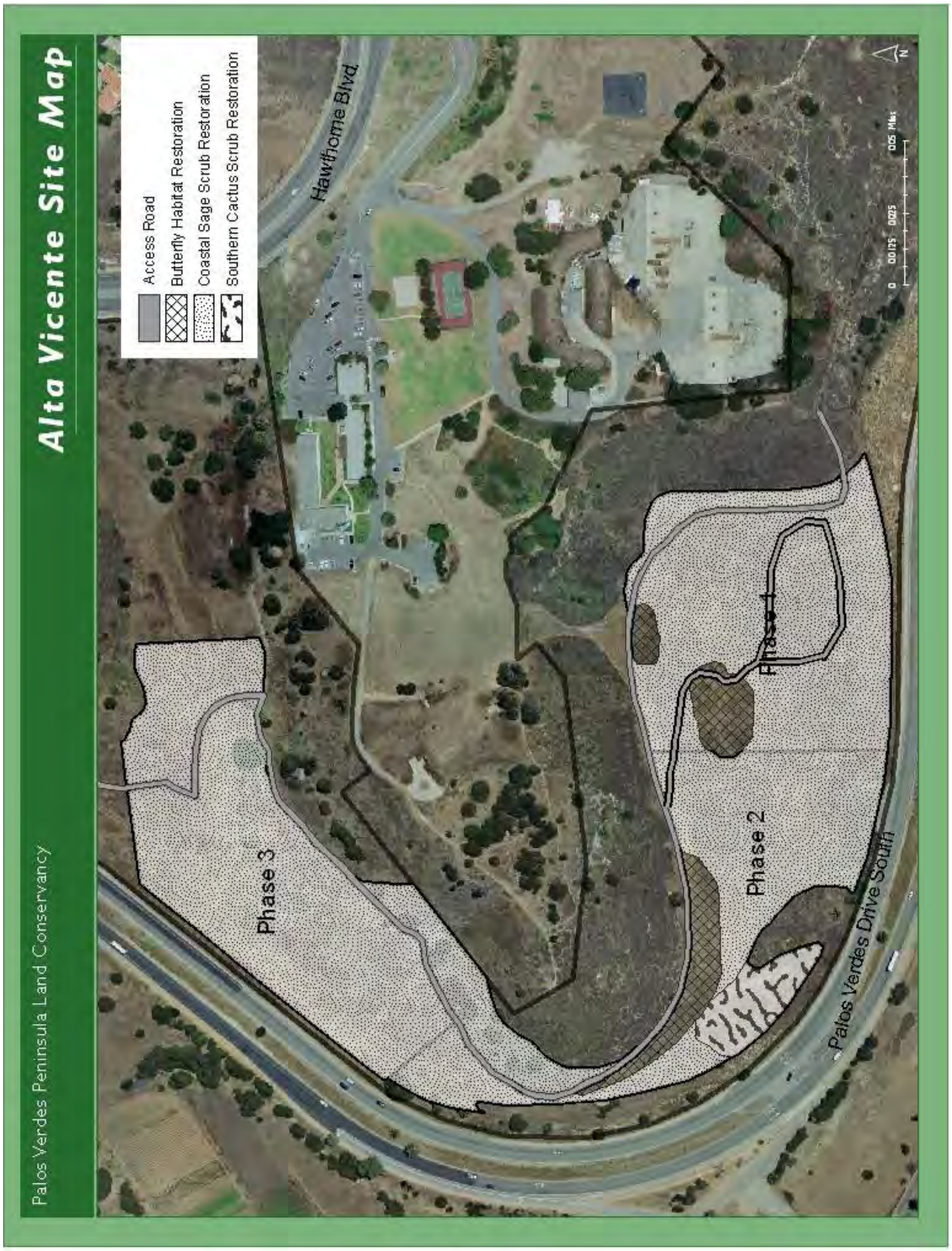


Figure 2: Map of Restoration Areas at Alta Vicente Reserve. Phase 3 has been postponed to implement burn recovery at Portuguese Bend.

3.2 PORTUGUESE BEND RESERVE RESTORATION

The restoration plan for Portuguese Bend is to complete 25 acres in five phases (Figure 3, Table 3).

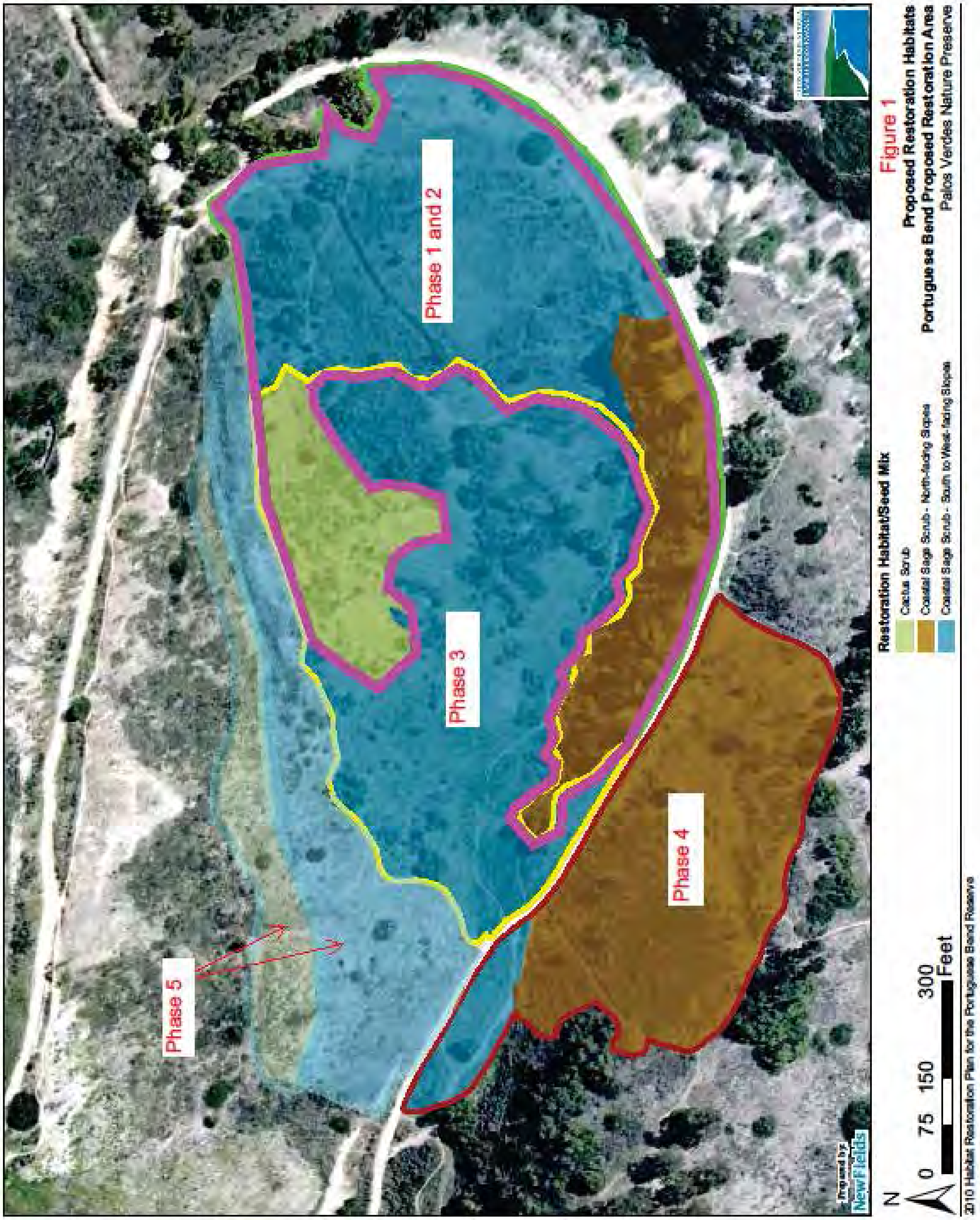
Site preparation at Portuguese Bend began in February 2010. Field staff weeded (hand/herbicide) the burn area in 2010. In February, 2011, goats were deployed to clear vegetation. Due to the high density of weeds, an additional year of weeding was implemented, and plants were installed on 10 acres in fall 2012 (Phase 1 and Phase 2).

PVPLC obtained permission from the City to irrigate eight acres to enable "grow and kill" prior to plant installation, and improve seed and plant survival after planting. Two acres of cactus scrub will not be irrigated.

Table 3
Restoration Project Schedule for Portuguese Bend Reserve Phases 1, 2, 3, 4 and 5, based on the Portuguese Bend Reserve Habitat Restoration Plan.

	Task	Date
PHASE1 and PHASE 2	Begin site preparation, weed removal	Fall 2010
	Install irrigation	Winter 2012
	Final site preparation: weed and thatch removal	Fall 2012
	Installation: Seeding and planting	Fall 2012-Early Winter 2013
	Maintenance weeding	Winter 2013-Spring 2014
	Fill-in planting, as needed	Fall 2013-Fall 2014
	5-year biological monitoring and maintenance	Spring 2013-Spring 2017
	Phase one and two completion	2017, end of Year 5
PHASE 3	Site preparation, weed removal	Fall 2012-Fall 2013
	Final site preparation: weed and thatch removal	Fall 2013
	Installation: Seeding and planting	Fall 2013-Early Winter 2014
	Maintenance weeding	Winter 2014-Spring 2015
	Remedial seeding, as needed	Fall 2014-Fall 2015
	5-year biological monitoring and maintenance	Spring 2014-Spring 2018
	Phase three completion	2018, end of Year 5
PHASE 4	Site preparation, weed removal	Fall 2013-Fall 2014
	Final site preparation: weed and thatch removal	Fall 2014
	Installation: Seeding and planting	Fall 2014-Early Winter 2015
	Maintenance weeding	Winter 2015-Spring 2016
	Remedial seeding, as needed	Fall 2015-Fall 2016
	5-year biological monitoring and maintenance	Spring 2015-Spring 2019
	Phase 4 completion	2019, end of Year 5
PHASE 5	Site preparation, weed removal	Fall 2014-Fall 2015
	Final site preparation: weed and thatch removal	Fall 2015
	Installation: Seeding and planting	Fall 2015-Early Winter 2016
	Maintenance weeding	Winter 2016-Spring 2017
	Remedial seeding, as needed	Fall 2016-Fall 2017
	5-year biological monitoring and maintenance	Spring 2016-Spring 2020
	Phase 5 completion	2020, end of Year 5

Figure 3. Map of restoration areas at Portuguese Bend Reserve.



4.0 ADDITIONAL RESTORATION IN 2014

PVPLC attempts to seek additional funding, to perform restoration on more than the minimum five acres per year required in the NCCP. Several opportunities of this nature occurred during the reporting period. Table 4 shows the timeline for each additional restoration project.

4.1 ABALONE COVE

Funding from the National Fish and Wildlife Foundation (NFWF), the Santa Monica Bay Restoration Commission, the Coastal Conservancy, the U.S. Fish and Wildlife Service Coastal Program, and the California Trails and Greenways Foundation provided funding to restore and enhance five acres of coastal sage scrub and coastal bluff scrub at Abalone Cove Reserve. Three acres were planted in 2013, and an additional two acres were restored and enhanced in 2014.

4.2 AGUA AMARGA

In September 2011, Los Angeles County Sanitation Districts (LACSD) provided funding to conduct 0.25 acre of riparian scrub restoration at the Lunada Canyon portion of the Agua Amarga Reserve as part of mitigation for one of their projects. A restoration plan was completed in 2011. In 2012, the PVPLC implemented weed and invasive plant removal (castor bean, ice plant, fennel). In Fall 2012, 362 container plants were installed. In Fall 2013 and 2014 additional plants were installed.

In 2012, an additional mitigation project (D&M Eight LTD) funded the planting of 147 riparian plants at Lunada Canyon. The plants were planted in January 2014 and irrigated with a drip irrigation system. Severe rains in 2014 caused torrential stream flows that removed some of the installed plants. PVPLC plans to install additional plants as fill-in in January 2015.

4.3 VICENTE BLUFFS

In June 2008, a grant agreement was signed with the State Coastal Conservancy to provide habitat restoration at Vicente Bluffs Reserve. PVPLC restored three acres of coastal bluff scrub and El Segundo blue butterfly habitat by removing acacia, pampas grass and ice plant, and installing container plants with coastal bluff scrub and El Segundo blue butterfly host plants. PVPLC has added plants to this site in 2013 and 2014.

4.5 PORTUGUESE BEND

In March 2010, the City of El Segundo provided funding to conduct 9.5 acres of coastal sage scrub and perennial grassland restoration at Portuguese Bend as part of mitigation for the Plaza El Segundo Development. The restoration site is on the upper portion of the Ishibashi Trail. In Fall 2010, the 9.5 acre-site was seeded with native grasses and coastal sage scrub. In Fall 2011, container plants were installed in 5 foot-wide strips, separated by 10-foot buffers because germination rates were low. PVPLC controlled weeds in the buffer zones in 2012 through 2014.

The coastal sage scrub installed within the Ishibashi, Peppertree and Eagles Nest areas as part of ongoing unauthorized trail closures (one acre), were maintained and watered as necessary.

Figure 4 provides a site map for each restoration project active in 2014, including the restoration at Alta Vicente and Portuguese Bend Reserves that fulfills the requirements of the NCCP Habitat Restoration Plan.

Figure 4. Site map for ongoing 2014 restoration projects in the Palos Verdes Nature Preserve.

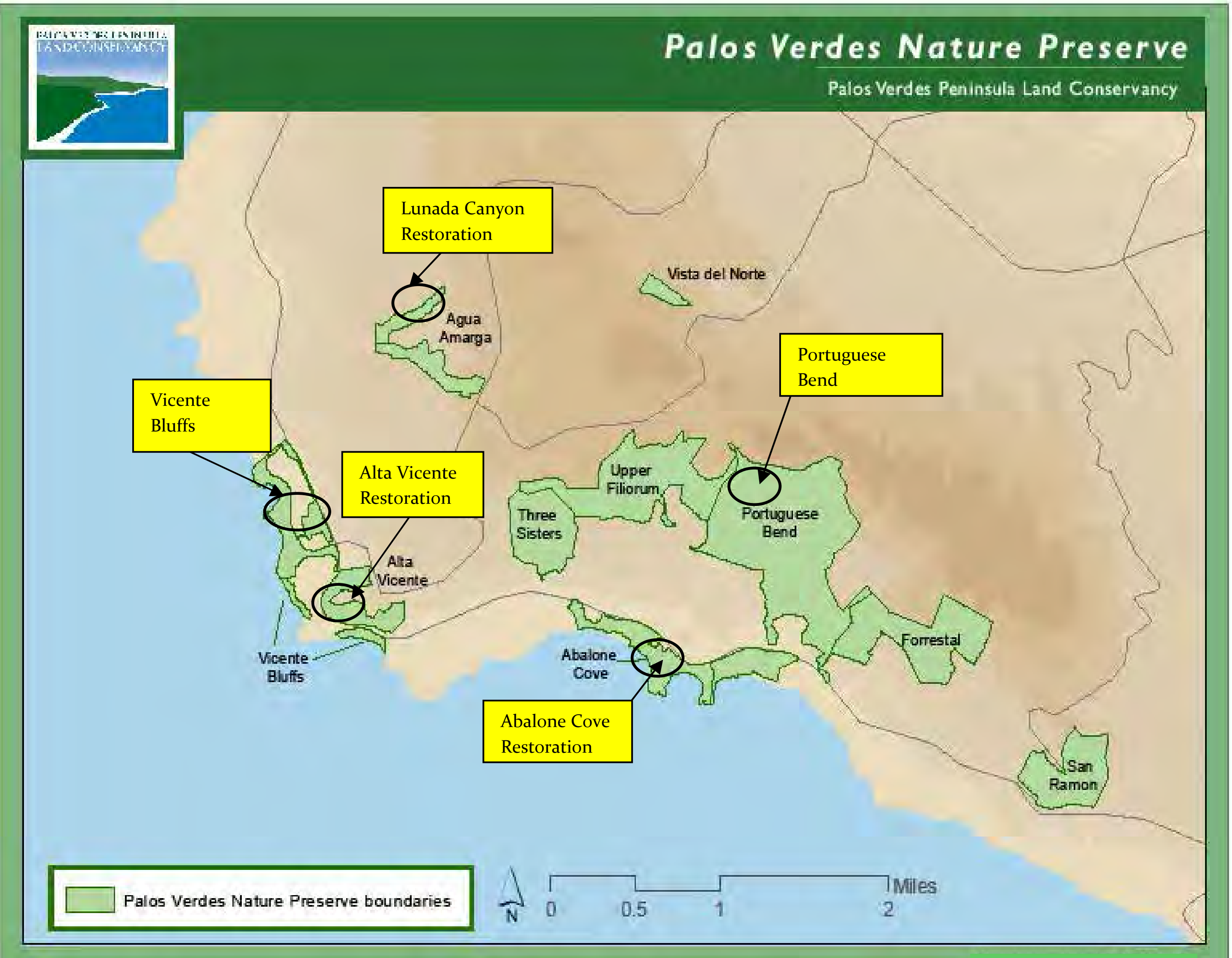


Table 4
Restoration Project Schedule for Additional Restoration in Palos Verdes Nature Preserve.

Portuguese Bend El Segundo Grant 9.5 acres	**Task**	**Date**
	Site preparation and weed control	Spring 2010-Fall 2010
	Seeding	Winter 2010/2011
	Fill-in plant installation	Winter 2013/2014
	Completion of installation/assessment of site installation	Following completion of installation and seeding and 120 day maintenance period.
	3-year monitoring and maintenance	To begin upon installation of restoration
Portuguese Bend HCF Grant (1 acre)	**Task**	**Date**
	Spur trail restoration: Ishibashi area	Fall 2012-Winter 2015
	Spur trail restoration: Peppertree area	Winter 2012 – Winter 2014
	Spur trail restoration: Eagle's Nest	Fall 2013-Winter 2015
Abalone Cove Grant (5 acres)	**Task**	**Date**
	Remove invasive plants	Spring 2013-Fall 2013
	Install plants	Fall 2013, Fall 2014
	Weed and maintain site	Through December 2016

4.6 COMPLETE LIST OF RESTORATION PROJECTS

A complete summary of all restoration work completed in the Preserve, along with maps of restoration sites, can be found in Appendix C.

5.0 MONITORING

5.1 RESTORATION MONITORING

PVPLC's stewardship staff conducted surveys at the restoration sites throughout the preserves, including photo point monitoring and vegetation transects. Vegetation transect surveys were conducted using standardized methods (line intercept, CNPS Rapid Vegetation Assessment) that provide data on the cover of native and non-native plants in the habitat. In 2014, restoration monitoring as per NCCP requirements was conducted at Alta Vicente and Portuguese Bend Reserves. At Alta Vicente, the plants in the restoration area are healthy and growing, but there remain gaps in native vegetation due to low seed germination. Future activities will focus on seeding and weed control. At Portuguese Bend Phase 1 and 2, additional plants were installed in Fall 2014 to increase native plant cover. Detailed results are in Appendix A.

5.2 COVERED SPECIES MONITORING

The NCCP/HCP requires updated surveys for covered plants and animals on the Preserve every three years. Surveys conducted for the 2007-2009 and 2010-2012 survey periods are located in the Comprehensive Management and Monitoring reports.

The draft NCCP/HCP includes a total of six covered plant species. They are aphanisma (*Aphanisma blitoides*), south coast saltscale (*Atriplex pacifica*), Catalina crossosoma (*Crossosoma californicum*), island green dudleya (*Dudleya virens* ssp. *insularis*), Santa Catalina Island desertthorn (*Lycium brevipes* var. *hassei*) and woolly seablite (*Suaeda taxifolia*).

6.0 TARGETED EXOTIC REMOVAL PROGRAM FOR PLANTS

The Targeted Exotic Removal Program for Plants (TERPP) is an element of the Preserve Habitat Management Plan for the Draft NCCP that requires the annual removal of exotic plant species of twenty individual populations or five acres found in the Preserve. The TERPP provides a protocol for ranking the degree of threat to native vegetation, the feasibility of eradication, and the invasiveness of each exotic species found in the Preserve. Populations of exotic plant species are then targeted for removal based on the results of the ranking outcome. The 2014 TERPP Report documents PVPLC's effort during the reporting period to fulfill the requirements of the TERPP plan. It details the methods of assessing the threat of individual exotic species to native vegetation, field methods for removal, and provides site-specific documentation related to every completed removal. The complete 2014 TERPP Report can be found in Appendix D of this report.

7.0 BRUSH CLEARANCE

Brush clearance is the clearing or minimizing of vegetation in areas that occur immediately adjacent to residential structures and roads. RPV is responsible for brush clearance within the Preserve, to provide an appropriate level of fire protection, emphasizing the protection of life, public safety, and property values in the urban-wildlife interface areas while minimizing environmental impacts of fire suppression and control. PVPLC has collaborated with RPV to develop clear protocols to ensure that all Best Management Practices associated with fuel modification activities are consistently followed. In 2014, RPV staff successfully collaborated with PVPLC to ensure that bird surveys were completed prior to fuel modification activities.

A portion of the Agua Amarga Reserve is owned by PVPLC and falls under our responsibilities to maintain brush clearance requirements. All of these requirements were met in May and June 2014. No other fuel modification areas within the Preserve fall under the responsibility of PVPLC.

8.0 SCIENTIFIC RESEARCH AND WILDLIFE MONITORING

The Preserve is an ideal setting for an outdoor laboratory, because it provides scientists and students with access to a variety of habitat. A report of 2014 research is located in Appendix E. PVPLC initiated a Citizen Science program focusing on cactus wren breeding activity and territory use, and developed a more comprehensive wildlife tracking Citizen Science program. Results of a USGS Western Ecological Research Station study of the genetics of cactus wrens and california gnatcatchers are included in Appendix E.

9.0 UTILITY AND CONTRACTOR ACCESS

Although some protocols are currently in place to ensure that utilities and contractors accessing the Preserve follow guidelines to remain on permitted trails and avoid damaging the habitat, PVPLC is collaborating with the City to create more effective protocols and outreach techniques. In 2014 a contractor hired by the City incorrectly graded and widened a portion of Toyon and Peppertree Trails in Portuguese Bend, in violation of the conservation easement. The City is creating a restoration plan for this site. Since then, PVPLC and the City have created a protocol for ensuring oversight of projects within the Preserve. PVPLC and the City are also developing a protocol for utilities to follow when they access the Preserve.

10.0 TRAIL MANAGEMENT AND MONITORING

10.1 PRESERVE TRAILS PLAN

Preserve trails fall under the City's Public Use Master Plan (PUMP), which is a NCCP-covered activity, and must follow certain avoidance measures and guidelines to protect covered species. City Council approved the updated Preserve Trails Plan in October 2012. The RPV City Council approved the PUMP which includes the Preserve Trails Plan in March 2013.

10.2 TRAIL MANAGEMENT

PVPLC continues to update maps and place maps at major trailheads, and post them on PVPLC's website. PVPLC has placed QR codes at major trailheads for people to access maps via smart phones. In 2014, PVPLC completed the replacement of all decals on carsonite signs in the Preserve to better delineate trails. "Walk Bike" signs were placed at multi-use canyon crossings at Filiorum and Portuguese Bend. In March 2014 PVPLC hired a part-time field operations technician, and in October this position was increased to full-time. The technician focuses on unauthorized trail closure, trail delineation and graffiti removal.

10.3 UNAUTHORIZED TRAIL CLOSURES

Implementing the Preserve Trails Plan involves closing many trails that were previously in use and no longer authorized. In 2014, PVPLC focused its attention at Portuguese Bend, Forrestal and Abalone Cove Reserves (Appendix G). Unauthorized trail closures were assisted by funds from the Habitat Conservation Fund, the Los Angeles County Grants, the National Fish and Wildlife Foundation, Coastal Conservancy and Santa Monica Bay Restoration Commission.

PVPLC's primary focus is to close newly created unauthorized trails before they become established and damage habitat. This is very intensive work, that requires continuously closing down the trail as signage, branches, and plants are removed. Rapid Response Team volunteers assist in maintaining closures by reclosing sections on a regular basis.

In 2014 PVPLC installed five “Area closed” signs, 583 decals, 27 carsonite signs for trail delineation, and 20 post and cable closures. Two signs describing difficult trail conditions were installed on either side of the Rim trail to dissuade the creation of new unauthorized trails by people not prepared to travel on a difficult trail.

10.4 TRAIL MONITORING

PVPLC stewardship staff or volunteers from the Keeping an Extra Eye on the Preserve for Environmental Review and Stewardship (Keepers) Program conducted all trail monitoring during the reporting period. The Keepers program is described in detail in the Volunteer Involvement section of the report (Appendix F). Monitoring was typically limited to overall trail conditions such as erosion, hazards, and vegetation overgrowth.

10.5 TRAIL REPAIR

A PVPLC volunteer trail crew assists in much of the trail work on the Preserve. A complete summary of the PVPLC Volunteer Trail Crew Program can be found in the Community Involvement section of the report (Appendix F). PVPLC staff or RPV Public Works department were also involved in trail enhancements.

The following lists the trail projects that Volunteer Trail Crew conducted in 2014.

Abalone Cove

- Installed a retaining wall and rock stairs on Cliffside Trail, and conducted tread repair and erosion control on Sacred Cove and Cliffside Trails

Filiorum

- Conducted tread repair on Kelvin Canyon Trail

Forrestal

- Removed T-bar stubs from Mariposa and Flying Mane trails
- Conducted erosion control and tread repair on Flying Mane Trail

Portuguese Bend

- Conducted a trail assessment at Toyon trail to reduce widening and impacts to habitat
- Conducted tread repair on Toyon and Ishibashi trails
- Conducted a trail assessment of Rim trail to better delineate it and close unauthorized trails

Vista Del Norte

- Assessed trail realignment and delineation on the reserve.

Future Trail Projects

Trail projects that may be completed in the future, based on funding, are listed in Appendix H.

Ranger Program

The PVPLC coordinated with the City on focal areas for Mountains Recreation and Conservation Authority (MRCA) rangers on the Preserve.

10.6 VOLUNTEER TRAIL WATCH

The PVPLC and City initiated the Volunteer Trail Watch Program in 2013 to help educate trail users about appropriate trail use and monitor preserve misuse. The mission of the Palos Verdes Nature Preserve Volunteer Trail Watch Program is to serve as eyes and ears of the City and the Palos Verdes Peninsula Land Conservancy with a view to 1) protect the natural resources of the Palos Verdes Nature Preserve, including the flora and fauna as well as the geology, topography and scenic landscape, and 2) enhance the safety of, and promote an enjoyable experience for all Preserve visitors. Volunteers educate the public about Preserve rules and etiquette; and enter observations of infractions into a web portal (i.e. dogs off leash, off-trail activity, user on non-designated trail, etc.) to allow rangers and Preserve managers to track time and location of these activities. Fourteen volunteers completed the second training workshop for the Volunteer Trail Watch took place in March 2014. In 2014, 28 volunteers spent a total of 1246 hours in the Preserve, observing and educating visitors.

11.0 VOLUNTEER INVOLVEMENT

PVPLC is a non-profit organization that relies heavily on the support of community involvement to perform many of the tasks necessary to manage the Preserve. The Volunteer Annual Report for January 1, 2014 through December 31, 2014 is located in Appendix F.

12 OFFICERS AND STAFF

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John Nieto, Education Manager

Development

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APPENDIX A

2014 RESTORATION MONITORING REPORT

In 2014 vegetation surveys were conducted at the restoration sites at Alta Vicente and Portuguese Bend to estimate percent cover of native and nonnative plants, litter and bare ground. These data are used to measure the success of the restoration, based on the goals determined in the NCCP. PVPLC also conducted a survey at the site of the 2012 fire at Three Sisters to monitor site recovery.

1.0 ALTA VICENTE SURVEY METHODS

Transect monitoring was conducted in Phase 1 (Year 5; AV1 and AV2) and Phase 2 restoration sites (Year 4; AV3, AV5, and AV6). Vegetation data was collected along 50 m transects within the restored areas at AVI, AV2, AV3, AV5 and AV6 (Figure 1). The height and length of each plant was measured at each 1m interval on the transect line. Photographs were taken at the beginning and end of each transect to provide a visual record of general conditions of the sampling area (Figure 2). Vegetation assessments of the overall species coverage were conducted at the permanent transects in Phase 1 and Phase 2 (AV1, AV2, AV3, AV5, and AV6), using a modified version of the California Native Plant Society (CNPS) standardized methodology (CNPS 2009). Surveys were conducted on April 29, May 6, May 13 and May 20, 2014.

Locations of transects and photo points are on Figure 1 (Appendix A1). Results of the Alta Vicente surveys are provided below.

1.1 ALTA VICENTE PHASE 1 SURVEY RESULTS (YEAR 5)

Coastal Sage Scrub (CSS)

The number of individual native plants counted in the CSS (AV1) in 2014 was 11 (Table 1). Native plant cover in the CSS site was 26%, and consisted of three species: *Artemisia californica* (14%), *Peritoma arborea* (4%), and *Eriogonum cinereum* (2%) (Table 2, Table 3). Percent non-native cover was 6%, and bare ground/litter 74% (Table 2). Shrub height ranged from 0.6 feet to 2.5 feet (Table 4). Overall native cover in the CSS based on the CNPS Rapid Vegetation Assessment protocol was 41% (Table 6).

Photopoints indicate that many plants have grown and are healthy and that the gaps are filling in as the plants grow larger (Figure 2, AV1). Recruitment from seed was very low. Lack of rain may have impacted plant recruitment from seed.

The site is approaching CSS success criteria for Year 5 cover (50%) but has not yet achieved the goal.

Palos Verdes Blue Butterfly Habitat (PVB)

The number of individual native plants counted in the PVB habitat (AV2) in 2014 was 7 (Table 1). Native plant cover was 18%, and consisted of 5 species, but no *Astragalus trichopodus.* The plant with the highest percent cover was *Artemisia californica* (10%). Bare ground cover was 8%, and litter cover was 74%(Table 2). Shrub height ranged from 0.5 feet to 2.9 feet (Table 4).

According to the Rapid Vegetation Assessment, native plant cover in the PVB habitat (AV2) in 2014 was 32%, but with no host plant cover (Table 6). Lack of rain may have impacted plant recruitment from seed. Native plant cover is within the range for year 4 goals, but host plants did not appear in the survey. Monitoring should occur earlier (March/April) to accurately measure host plant cover, because they die back in late spring (May).

1.2 ALTA VICENTE PHASE 2 (YEAR 4)

Cactus Scrub

The number of individual native plants counted in the Cactus Scrub (AV3) in 2014 was 16 (Table 1). Native plant cover was 32%, and the species with the highest percent cover were *Encelia californica*(14%), *Eriogonum cinereum* (8%), and *Opuntia littoralis (4%)* (Table 2, Table 3). Percent non-native cover was 8%, and bare ground/litter cover was 62% (Table 2). Shrub height ranged from 0.8 feet to 1.7 feet (Table 4). Overall native cover in the Cactus scrub based on the CNPS Rapid Vegetation Assessment protocol was 38%, and cactus cover was 11% (Table 6).

Photo points indicate that cactus is growing, with 3 to 5 pads on each individual. (Figure 2, AV3).

The cactus scrub habitat is meeting success criteria for native cover and for cactus cover.

PVB Butterfly Habitat

In the butterfly habitat, the number of native plants counted in the transect (AV5) was 2. Native cover was 4%, with 2% of cover consisting of host plant (ocean locoweed) (Table 2, Table 3). Percent non-native cover was 34%, and bare ground/litter 80%, bare alone (10%) (Table 2). Shrub height was 0.2 feet (Table 4). Native plant cover in the butterfly habitat based on the CNPS Rapid Vegetation Assessment protocol was 17%, with 2% host plant, and 29% bare ground (Table 6). Both survey techniques indicate low PVB host plant cover.

Photo points show that native plants are present, but remain small (Figure 2, AV5). The second PVB host plant, deerweed, included in the seed mix, did not germinate at the site.

Host plant cover is lower than goals of 10%, and bare ground should be higher (30%-70%). Host plant survival by the month of May is low at this site. Monitoring may need to occur earlier (March/April) to accurately measure host plant cover, because they seem to die back by May.

Coastal Sage Scrub (CSS)

The number of individual native plants counted in the CSS (AV6) in 2014 was 13 (Table 1). Native plant cover in the CSS site was 26%, and consisted of two main species: *Encelia californica* (18%) and *Eriogonum cinereum* (6%) (Table 2, Table 3). Percent non-native cover was 6%, and bare ground/litter 72% (Table 2). Shrub height ranged from 0.9 feet to 1.8 feet (Table 4). Overall native cover in the CSS based on the CNPS Rapid Vegetation Assessment protocol was 29% (Table 6).

Native plant cover and species composition differs from 2013 data. Photo points indicate that the transect was placed at a different location from the previous year (Figure 2, AV1).

In 2014, CSS cover was lower than the success goals for Year 4 (> 40%). However, the success criteria were met in 2013 along the original transect.

1.3 ALTA VICENTE PLANT INVENTORY

A plant inventory conducted in Phase I and Phase 2 during the 2014 surveys identified 25 native species (Table 5). Plants were identified on either side (within one meter) of a 50 meter transect in Phase 1 and Phase 2.

1.4 ALTA VICENTE CONCLUSIONS AND RECOMMENDATIONS

The Phase I restoration will require more time for plants to fill in the gaps. Staff will follow up with weed control and seeding to increase native cover at the site.

The Phase 2 restoration is meeting success criteria for year 3, and native plant cover will continue to increase as container plants mature, and germinating seedlings increase in size. PVPLC will continue to weed the site to decrease competition from weeds.

2.0 PORTUGUESE BEND SURVEY METHODS (PHASE 1, 2 AND 3)

Intensive weed control took place for an additional year at Portuguese Bend to reduce the very high weed density at the site. Plants were installed in both Phase I and Phase II in 2013. Therefore, for the purposes of the goals of the NCCP, in 2014 Phase I and II are in Year 2. Phase 3, installed in 2013, was also monitored at a permanent transect (PB4). Photo point monitoring was completed along the permanent transects in the Phase 1, II and III restoration areas (PB1, PB2, PB3, PB 4, PB6). PB 1, PB2 and PB4 are located in south-facing coastal sage scrub habitat. PB3 is located in north-facing coastal sage scrub habitat. PB6 is located in cactus scrub habitat. Vegetation assessments of the overall species coverage were conducted at the permanent transects using a modified version of the California Native Plant Society (CNPS) standardized methodology (CNPS 2009). Surveys were conducted on April 3, April 10, and April 17, 2014.

Locations of transects and photo points are on Figure 3. Results of the Portuguese Bend surveys are provided below.

2.1 PORTUGUESE BEND SURVEY RESULTS (PHASE 1 AND 2) YEAR 2

South-facing Coastal Sage Scrub (CSS)

Native plant cover in the CSS site (PB1, PB2) in 2014 ranged from 26 to 33% (Figure 4, Table 5). This area benefitted from the fact that some shrubs were already present prior to restoration. The most common plants were *Artemisia californica*, *Baccharis pilularis, Heteromeles arbutifolia* and *Eriogonum fasciculatum*. Non-native plant cover ranged between 11 and 18%. Some recruitment from seed was also observed.

North-facing Coastal Sage Scrub (CSS)

Native plant cover in the CSS site (PB3) in 2014 was 21% (Figure 4, Table 5). The most common plants were *Baccharis pilularis and Heteromeles arbutifolia*. Non-native plant cover was 7%.

Cactus Scrub

Native plant cover in the cactus scrub restoration area (PB6) in 2014 was approximately 20% (Figure 3, Table 5). The most common plant were *Encelia californica, Opuntia litoralis*, and *Rhus integrifolia*. Non-native plant cover was 19%, and gaps in vegetation were high (63%) based on percent cover of litter and bare ground.

2.1 PORTUGUESE BEND SURVEY RESULTS (PHASE 3) YEAR 1

South-facing Coastal Sage Scrub (CSS)

Native plant cover in the CSS site (PB4) in 2014 was 19% (Figure 4, Table 5). This area benefitted from the fact that some shrubs were already present prior to restoration. The most common plants were *Artemisia californica*, *Baccharis pilularis, Heteromeles arbutifolia* and *Eriogonum fasciculatum*. Non-native plant cover was 68%. Some recruitment from seed was also observed.

2.2 PORTUGUESE BEND PLANT INVENTORY

The plant inventory at Portuguese Bend, based on the Rapid Response Survey, identified 28 native species (Table 6).

2.3 CONCLUSIONS AND RECOMMENDATIONS

Native plant cover at Portuguese Bend in both Year 1 and Year 2 appears to be online for reaching success criteria in Year 3. Plants were installed as fill-in in 2013 in Phase 1 and 2 and seeds are germinating at the site.

Table I: ALTA VICENTE

Number of plants per 50 m transect with line intercept method, 1 m intervals.

Species	**Year 5 CSS: AV1**	**Year 5 PVB: AV2**	**Year 4 Cactus Scrub: AV3**	**Year 4 PVB: AV5**	**Year 4 CSS: AV6**
Artemisia californica	7	3	1		1
Astragalus trichopodus				1	
Elymus condensatus		1			
Encelia californica			7		9
Eriogonum cinereum	1	1	4		3
Eriogonum parvifolium		1	1		
Opuntia littoralis	1		2		
Peritoma arborea	2				
Rhus integrifolia			1		
Salvia mellifera		1			
Stipa spp				1	
Total Native Plants	**11**	**7**	**16**	**2**	**13**
NNAG	2		1	5	1
NNP	1		3	12	2
Total Non-Native Plants	**3**	**0**	**4**	**17**	**3**
Total plants	**14**	**7**	**20**	**19**	**16**
Bare	2	4	10	5	13
Litter	35	37	21	35	23
Litter and Bare	37	41	31	40	36

Table 2: ALTA VICENTE

Percent cover along 50 m line transects with line intercept method, 1 m intervals.

Species	**Year5 CSS: AV1**	**Year 5 PVB: AV2**	**Year 4 Cactus Scrub: AV3**	**Year 4 PVB: AV5**	**Year 4 CSS: AV6**
Artemisia californica	18	10	2	0	2
Astragalus trichopodus	0	0	0	2	0
Elymus condensatus	0	2	0	0	0
Encelia californica	0	0	14	0	18
Eriogonum cinereum	2	2	8	0	6
Eriogonum parvifolium	0	2	2	0	0
Opuntia littoralis	2	0	4	0	0
Peritoma arborea	4	0	0	0	0
Rhus integrifolia	0	0	2	0	0
Salvia mellifera	0	2	0	0	0
Stipa spp	0	0	0	2	0
Total Native Plants	**26**	**18**	**32**	**4**	**26**
NNAG	4	0	2	10	2
NNP	2	0	6	24	4
Total Non-Native Plants	**6**	**0**	**8**	**34**	**6**
Total plants	**32**	**18**	**40**	**38**	**32**
Bare	4	8	20	10	26
Litter	70	74	42	70	46
Litter and Bare	74	82	62	80	72

Table 3: ALTA VICENTE
Relative percent cover along 50 m line transects with line intercept method, 1 m intervals.

Species	**Year 5 CSS: AV1**	**Year 5 PVB: AV2**	**Year 4 Cactus Scrub: AV3**	**Year 4 PVB: AV5**	**Year 4 CSS: AV6**
Artemisia californica	17	10	2	0	2
Astragalus trichopodus	0	0	0	2	0
Elymus condensatus	0	2	0	0	0
Encelia californica	0	0	14	0	17
Eriogonum cinereum	2	2	8	0	6
Eriogonum parvifolium	0	2	2	0	0
Opuntia littoralis	2	0	4	0	0
Peritoma arborea	4	0	0	0	0
Rhus integrifolia	0	0	2	0	0
Salvia mellifera	0	2	0	0	0
Stipa spp	0	0	0	2	0
Total Native Plants	**25**	**18**	**31**	**3**	**25**
NNAG	4	0	2	8	2
NNP	2	0	6	20	4
Total Non-Native Plants	**6**	**0**	**8**	**29**	**6**
Total Plants	**30**	**18**	**39**	**32**	**31**
Bare	4	8	20	8	25
Litter	66	74	41	59	44
Litter and Bare	70	82	61	68	69

Table 4: ALTA VICENTE
Average plant height (ft) at each transect.

Species	**Year 5 CSS: AV1**	**Year 5 PVB: AV2**	**Year 4 Cactus Scrub AV3**	**Year 4 PVB AV5**	**Year 4 CSS: AV6**
Artemisia californica	2.2	2.9	1.6		1.8
Astragalus trichopodus				0.2	
Elymus condensatus		0.5			
Encelia californica			1.1		0.9
Eriogonum cinereum	1.4	0.6	1.7		1.2
Eriogonum parvifolium		0.2	0.8		
Opuntia littoralis	0.2		0.8		
Peritoma arborea	1.7				
Rhus integrifolia			1.4		
Salvia mellifera		1.3			
Stipa spp				0.2	

Table 5 ALTA VICENTE
Vegetation percent cover based on CNPS Rapid Vegetation Assessment protocol.

Species	**Year 5 CSS AV1**	**Year 5 PVB AV2**	**Year 4 Cactus Scrub AV3**	**Year 4 PVB AV5**	**Year 4 CSS AV6**
Artemisia californica	9	9	4	5	5
Astragalus trichopodus				2	1
Baccharis salicifolia	1				
Corethrogyne filaginifolia		1			
Cylindropuntia prolifera	2	1	2		1
Elymus condensatus	2				
Encelia californica			12	5	6
Eriogonum cinereum	5	5	7	2	4
Eriogonum fasciculatum	2				
Eriogonum parvifolium	1	2			1
Grass, unknown	1				
Hazardia squarrosa	1				
Heteromeles arbutifolia	2	1			
Leymus condensatus		2			
Lupinus succulentus					1
Malosma laurina	3	1			
Mirabilis californica	1				
Opuntia littoralis	2	2	11		4
Peritoma aborea					2
Peritoma arborea	2	2	1		
Rhus integrifolia	3	1	1	2	2
Salvia leucophylla	2	3			
Salvia mellifera	2	2			
Solanum douglasii					1
Stipa lepida					1
Stipa spp				1	
Total Native Plants	**41**	**32**	**38**	**17**	**29**
NNAG	1	1	3	1	1
NNP	1	4	8	26	3
Total Non-native Plants	**2**	**5**	**11**	**27**	**4**
Bare	7	8	31	29	33
Litter	50	55	20	28	37
Bare and Litter	**57**	**63**	**51**	**57**	**70**

Table 6. Portuguese Bend: Vegetation percent cover based on CNPS Rapid Vegetation Assessment protocol.

Species	**Year 2 CSS South PB1**	**Year 2 CSS South PB2**	**Year 2 CSS North PB3**	**Year 2 Cactus Scrub PB6**	**Year 1 CSS South PB4**
Acmispon glaber	2	3			
Artemisia californica	6	3		1	1
Asclepias fascicularis	1				
Astragalus trichopodus		1			
Baccharis pilularis	3	1	6	1	3
Cylindropuntia prolifera				1	
Elymus condensatus			1		
Encelia californica	1	3		7	1
Eriogonum fasciculatum	3	3			1
Eschscholzia californica	1		1		1
Hazardia squarrosa		1			
Heteromeles arbutifolia	4		7	2	3
Isocoma menziesii	1	1			1
Lupinus succulentus					
Marah macrocarpa			2		
Melica imperfecta	1	1	2		
Opuntia littoralis				3	
Peritoma arborea	1	1			1
Phacelia cicutaria					
Plantago lanceolata var *fastigiata*	1	1			2
Prunus ilicifolia				1	
Pseudognaphalium californicum		1			
Rhus integrifolia	3	1		3	2
Salvia leucophylla	1	1		1	
Salvia mellifera	2	1			1
Sambucus nigra subsp *caerulea*	1	1			1
Sisyrinchium bellum		1			
Stipa spp	1	1	2		1
Total Native Plants	**33**	**26**	**21**	**20**	**19**

NNAG	1	1	5	1	32
NNP	17	10	2	18	36
Total Non-native Plants	**18**	**11**	**7**	**19**	**68**
Bare	39	40	42	42	11
Litter	12	24	31	21	2
Bare and Litter	**51**	**64**	**73**	**63**	**13**

3.0 FIRE RESPONSE

3.1 THREE SISTERS 2012 FIRE

On January 9, 2012, the Crest Fire burned approximately 12.7 acres of the 99-acre Three Sisters Reserve, as well as some habitat in McCarrell's canyon, outside of the Preserve. The wildfire burned native and non-native vegetation and known habitat of the threatened coastal California gnatcatcher and cactus wren. The Fire Report and Restoration Plan for the site recommends cactus planting in key areas, weed control and monitoring. The burn area was weeded and planted with large cactus in 2012. Surveys in 2014 showed that burned cactus and other native vegetation were recovering, and weed cover was low. There remains a high amount of bare ground due to the lack of rain in 2013/14 (Appendix A3).

3.2 VISTA DEL NORTE 2014 FIRE

On June 17, 2014, the Vista del Norte fire burned 6.7 acres of the 14-acre Vista del Norte Reserve. The wildfire burned native and non-native vegetation: 6.5 acre of black mustard (*Brassica nigra*) vegetation type and 0.2 acre of coyote bush (*Baccharis pilularis*) vegetation type. Recovery actions include erosion control and native seeding. Milkweed (*Asclepias fascicularis*) germinated post-fire (Appendix A4).

Figure 1. Alta Vicente Restoration Monitoring Map.

Alta Vicente Photo Points.

Flower garden within the restoration area.


Photopoint AV1Begin


Photopoint AV1End


Transect AV2 Begin


Transect AV2 Middle


Transect AV2 End


Transect AV3 Begin


Transect AV3 End

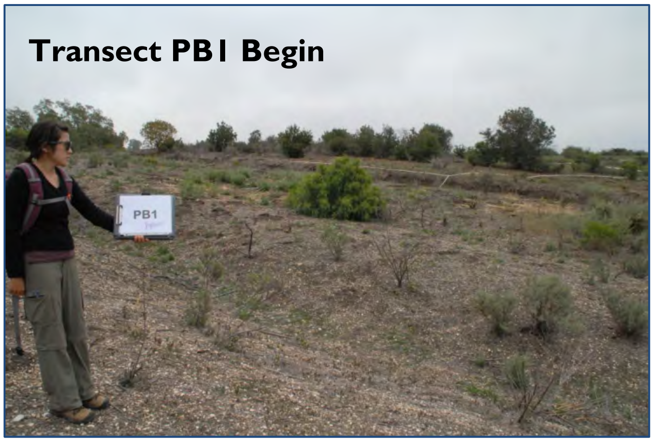

Transect AV5 Begin


Transect AV5 End

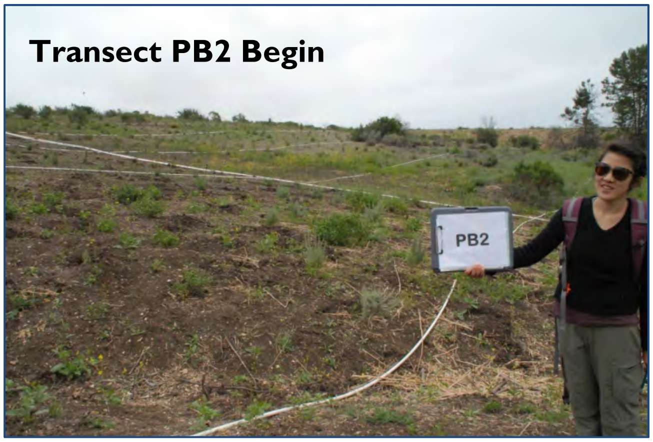

Transect AV6 Begin


Transect AV6 End

Appendix A2. Portuguese Bend Photopoints


Transect PB1 Begin


Transect PB1 End


Transect PB2 Begin


Transect PB2 End


Transect PB3 Begin


Transect PB3 End

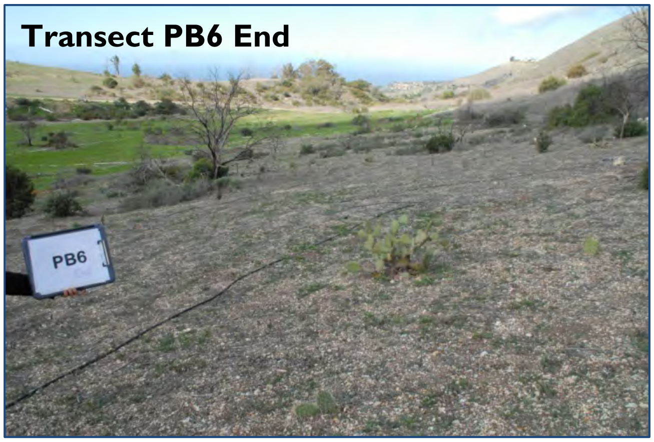

Transect PB4 Begin


Transect PB4 End

Transect PB5 Begin

Transect PB5 End

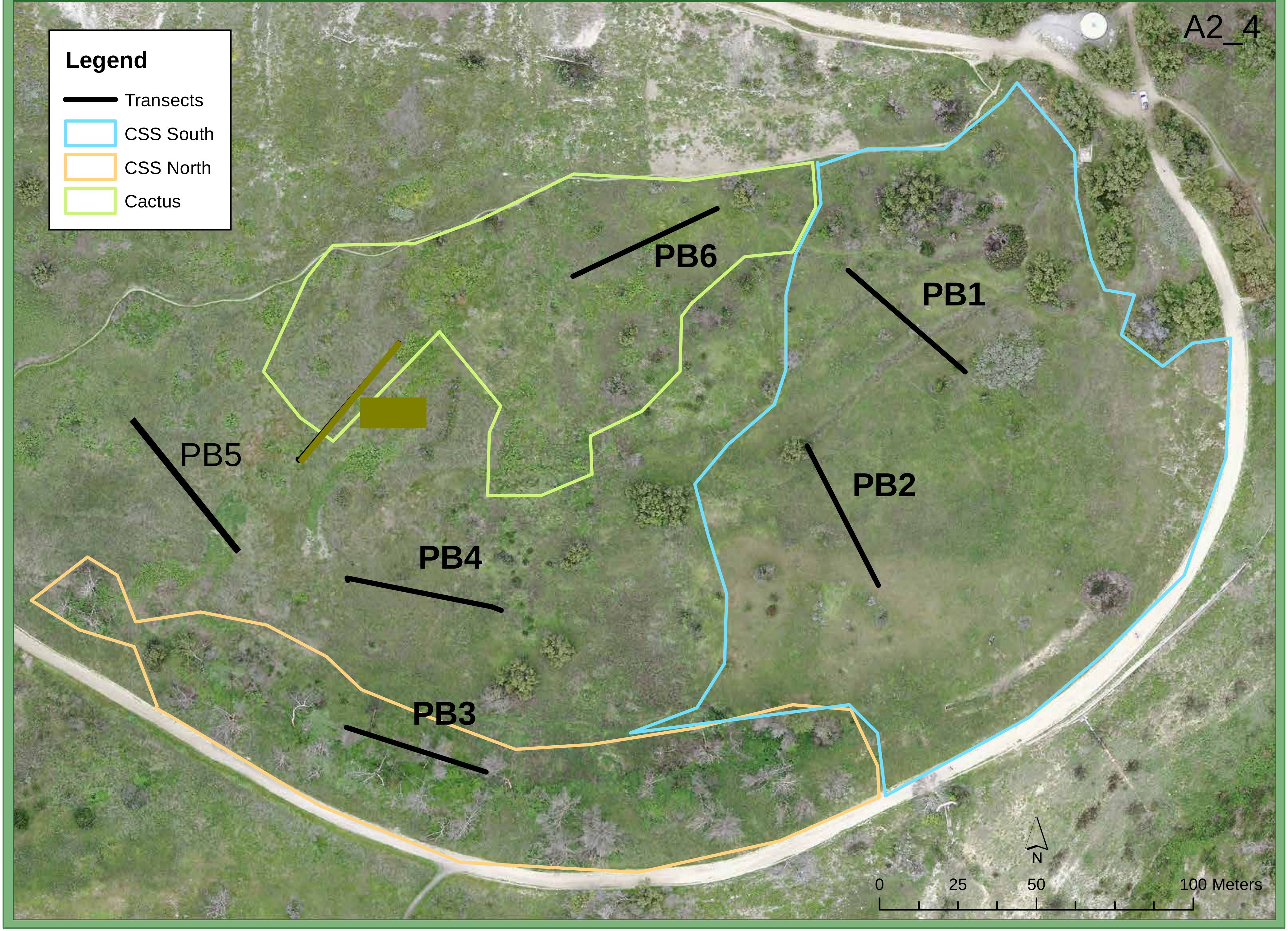
Transect PB6 Begin



Transect PB6 End

Portuguese Bend Reserve

NCCP Restoration Transects



Appendix A3. Three Sisters Fire 2014 Monitoring Photopoints

A3_2

A3_3

APPENDIX 4: VISTA DEL NORTE FIRE REPORT AND RESTORATION PLAN

1. INTRODUCTION

The June 17, 2014, Vista del Norte fire burned approximately 6.7 acres of the 14-acre Vista del Norte Reserve. The wildfire burned native and non-native vegetation. No coastal California gnatcatcher (*Polioptila californica californica*) or cactus wren (*Campylorhynchus brunneicapillus*) had been identified at the Reserve in previous surveys.

This report addresses the management and recovery of habitat and trails in the fire-affected area of the Vista del Norte Reserve. The recommendations in the report are based on the management of the PVNP under a draft Natural Community Conservation Plan to "maximize benefits to wildlife and vegetation communities while accommodating appropriate economic development within the City of Rancho Palos Verdes." Under the plan, the Palos Verdes Peninsula Land Conservancy (PVPLC) serves as the habitat management agency for the PVNP, for the land owners (the City of Rancho Palos Verdes). This report does not offer post-fire recommendations for public safety, enforcement or other responsibilities outside of the scope of habitat management.

Section 2 of the fire recovery plan documents existing, pre-fire conditions and management of the Reserve. Section 3 provides restoration and monitoring recommendations, based on available funding for expected burns, as outlined in the draft NCCP. Section 4 is a Summary of Recommended Actions.

2. PRE-FIRE CONDITIONS

In Spring 2009, vegetation mapping using California Native Plant Society's Rapid Vegetation Assessment Protocol was completed. This information describes the Reserve's pre-fire habitat types with both native and introduced vegetation stands (*Figure 1*).

Of the 6.7 acres that burned at Vista del Norte Reserve, Black mustard (*Brassica nigra*), an introduced species, was the dominant native vegetation type (*Table 1, Figure 1*). Burned native vegetation consisted of 0.2 acres of coyote bush vegetation type (*Baccharis pilularis*).

TABLE 1: Pre-fire vegetation types and associated acreages

Vegetation Type	**Acres**	**Native**
Brassica nigra	6.5	N
Baccharis pilularis	0.2	Y
Total	***6.7***	

Figure 1. Vista del Norte 2014 Fire Boundary and Pre-Fire Vegetation.

3 RESTORATION AND MONITORING RECOMMENDATIONS

3.1 EROSION AND TRAILS

Increased surface erosion of hillsides, canyons and trails may occur in the burn area until the area stabilizes, especially during storm events. Stabilization of the area will come over time but permanent native vegetation is the best long-term solution for soil stabilization and erosion control. Some targeted replanting of mature native vegetation in combination with native seeding is a possible method to counteract erosion and mudflow. However, it is important to understand that soil movement and erosion are natural occurrences in a post-fire environment.

The fire burned almost all plants down to the ground, exposing the soil. Due to the steep slopes at Vista del Norte, PVPLC recommends that erosion control efforts in the Reserve include hydroseeding with a coastal sage scrub seed mix, and the placement of straw wattles along slope contours prior to the start of the rainy season.

The trail system was not affected by the fire. PVPLC will monitor the area for signs of e off-trail and unauthorized trail usage. PVPLC will monitor to determine if unauthorized trails are being created and need to be closed. Along with Reserve rule enforcement, techniques to minimize off-trail use include: trail signs designating official trails, areas closed for restoration, and directional signs pointing away from unauthorized and closed trails.

3.2 INVASIVE SPECIES CONTROL

Only a small patch of native vegetation was burned (0.2 acre). Invasive species should be targeted for removal in areas that were previously composed of native vegetation. Based on limited funding, priority areas for weed control will be known stands of pre-fire dominant native vegetation (Figure 1). Species priority will be based on PVPLC's Targeted Exotic Removal Plant Program guidelines, which use a synthesized rating system drawn from plant invasiveness rankings from both the California Invasive Plant Council and the California Department of Food and Agriculture. Removal methodologies will include, but are not limited to: herbicide, hand removal, and mechanical weeding.

3.3 HABITAT RESTORATION AND ENHANCEMENT

The purpose of this habitat restoration plan is to establish ecologically appropriate native habitats in areas disturbed by fire. The following general goals were determined for the habitat restoration after evaluating the post-fire conditions of the Reserve:

Primary Goal

Assist in native vegetation recovery in area previously identified as native vegetation (Figure 1). This will be accomplished through hydroseeding the site and invasive weed control.

3.4 MONITORING

Monitoring will be limited to visual inspections on a quarterly basis, to document invasive weed growth and weed control needs.
Annual vegetation assessments (the California Native Plant Society's Rapid Vegetation Assessment protocol), will be conducted in the first three years following the fire, to assess vegetation recovery. The success criteria listed below for the pre-fire habitat type will indicate successful fire recovery. Other sources of funding may be sought if vegetation recovery is not approaching minimum success criteria.

Baccharis pilularis **vegetation type:**

- After the third year, non-native plant cover less than 30%
- Native plant cover after the third year greater than 40%

4 SUMMARY OF RECOVERY ACTIONS

The following actions are a summary of the recommendations outlined in the above Section 3 of this report:

Task 1: Targeted Invasive Species Removal

Implement invasive plant species removal within the burn area as needed. Priority will be based on PVPLC's NCCP Targeted Exotic Removal Plant Program guidelines, which use a synthesized rating system drawn from plant invasiveness rankings from both the California Invasive Plant Council and the California Department of Food and Agriculture. Removal methodologies will include, but are not limited to: herbicide, hand removal, and mechanical weeding.

Task 2: Erosion Control

Straw wattles will be installed for erosion control. The burned area will be hydroseeded for erosion control.

Task 3: Native Seeding

The site will be hydroseeded with native seeds for erosion control, and passive recovery will be monitored.

Based on the NCCP, for repetitive fires (less than 56 acres in size), maximum costs, shared by the City of RPV and PVPLC, are $1,300 per acre. Therefore, total funds that may be allocated for fire response are $8,710. Table 2 shows the estimated maximum costs that may be incurred.

Table 2. Recommended Actions.

		Cost	**Timeline**
Task 1	Monitor and weed as necessary	$3,000	Summer 2014-Spring 2017
Task 2	Install erosion protection	$1,000	Fall 2014
Task 3	Hydroseed burned area	$4,710	Fall 2014
Total		**$8,710**	

Table 3. Coastal Sage Scrub Seed mix for burned area (6.7 acres)

Scientific Name	Common Name	Pounds of bulk seed per acre
Artemisia californica	California sagebrush	3.0
Deinandra fasciculata	fascicled tarweed	1.0
Encelia californica	California encelia	1.5
Eriogonum cinereum	ashyleaf buckwheat	1.0
Eriogonum fasciculatum	California buckwheat	3.0
Gnaphalium californicum	California everlasting	0.5
Hazardia squarrosa	saw-toothed goldenbush	0.5
Heteromeles arbutifolia	toyon	0.1
Isocoma menziesii	coast goldenbush	1.5
Leymus condensatus	giant wild rye	1.0
Lotus scoparius	deerweed	1.0
Lotus strigosus	strigose lotus	1.5
Lupinus bicolor	miniature lupine	3.0
Lupinus succulentus	arroyo lupine	1.0
Malosma laurina	laurel sumac	0.1
Melica imperfecta	melic grass	2.0
Nassella lepida	foothill needlegrass	2.0
Nassella pulchra	purple needlegrass	2.0
Phacelia cicutaria	catepillar phacelia	0.4
Plantago insularis	wooly plantain	10.0
Rhus integrifolia	lemonadeberry	0.1
Salvia leucophylla	Purple sage	1.5
Vulpia microstachys	small fescue	4.0

Appendix B.

Portuguese Bend NCCP Site Proposed Revised Restoration Plan for Phase 4 and 5

3.5 SEEDING AND PLANTING SPECIFICATIONS

The following methods will be used to seed and plant during the restoration of coastal sage scrub and cactus scrub habitats within the Portuguese Bend Reserve. Seeding and planting should be implemented in October 2012 to take advantage of the entire rain season.

3.5.1 Seeding

Seed shall be applied by hand with a belly grinder in the areas between container plant groupings as well as in between the plants among the container plant groups in all restoration areas. The seed will be mixed together as specified for the seed mix. Specified VAM will be spread by hand with a belly grinder over the seeding area prior to seeding. The seed shall be broadcast and raked, where practical, into the ground to no more than a quarter of an inch to incorporate the seed into the soil to increase germination success. The seed palettes are the same as in the 2010 Restoration Plan (see Table 2, 4, 6).

3.5.2 Planting

Container plant palettes were based on the seed palette in the 2010 Restoration plan (Tables 1, 3, 5).

Container plants consist of dominant shrubs and 40 to 60 plants will be planted in groups of mixed species throughout the restoration area. However, cactus species will be planted in the 2 acre restoration area with no other species planted within the group. The layout for container plants will be determined for each area based on micro topographic features and planting sites will be marked on the site using different colored pin flags under the supervision of the restoration ecologist or PVPLC biologist. Spacing of plants within the groups will follow the specifications presented in the tables for container plant palettes. Groups of container plants will be spaced in a natural looking mosaic in each area.

All container plants are to be planted to the following specifications:

- Planting holes shall be made with the minimum disturbance to accommodate the containers.
- Prior to planting, the planting hole shall be filled with water, and allowed to drain.
- Plants shall be set in the planting hole so that the crown of the root ball is approximately 0.25 inch above finish grade. Under no circumstance should the plant crown be buried.
- A watering basin shall be provided around each plant from 18 – 24 inches in diameter.
- Watering basins shall be filled with water after planting, at least twice.
- The irrigation system should be tested to ensure that all emitters are functioning.

3.6 IRRIGATION SYSTEM

A temporary above ground irrigation system is specified for the groups of container plants within the coastal sage scrub restoration areas. The irrigation system will be used, as necessary to supplement the annual rainfall during the establishment period. The temporary irrigation system will be installed in summer prior to planting to permit “grow and kill” weed treatments.

The temporary above ground irrigation system will be used in the early fall and late spring seasons. The irrigation system will slightly lengthen the growing season to maximize the development of the habitat. Depending on rainfall, irrigation likely will be required for the first two growing seasons for establishment.

3.7 SITE MAINTENANCE

One of the goals for the restoration is to provide self-sustaining habitats. However, initially, maintenance of the restoration area will be necessary to establish the newly planted and seeded areas. Maintenance will include any activities required to meet the performance standards set forth in this plan, in the estimation of the restoration specialist or PVPLC biologist. For the Three Sisters Reserve, these include the following:

- Weed control, at a minimum for fennel, acacia, mustards, wild oats and purple false brome;
- Irrigation for the container plants;
- Replacement hand seeding in areas of more than 200 sq. ft where target seed germination failed after one good season of rainfall;
- Replacement of container plants in areas with less than 80 percent survival in years two and three, based on visual observations of substantial mortality; and
- Pest and disease control, if necessary.

The establishment maintenance period is generally three years duration with the most intense maintenance in the first and second year, and only seasonal weeding activities in the third year. The amount of maintenance each year will depend on weather conditions and how well the site develops. The following specifications for maintenance may require adjustments as determined by the restoration specialist or PVPLC biologist over the three-year maintenance period.

3.7.1 Weed Control

During the active maintenance period, the target cover from exotic weed species will be generally 10 percent or less. Control of the wild oats and purple false brome is especially important because annual grasses have been shown to compete with shrub species in restoration (Eliason and Allen 1997; Corbin and D’Antonio 2004). Purple false brome is a relatively recent invader to southern California, and the habitat of this species is relative dense growth.

Weeds will be controlled during late winter through early summer, as necessary, before they set seed and/or before they reach approximately 12 inches in height. Three weeding events should be estimated for a normal rainfall season, with more or less as dictated by rainfall. Weeds, such as purple false brome will be removed from the site if seeds have set prior to weeding. Since removal of weeded material is expensive, weeded material may be left on site as organic mulch material if seeds have not yet set. Removal of herbicide treated material is not an issue.

Weed control will mainly employ hand pulling, mechanical methods, and spot spraying of herbicides for certain species such as fennel and acacia as described in Section 3.2.1.

3.7.2 Irrigation of Container Plants

Temporary irrigation will only be used in the areas where groups of container plants are to be planted. Irrigation will be used in the first two seasons from planting to extend the rainy season and establish the shrubs, as necessary. The timing of irrigation events will depend on evapo-transpiration between irrigation events and soil moisture. The following management scheme is anticipated as a guideline for water management of native trees and shrubs:

- Irrigate soil to full field capacity to the desired depth (approximately 18 inches after planting; and 18–24 inches during plant establishment).
- Allow soil to dry down to approximately 50-60 percent of field capacity in the top 6-12 inches before the next irrigation cycle. Depth of soil dry down between irrigation events will depend on development of container plants.

Wetting of the full root zone and drying of the soil between irrigation events is essential to the maintenance of the plants and the promotion of a deep root zone that will support the vegetation in the years after establishment. A soil probe or shovel should be used to examine soil moisture and rooting depth directly.

3.7.3 Seeding and Plant Replacement

Target values for relative cover of the native vegetation, including nurse and erosion control species, will be as follows with at least 20 percent cover in Year 1, 30 percent in Year 2, and 40 percent in Year 3. Actual cover values will depend mainly on weather conditions (seasonal rainfall and temperature) during the establishment period.

Areas of significant erosion shall be repaired and re-seeded in the first fall season after damage. Re-seeding will occur in areas if coverage is less than 20 percent of native species over any contiguous area of 200 sq ft.

Survival of the container plants within the first growing season should be 80 percent. Plants shall be replaced if survivorship falls below 80 percent in the first season. Replacements will be planted as previously specified and maintained for one growing season, as necessary. As sites develop, it is impractical to implement direct counts of all the container plants. Replacement planting after the first season shall only be specified if the visual estimate indicates substantial mortality and the function of these species has not been replaced by seeded material and natural recruitment.

Table 1. Northerly Facing Slope Coastal Sage Scrub Container Plant Palette.

Species	**Plants per acre**
Artemisia californica	900
Encelia californica	100
Eriogonum cinereum	222
Eriogonum fasciculatum	409
Eschscholzia californica var. maritima	40
Hazardia squarrosa	50
Gnaphalium californicum	50
Heteromeles arbutifolia	11
Leymus condensatus	55
Isocoma menziessi	50
Lotus strigosus	0
Lotus scoparius	55
Malosma laurina[1]	11
Melica imperfecta	50
Nassella lepida	55
N. pulchra	55
Phacelia cicutaria	10
Rhus integrifolia[1]	11
Salvia leucophylla	245
Vulpia microstachys	20
Bloomeria crocea	As available
Dichelostemma capitatum	As available
Calochortus catalinae	As available
[1] In groupings	

Table 2. Northerly Facing Slope Coastal Sage Scrub Seed Mix.

Species	**Lbs. Per Acre**
Artemisia californica	2
Castilleja exserta	0.5
Deinandra fasciculata	0.5
Encelia californica	0.5

Eriogonum cinereum	2
Eriogonum fasciculatum	3
Eschscholzia californica var. maritima	1.5
Hazardia squarrosa	0.5
Gnaphalium californicum	0.5
Heteromeles arbutifolia	0.1
Leymus condensatus	1
Isocoma menziessi	0.5
Lotus strigosus	1
Lotus scoparius	1
Lupinus succulentus	1
Lupinus bicolor	1
Malosma laurina	0.1
Melica imperfecta	2
Nassella lepida	1
N. pulchra	1
Phacelia cicutaria	0.4
Rhus integrifolia	0.1
Salvia leucophylla	1.5
Vulpia microstachys	1
Bloomeria crocea	as available
Dichelostemma capitatum	as available
Calochortus catalinae	as available

Table 3. Southerly and Westerly Facing Slope Coastal Sage Scrub Plant Palette.

Species	**Plants per acres**
Artemisia californica	500
Castilleja exserta	10
Deinandra fasciculata	50
Encelia californica	50
Eriogonum cinereum	188

Eriogonum fasciculata	563
Eschscholzia californica var. maritima	120
Gnaphalium californicum	47
Heteromeles arbutifolia	19
Isocoma menziessi	20
Lotus scoparius	90
Lupinus succulentus	50
Lupinus bicolor	50
Malosma laurina[1]	9
Melica imperfecta	95
Nassella lepida	60
N. pulchra	60
Phacelia cicutaria	10
Rhus integrifolia[1]	9
Salvia leucophylla	100
Salvia mellifera	80
Sisyrinchium bellum	10
Bloomeria crocea	As available
Dichelostemma capitatum	As available
Calochortus catalinae	As available
[1] In groupings	

Table 4. Southerly and Westerly Facing Slope Coastal Sage Scrub Seed Mix.

Species	**Lbs. Per Acre**
Artemisia californica	2
Castilleja exserta	0.5
Deinandra fasciculata	0.5
Encelia californica	0.5
Eriogonum cinereum	2
Eriogonum fasciculata	6
Eschscholzia californica var. maritima	1.5
Gnaphalium californicum	0.5
Heteromeles arbutifolia	0.3
Isocoma menziessi	0.5
Lotus strigosus	1.5
Lotus scoparius	1.5
Lupinus succulentus	1

Lupinus bicolor	1.5
Malosma laurina	0.1
Melica imperfecta	0.5
Nassella lepida	0.5
N. pulchra	0.5
Phacelia cicutaria	0.4
Rhus integrifolia	0.1
Salvia mellifera	0.5
Sisyrinchium bellum	0.5
Vulpia microstachys	0.5
Bloomeria crocea	as available
Dichelostemma capitatum	as available
Calochortus catalinae	as available

Table 5. Cactus Scrub Container Plant Palette.

Scientific Name	Common Name	Container Size[1]	Plants per acre [2, 3]	
Cylindropuntia prolifera	Coastal cholla	1-gallon	40	
Opuntia littoralis	Coast prickly pear	1-gallon	120	
Sambucus nigra	Blue elderberry	1-gallon	3	
Artemisia californica	California sagebrush	1-gallon	400	
Eriogonum cinereum	Coast buckwheat	1-gallon	100	
Eriogonum fasciculatum	California buchwheat	1-gallon	300	
			TOTAL	**963**

[1] A combination of pads, 1-gallon, and 5-gallon cactus can be used.

[2] Spacing = feet on-center distance from other cactus within planting groups. Spacing of 5-gallon cactus should be 6' from next closest cactus.

[3] Cactus should be planted in groups of 30. Planting groups can consist of a combination of cactus pads, 1-gallon, and 5-gallon plants at the specified number of plants per acre.

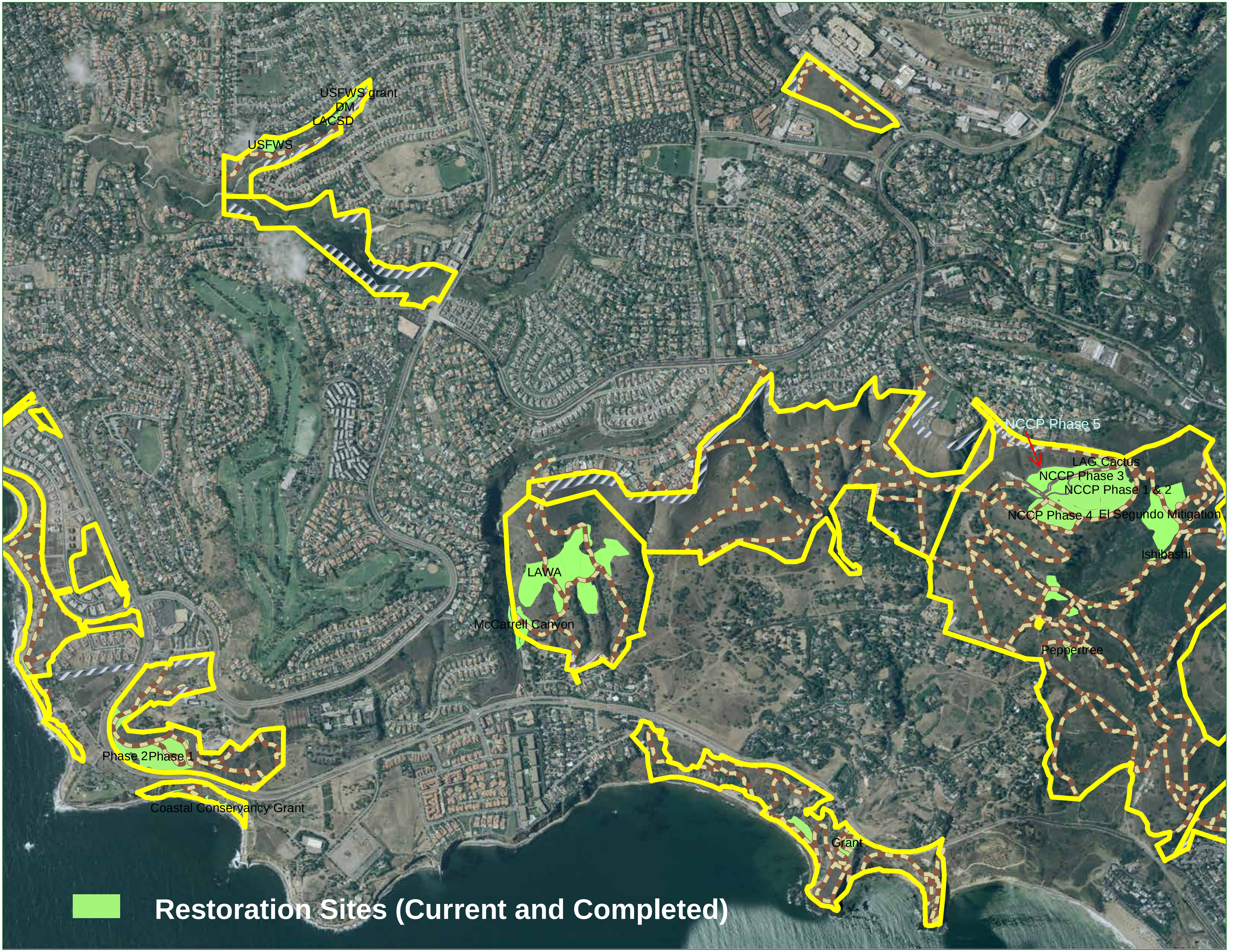
Table 6. Cactus scrub seed mix.

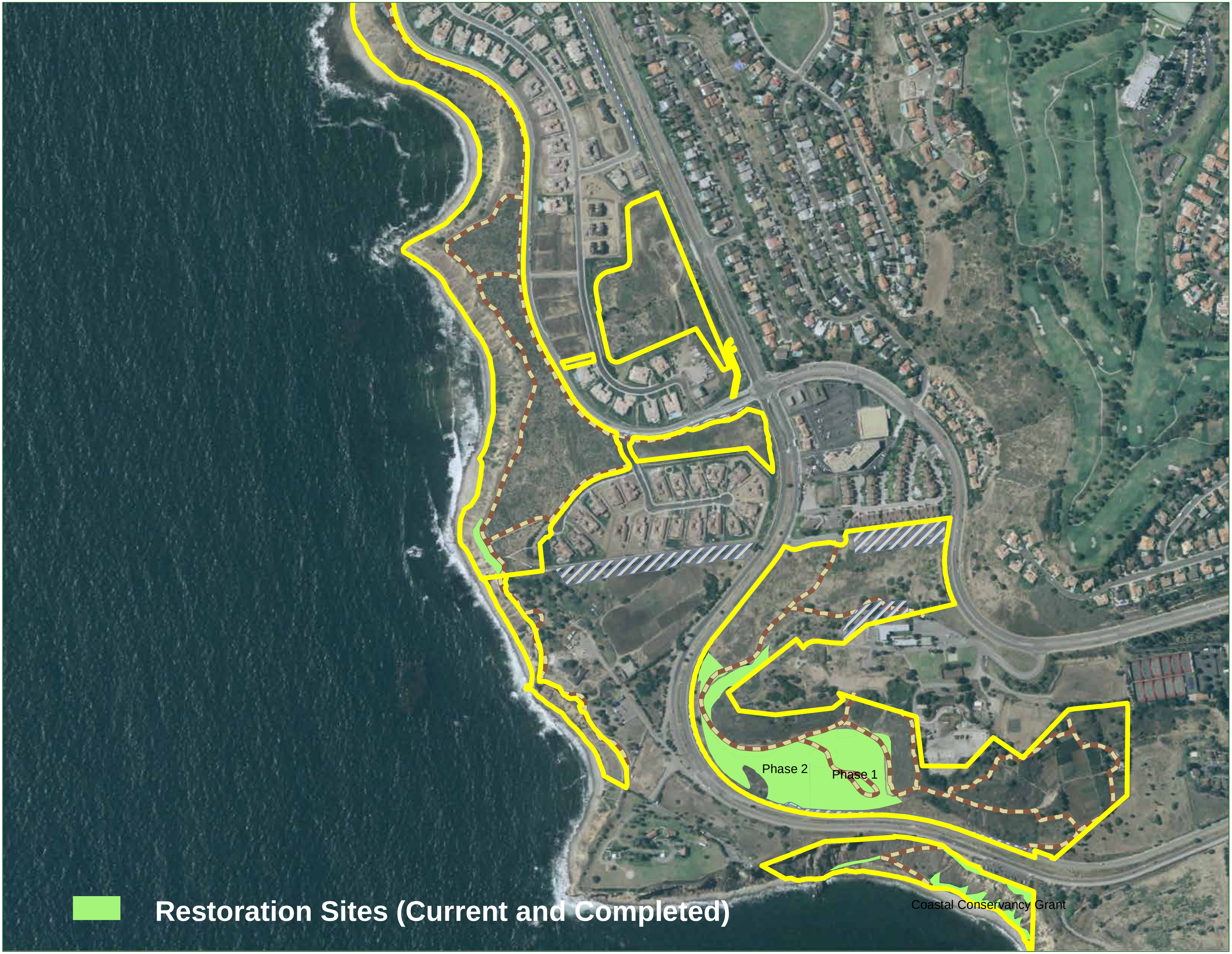
Scientific Name	Common Name	Pounds of bulk seed per acre
Artemisia californica	California sagebrush	2.0
Eriogonum cinereum	ashyleaf buckwheat	2.0
Eriogonum fasciculatum	California buckwheat	6.0
Gnaphalium californicum	California everlasting	0.5
Lotus scoparius	deerweed	6.0
Lotus strigosus	strigose lotus	1.5
Lupinus bicolor	miniature lupine	3.0
Lupinus succulentus	arroyo lupine	1.0
Melica imperfecta	melic grass	2.0
Nassella lepida[3]	foothill needlegrass	2.5
Phacelia ramosissima	branching phacelia	0.4
Plantago insularis[4]	wooly plantain	20.0
Sambucus Mexicana	Mexican elderberry	0.5
Sisyrinchium bellum	blue-eyed grass	0.5
Vulpia microstachys[4]	small fescue	6.0

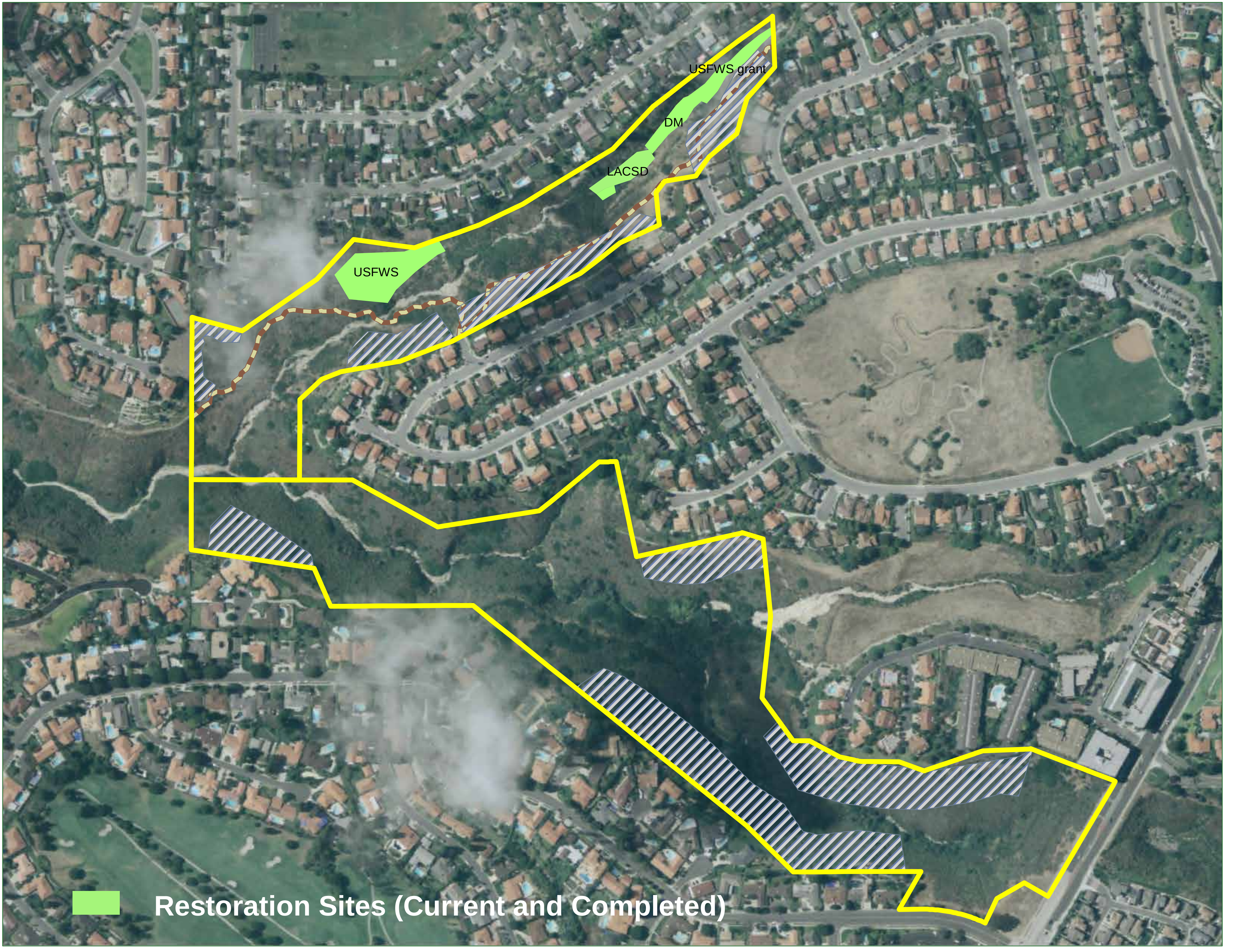
APPENDIX C. PALOS VERDES NATURE PRESERVE RESTORATION PROJECTS THROUGH 2014

	Funding source	**Location**	**Habitat Type**	**Acres**	**Status**	**Start Date**	**End Date**
NCCP							
Alta Vicente	NCCP	Phase 1	CSS	4.5	ongoing	2007	2014
Alta Vicente	NCCP	Phase 1	PVB habitat	0.5	ongoing	2007	2014
Alta Vicente	NCCP	Phase 2	CSS	4	ongoing	2008	2015
Alta Vicente	NCCP	Phase 2	cactus scrub	0.5	ongoing	2008	2015
Alta Vicente	NCCP	Phase 2	PVB habitat	0.5	ongoing	2008	2015
Portuguese Bend	NCCP	Phase 1 and 2	CSS	8	ongoing	2010	2017
Portuguese Bend	NCCP	Phase 1 and 2	cactus scrub	2	ongoing	2010	2017
Portuguese Bend	NCCP	Phase 3	CSS	5	ongoing	2012	2018
Portuguese Bend	NCCP	Phase 4	CSS	5	ongoing	2013	2019
Portuguese Bend	NCCP	Phase 5	CSS	4	ongoing	2014	2020
Portuguese Bend	NCCP	Phase 5	cactus scrub	1	ongoing	2014	2020
Additional Projects							
Abalone Cove	Coastal Conservancy, NFWF, SMBRC, USFWS		CSS	4	ongoing	2013	2016
Agua Amarga	USFWS		CSS	2	completed	2001	2003
Agua Amarga	USFWS		riparian	0.5	completed	2004	2005
Agua Amarga	LACSD		riparian	0.25	ongoing	2011	2016
Agua Amarga	D&M		riparian	0.2	ongoing	2012	2017
Portuguese Bend	El Segundo Mitigation	ishibashi	CSS and grassland	9.5	ongoing	2010	2015
Portuguese Bend	HCF grant	ishibashi	CSS	0.25	ongoing	2012	2015
Portuguese Bend	HCF grant	peppertree	CSS	0.5	ongoing	2012	2015
Portuguese Bend	Local Assistance Grant		cactus scrub	3	completed	2010	2011
Three Sisters	LAWA		CSS	13.3	completed	2007	2013
Three Sisters	LAWA		grassland	7.7	completed	2007	2013

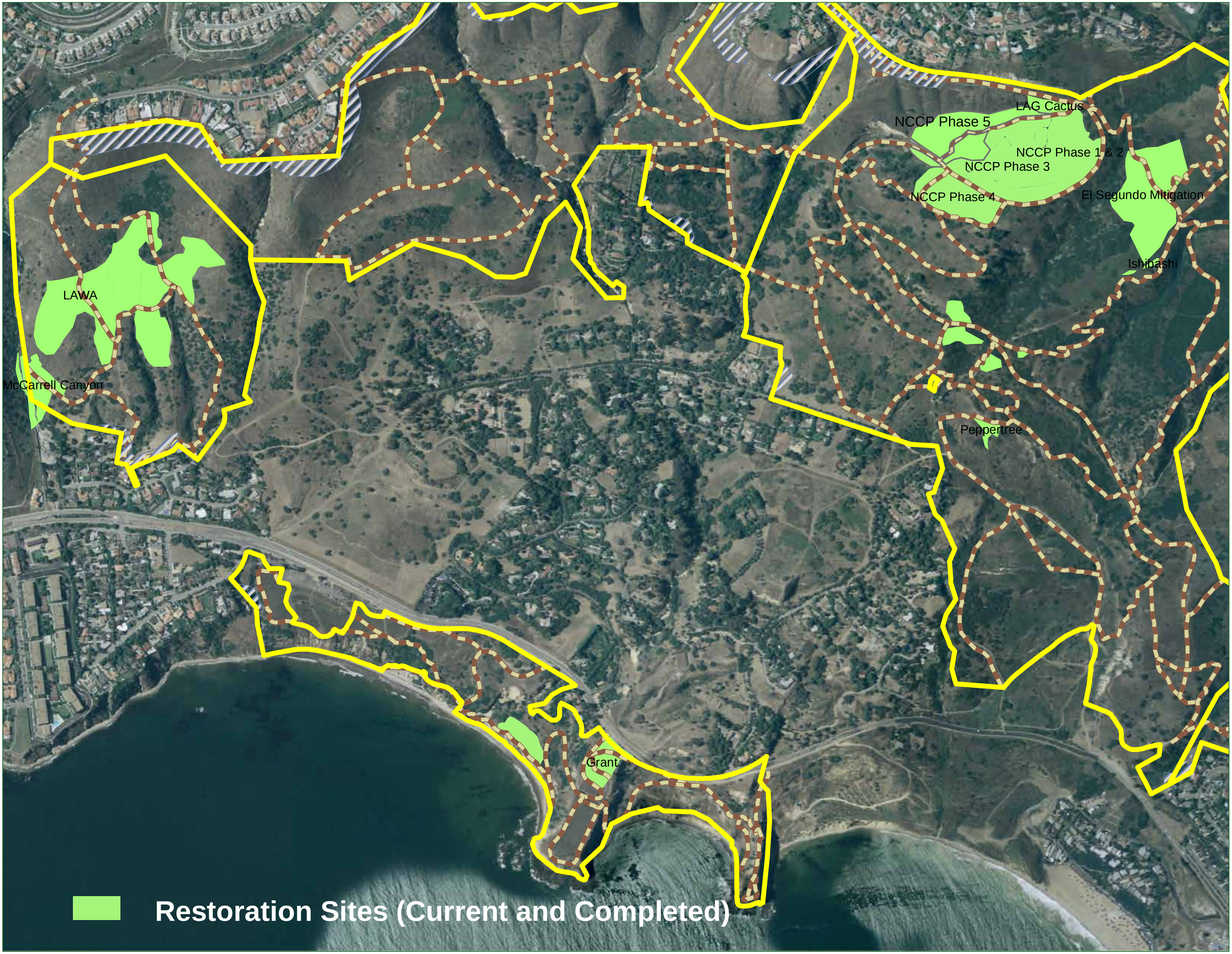
Three Sisters/McCarrell's Ca	Coastal Conservancy		riparian	0.5	completed	2009	2012
Three Sisters/McCarrell's Ca	Coastal Conservancy		CSS	2	completed	2009	2012
Vicente Bluffs	Coastal Conservancy		coastal scrub	2	completed	2009	2014


USFWS grant
DM
LACSD
USFWS
NCCP Phase 5
LAG Cactus
NCCP Phase 3
NCCP Phase 1 & 2
NCCP Phase 4
El Segundo Mitigation
Ishibashi
LAWA
McCarrell Canyon
Peppertree
Phase 2
Phase 1
Coastal Conservancy Grant
Grant
🟩 Restoration Sites (Current and Completed)


🟩 Restoration Sites (Current and Completed)
Phase 2
Phase 1
Coastal Conservancy Grant



🟩 Restoration Sites (Current and Completed)


NCCP Phase 5
LAG Cactus
NCCP Phase 1 & 2
NCCP Phase 3
NCCP Phase 4
El Segundo Mitigation
Ishibashi
LAWA
McCarrell Canyon
Peppertree
Grant
🟩 Restoration Sites (Current and Completed)

APPENDIX D

ANNUAL REPORT FOR THE

2014

TARGETED EXOTIC REMOVAL PROGRAM FOR PLANTS (TERPP)

1.0 INTRODUCTION

The Palos Verdes Peninsula Land Conservancy (PVPLC), as manager of the Palos Verdes Nature Preserve (PVNP), conducts strategic weed control activities throughout the year as part of the Targeted Exotic Plant Removal Plan for Plants (TERPP). As directed in the draft Rancho Palos Verdes Natural Communities Conservation Plan (NCCP), PVPLC selects five acres or 20 small sites of exotic plants for removal each year. The overall goal of this program is to systematically target invasive species throughout the PVNP to increase the success of native plant growth and create greater habitat opportunities for wildlife.

The TERPP is an element of the NCCP that includes a specific protocol for ranking exotic species populations and strategically removing those species over time (Appendix D1-D7). The 2014 TERPP Report documents PVPLC's effort over the past year to remove exotic plant species that threaten native vegetation in the PVNP. It details the methods of assessing the threat of individual exotic species to native vegetation, field methods for removal and provides site-specific documentation related to every completed removal site.

As of the writing of this report, the NCCP is still in draft format and the regulatory agencies have not yet signed the final plan. However, the City of Rancho Palos Verdes and PVPLC currently perform the responsibilities outlined in the draft NCCP, including fulfillment of the TERPP requirements.

2.0 SITE ASSESSMENT

Invasive species control is included in PVPLC's annual conservation planning strategy where Stewardship staff prioritize potential TERPP sites and assess best practice methods for removal. Guided by the NCCP, which ranks known PVNP exotic species based on State and Federal guidelines, PVPLC staff locate TERPP sites to target for the calendar year, assess the best method for eradication, photo document and map the population/s, and conduct weed removal accordingly.

The PVPLC weighs potential areas for exotic species control based on several criteria:

1. Threat to native vegetation, particularly populations of NCCP-covered species;
2. Feasibility of eradication, which includes limiting disturbance to native habitat and ease of access, and;
3. Invasiveness of exotic species, using a synthesized rating system drawn from plant invasiveness rankings from both the California Invasive Plant Council (Cal-IPC) and the California Department of Food and Agriculture (CDFA).

Through regular property reviews and viewing fine scale imagery through the Geographic Information System (GIS), ArcGIS, PVPLC plans for exotic species control across the entire NCCP area.

To more effectively collect baseline data and track invasive species within the Preserve, PVPLC is currently developing a new methodology for collecting TERPP information. A new TERPP form is in Appendix D1. The forms provide basic information about the species targeted, including site identification number and property, approximate location, removal methods used, and general comments related to the removal activities. PVPLC also includes photo documentation: staff photographs the sites before work takes place and after the removal of the individual or population of exotic species. Photo documentation not only confirms completion of the work, but also provides a snapshot of the surrounding environment at the time of the TERPP-related activities. This record helps to create a historical record of the presence of non-native plant species on the sites, which may inform future restoration efforts.

Each TERPP site is tracked via GIS, a tool that aids planning and monitoring efforts. Since 2006, PVPLC has treated 104 individual TERPP sites. Since *Euphorbia terracina* is a high priority invasive and may take multiple treatments to control, these populations are treated every year. In 2014, of the 31 TERPP treatments, five were new sites, and the remaining 24 were *Euphorbia terracina* populations that were treated in previous years, and two were *Coronilla valentina* populations treated in 2013. Use of GIS allows staff not only to look at the land within the NCCP boundaries, but to view the Palos Verdes Peninsula at a landscape level. In addition to the TERPP sites treated in 2014, this report maps all previous TERPP treatments (Appendix D8 of TERPP report). In 2012, interns started mapping invasive species locations in the Preserve, but the project has not been completed due to lack of funding. These maps will assist in selecting sites for invasive species eradication. While the most common approach to managing invasions of exotic species may be to target individual species, a more comprehensive approach is to identify major pathways for invasion that will influence more efficient and economic management of the exotic species.

3.0 FIELD METHODS

PVPLC staff uses best practice, the most effective and least intrusive, methods at all times when conducting TERPP-related activities. High priority areas may occur near rare or endangered biological populations. Care is taken to minimize soil erosion, fire risk, disturbance to surrounding native vegetation and further dispersal of the exotic species. PVPLC utilizes a combination of methods to conduct exotic species removal, generally limited to the following:

- Mechanical removal - staff may use tools with motorized blades to fell larger species;

- Hand removal - staff conduct most removals by hand pulling and/or with small hand tools for pruning and cutting;
- Chemical control - trained staff applies herbicides at the appropriate phase of vegetative growth;
- Growth and seed maturation, and;
- Disposal - City of Rancho Palos Verdes staff coordinate with waste companies to supply green waste and trash containers.

Qualified Licensed Applicator(s) develop all recommendations for chemical pest control and senior staff supervises field staff and contractors in sensitive areas. Additionally, field staff has an integral role in the TERPP and often have crucial, site-specific knowledge related to the sites.

4.0 2014 TERPP

In 2014, PVPLC treated 28 populations of invasive plants (Table 1, photopoints in Appendix D9). PVPLC treated 24 populations of *Euphorbia terracina* (Geraldton spurge, Euphorbia). Euphorbia grows rapidly in disturbed areas, is a prolific seeder and is rapidly expanding its distribution in southern California. Invaded areas show reduced ecological quality and inferior habitat quality compared to un-invaded areas. Continued spread of this species throughout California seems possible and even likely if action is not taken immediately. Euphorbia shows a broad habitat tolerance in southern California, invading both cool coastal areas and hot, dry, interior areas. Most of the populations of Euphorbia have been treated for several years, in attempts to keep it from spreading further into the Preserve.

PVPLC treated two populations of *Acacia cyclops.* At Portuguese Bend, acacia that was encroaching into cactus scrub were removed. At Vicente Bluffs, an acacia population adjacent to coastal sage scrub was removed.

At Vicente bluffs, a population of *Cortaderia selloana* located along the edge of coastal sage scrub was removed.

At Portuguese Bend, staff is controlling new shoots in a *Eucalyptus globulus* population damaged by the 2009 fire.

Table 1. 2014 TERPP Treatments.

StandID	Reserve	Species Name	StandSize	Number of Individuals	Treatment	Percent Treated	Outcome
AA_EuTe_01	Agua Amarga	*Euphorbia terracina*	300 ft2 - 600 ft2	10-50	Hand pull, herbicide	75-100%	ongoing
AA_EuTe_02	Agua Amarga	*Euphorbia terracina*	10 ft2 - 100 ft2	200-500	Hand pull	75-100%	ongoing
AC_EuTe_01	Abalone Cove	*Euphorbia terracina*	> 1000 ft2	500-1000	Hand pull; Herbicide	75-100%	ongoing
AC_EuTe_02	Abalone Cove	*Euphorbia terracina*	1 ft2 - 10 ft2	1-10	Hand pull	75-100%	ongoing
AC_EuTe_03	Abalone Cove	*Euphorbia terracina*	100 ft2 - 300 ft2	1-10	Hand pull	75-100%	ongoing
AC_EuTe_05	Abalone Cove	*Euphorbia terracina*	100 ft2 - 300 ft2	500-1000	Hand pull	75-100%	ongoing
AV_EuTe_01	Alta Vicente	*Euphorbia terracina*	100 ft2 - 300 ft2	10-50	Herbicide	75-100%	ongoing
AV_EuTe_02	Alta Vicente	*Euphorbia terracina*		10-50	Hand pull; Herbicide		ongoing
AV_EuTe_04	Alta Vicente	*Euphorbia terracina*	300 ft2 - 600 ft2	200-500	Herbicide	75-100%	ongoing
AV_EuTe_05	Alta Vicente	*Euphorbia terracina*	1 ft2 - 10 ft2	1-10	Hand pull	75-100%	ongoing
FI_EuTe_01	Filiorum	*Euphorbia terracina*	600 ft2 - 1000 ft2	>1000	Herbicide	50-75%	ongoing
FO_EuTe_03	Forrestal	*Euphorbia terracina*	10 ft2 - 100 ft2	10-50	Hand pull	75-100%	ongoing
PB_AcCy_01	Portuguese Bend	*Acacia cyclops*	600 ft2 - 1000 ft2	10-50	Cut at base	75-100%	Successful
PB_EuGl_01	Portuguese Bend	*Eucalyptus globulus*	600 ft2 - 1000 ft2	10-50	Cut at base	75-100%	trees damaged by fire; controling new shoots
PB_EuTe_01	Portuguese Bend	*Euphorbia terracina*	1 ft2 - 10 ft2	1-10	Hand pull	75-100%	ongoing

PB_EuTe_02	Portuguese Bend	*Euphorbia terracina*	1 ft2 - 10 ft2	1-10	Hand pull	75-100%	ongoing
PB_EuTe_03	Portuguese Bend	*Euphorbia terracina*	1 ft2 - 10 ft2	1-10	Hand pull	75-100%	ongoing
PB_EuTe_04	Portuguese Bend	*Euphorbia terracina*	10 ft2 - 100 ft2	200-500	Hand pull	75-100%	ongoing
PB_EuTe_07	Portuguese Bend	*Euphorbia terracina*	10 ft2 - 100 ft2	50-100	Handpull; herbicide		ongoing
PB_EuTe_08	Portuguese Bend	*Euphorbia terracina*	1 ft2 - 10 ft2	1-10	Hand pull	75-100%	ongoing
SR_EuTe_01	San Ramon	*Euphorbia terracina*	100 ft2 - 300 ft2	>1000	Hand pull	75-100%	ongoing
TS_EuTe_02	Three Sisters	*Euphorbia terracina*	300 ft2 - 600 ft2	200-500	Herbicide	50-75%	ongoing
TS_EuTe_03	Three Sisters	*Euphorbia terracina*		200-500	Herbicide		ongoing
VB_AcCy_05	Vicente Bluffs	*Acacia cyclops*	300 ft2 - 600 ft2	10 to 50	stump cut; herbicide	75-100%	Successful
VB_CoSe_04	Vicente Bluffs	*Cortaderia sellanoa*	10 ft2 - 100 ft2	1-10	Removed	75-100%	Successful
VB_EuTe_01	Vicente Bluffs	*Euphorbia terracina*	10 ft2 - 100 ft2	1-10	Hand pull	75-100%	ongoing
VB_EuTe_02	Vicente Bluffs	*Euphorbia terracina*	10 ft2 - 100 ft2	1-10	Hand pull	75-100%	ongoing
VB_EuTe_03	Vicente Bluffs	*Euphorbia terracina*	10 ft2 - 100 ft2	10-50	Hand pull	75-100%	ongoing

5.0 REFERENCES

California Invasive Plant Council 2006. California Invasive Plant Inventory. February. California Invasive Plant Council: Berkley, CA.

Palos Verdes Peninsula Land Conservancy 2007a. 2007 Targeted Exotic Removal Plan for Plants for the Portuguese Bend Nature Preserve For the Rancho Palos Verdes Draft Natural Community Conservation Plan and Habitat Conservation Plan. April.

Palos Verdes Peninsula Land Conservancy 2008. 2008 Annual Report for the Targeted Exotic Removal Program for Plants for the Portuguese Bend Nature Preserve For the Rancho Palos Verdes Draft Natural Community Conservation Plan and Habitat Conservation Plan. September.

State of California 2007. Department of Food and Agriculture Division of Plant Health & Prevention Services Noxious Weed Ratings. Retrieved September 2007, from: <http://www.cdfa.ca.gov/phpps/ipc/encycloweedia/pdfs/noxiousweed_ratings.pdf>.

URS 2006. City of Rancho Palos Verdes Draft Natural Community Conservation Plan and Habitat Conservation Plan. June 9.

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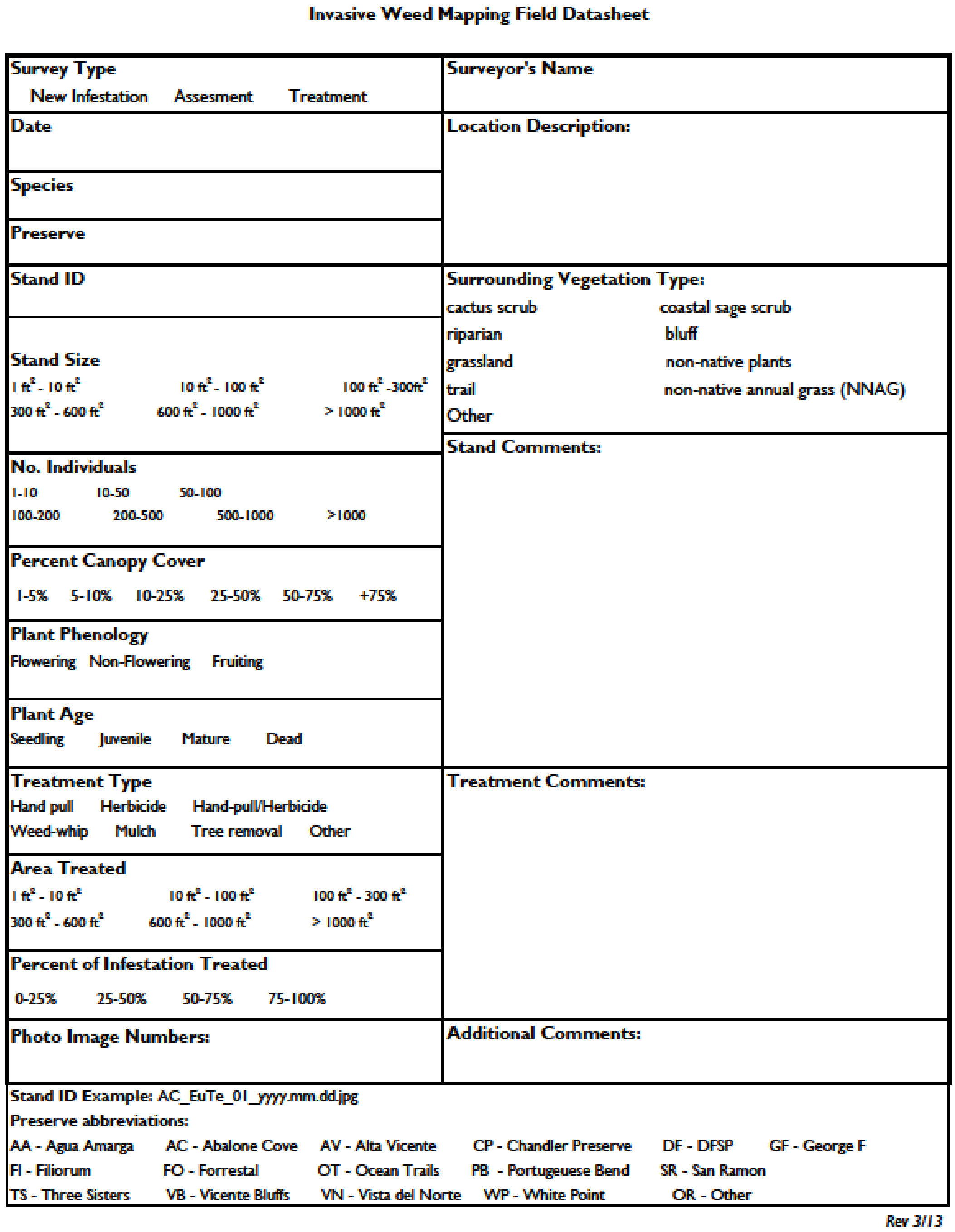
APPENDIX D1: SAMPLE TERPP FORM



Invasive Weed Mapping Field Datasheet

Survey Type
New Infestation Assesment Treatment

Surveyor's Name

Date

Location Description:

Species

Preserve

Stand ID

Surrounding Vegetation Type:
cactus scrub coastal sage scrub
riparian bluff
grassland non-native plants
trail non-native annual grass (NNAG)
Other

Stand Size
1 ft^2 - 10 ft^2 10 ft^2 - 100 ft^2 100 ft^2 -300ft^2
300 ft^2 - 600 ft^2 600 ft^2 - 1000 ft^2 > 1000 ft^2

Stand Comments:

No. Individuals
1-10 10-50 50-100
100-200 200-500 500-1000 >1000

Percent Canopy Cover
1-5% 5-10% 10-25% 25-50% 50-75% +75%

Plant Phenology
Flowering Non-Flowering Fruiting

Plant Age
Seedling Juvenile Mature Dead

Treatment Type
Hand pull Herbicide Hand-pull/Herbicide
Weed-whip Mulch Tree removal Other

Treatment Comments:

Area Treated
1 ft^2 - 10 ft^2 10 ft^2 - 100 ft^2 100 ft^2 - 300 ft^2
300 ft^2 - 600 ft^2 600 ft^2 - 1000 ft^2 > 1000 ft^2

Percent of Infestation Treated
0-25% 25-50% 50-75% 75-100%

Photo Image Numbers:

Additional Comments:

Stand ID Example: AC_EuTe_01_yyyy.mm.dd.jpg
Preserve abbreviations:
AA - Agua Amarga AC - Abalone Cove AV - Alta Vicente CP - Chandler Preserve DF - DFSP GF - George F
FI - Filiorum FO - Forrestal OT - Ocean Trails PB - Portugeuese Bend SR - San Ramon
TS - Three Sisters VB - Vicente Bluffs VN - Vista del Norte WP - White Point OR - Other

Rev 3/13

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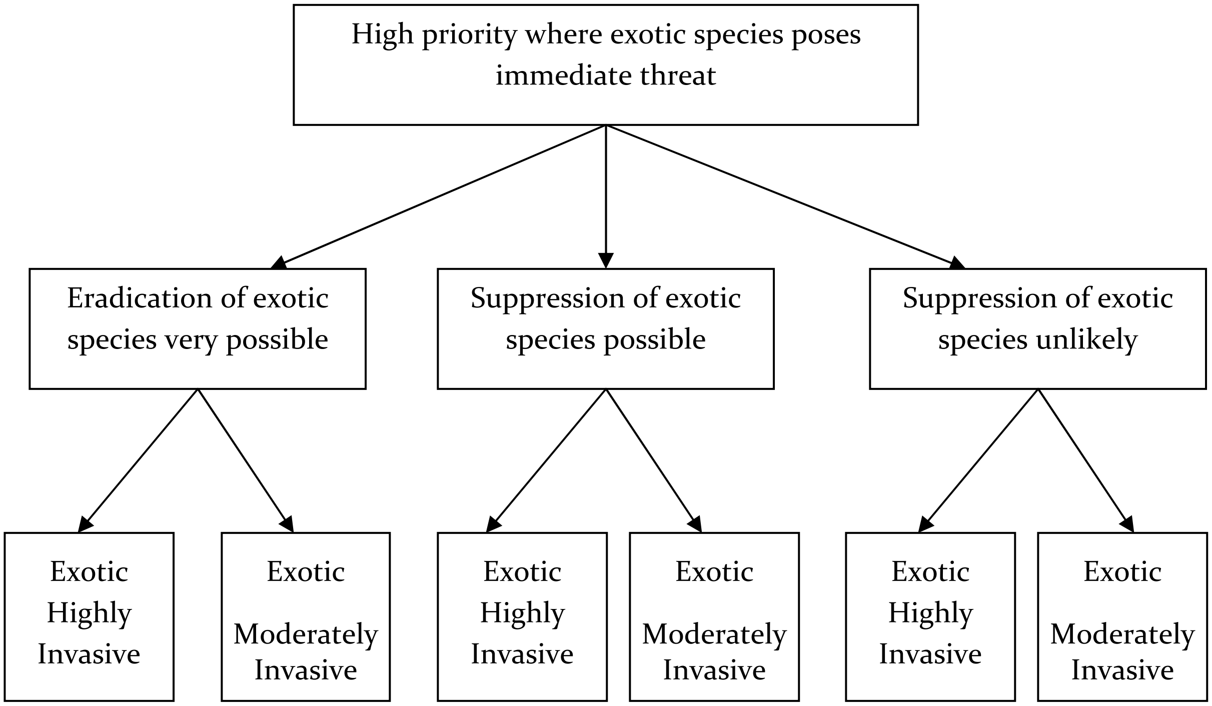
APPENDIX D2: FLOWCHART FOR HIGH PRIORITY THREAT TO NATIVE VEGETATION



Priority Ranking For Control of Exotic Species

1-3= Low priority 4-7= Medium priority 8-10= High priority

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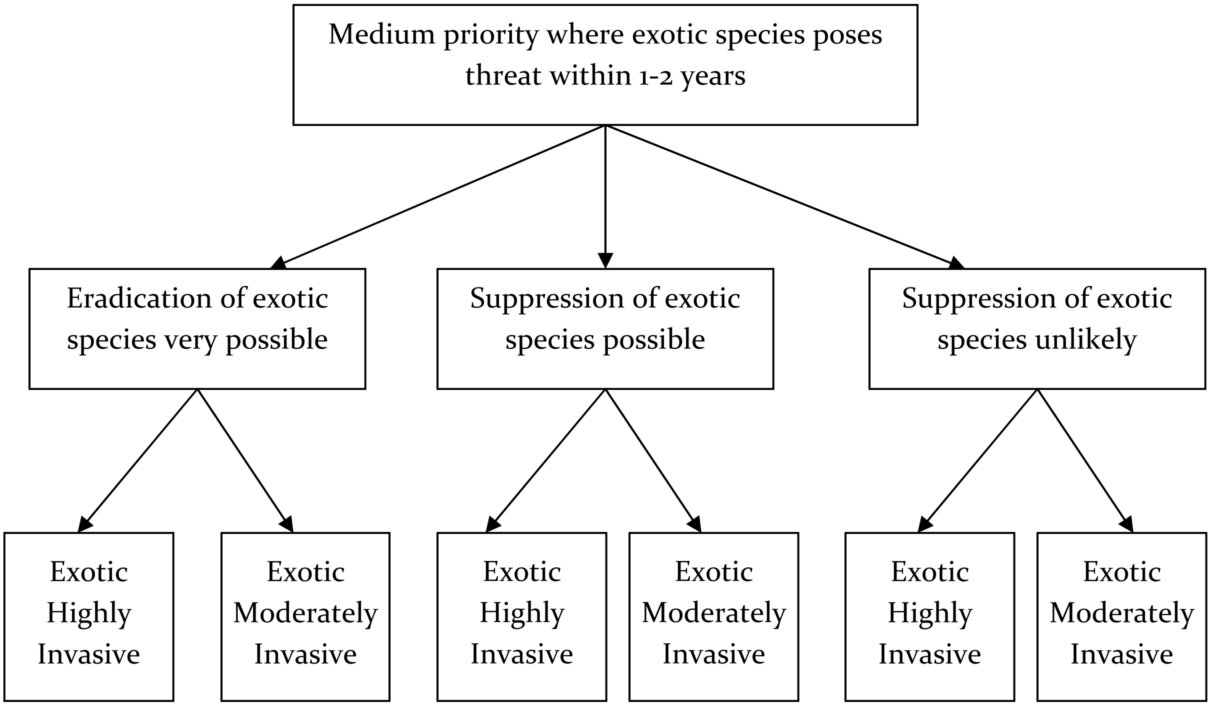
APPENDIX D3: FLOWCHART FOR MEDIUM PRIORITY DEGREE OF THREAT TO NATIVE VEGETATION



Priority Ranking For Control of Exotic Species

1-3= Low priority 4-7= Medium priority 8-10= High priority

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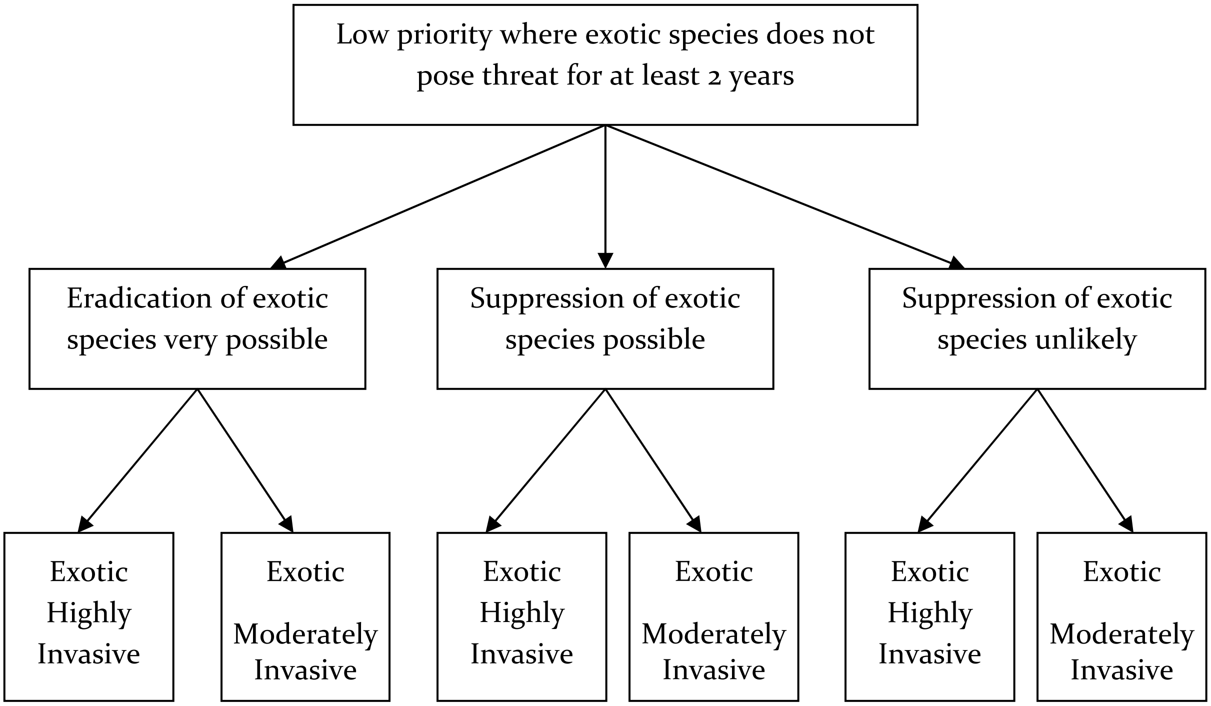
APPENDIX D4: FLOWCHART FOR LOW PRIORITY DEGREE OF THREAT TO NATIVE VEGETATION



Priority Ranking For Control of Exotic Species

1-3= Low priority 4-7= Medium priority 8-10= High priority

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APPENDIX D5: HIGHLY INVASIVE SPECIES

Genus species	**Common name**
Arundo donax	Giant reed
Asparagus asparaagoides	Bridal creeper
Avena barbata	Slender oat
Avena fatua	Wild oat
Brachypodium distachyon	False brome
Brassica nigra	Black mustard
Bromus diandrus	Ripgut grass
Bromus madritensis ssp. rubens	Red brome
Carpobrotus edulis	Hottentot fig
Caesalpinia spinosa	Spiny holdback
Centaurea melitensis	Tocalote
Chrysanthemum coronarium	Garland chrysanthemum
Cortaderia selloana	Pampas grass
Cynodon dactylon	Bermuda grass
Euphorbia terracina	Spurge
Foeniculum vulgare	Fennel
Malva nicaeensis	Bull mallow
Malva parviflora	Cheeseweed
Malva sylvestris	Mallow
Mesembryanthemum crystallinum	Annual iceplant
Nicotiana glauca	Tree tobacco
Pennisetum clandestinum	Kikuyu grass
Pennisetum setaceum	Fountain grass
Picris echioides	Bristly ox-tongue
Pistacia atlantica	Pistachio

Pittosporum undulatum	Pittosporum
Raphanus sativus	Wild radish
Ricinus communis	Castor bean
Salsola tragus	Russian thistle
Silybum marianum	Milk thistle
Sonchus asper	Prickly sow thistle
Sonchus oleraceus	Sow thistle
Spartium junceum	Spanish broom
Tamarix species	Tamarisk
Tropaeolum majus	Garden nasturtium

APPENDIX D6: MODERATELY INVASIVE SPECIES

Genus species	**Common Name**	**Genus species**	**Common Name**
Acacia cyclops	Acacia	*Limonium perezii*	Sea lavender
Acacia species	Acacia	*Limonium sinuatum*	Sea lavender
Aegilops cylindrica	Jointed goat grass	*Lobularia maritima*	Sweet alyssum
Ageratina adenophorum	Eupatory	*Lolium multiflorum*	Italian rye
Atriplex semibaccata	Australian saltbush	*Lolium perenne*	Perennial ryegrass
Bassia hyssopifolia	Five-Hook bassia	*Marrubium vulgare*	Horehound
Bromus hordeaceus (mollis)	Soft brome	*Medicago polymorpha*	Bur clover
Bromus catharticus	Rescue grass	*Medicago sativa*	Alfalfa
Cakiel maritime	Sea rocket	*Melilotus albus*	White sweet clover
Carduus pycnocephalus	Italian thistle	*Melilotus indicus*	Yellow sweet clover
Carpobrotus aequilaterus	Sea Fig	*Myoporum laetum*	Myoporum
Carpobrotus chilensis iceplant	Fig-Marigold	*Olea europea*	Olive
Conium maculatum	Poison hemlock	*Oxalis pes-caprae*	Bermuda buttercup
Convolvulus arvensis	Bindweed	*Pelargonium zonale*	Zonal geranium
Erodium cicutarium	Red stem filaree	*Phalaris minor*	Phalaris
Eucalyptus camaldulensis	Red gum tree	*Phoenix canariensis*	Phoenix palm
Eucalyptus globulus	Blue gum tree	*Piptatherum miliacea*	Smilo grass
Eucalyptus species	Gum tree	*Pittosporum undulatum*	Pittosporum
Hirschfeldia incana	Annual mustard	*Plantago lanceolata*	English plantain
Hordeum murinum leporinum	Foxtail barley	*Polygonum aviculare*	Knotweed
Hordeum vulgare	Common barley	*Polypogon monspessulensis*	Rabbitsfoot
Lactuca serriola	Compass plant	*Pyracantha sp.*	Firethorn
Lathyrus tangianus	Tangier pea	*Rumex crispus*	Curly dock

Schinus molle	Mexican pepper	*Washington robusta*	Mexican fan palm
Schinus terebinthifolius	Brasilian pepper	*Vicia sativa*	Spring vetch
Sisymbrium irio	London rocket	*Vulpia myuros varhirsuta*	Annual fescue
Trifolium hirtum	Rose clover	*Vulpia myuros var myuros*	Rattail fescue

APPENDIX D7: EXOTIC, NON-INVASIVE SPECIES

Scientific Name	**Common Name**	**Genus species**	**Common Name**
Amaranthus albus	Tumbleweed		
Anagallis arvensis	Pimpernel		
Apium graveolens	Celery		
Aptenia cordifolia	Baby sun-rose		
Atriplex glauca	Saltbush		
Bidnes pilosa	Common beggar-ticks		
Capsella bursa-pastoris	Shepherd's purse		
Centranthus rubber	Red valerian		
Ceratonia siliqua	Locust bean tree		
Chamaesyce maculata	Spotted spurge		
Chenopodium album	Lamb’s quarters		
Chenopodium ambrosioides	Mexican tea		
Chenopodium murale	Nettleleaf goosefoot		
Conyza canariensis	Horseweed		
Coronilla valentina	Coronilla		
Cyperus involucratus	Umbrella plant		
Digitaria sanguinalis	Hairy crabgrass		
Echium fastuosum	Pride of madeira		
Erodium botrys	Long-beaked filaree		
Euphorbia lathyris	Gopher plant		
Euphorbia peplus	Petty spurge		
Filago gallica	Narrow-leaf filago		
Fraxinus uhdei	Shamel ash		
Gazania species	Gazania		
Geranium carolinianum	Geranium		

Gnaphalium luteo-album	White cudweed
Koehlreuteria species	Koehlreuteria
Lamarckia aurea	Goldentop
Lantana montevidensis	Lantana
Lathyrus odoratus	Sweet pea
Lycium species	Lycium
Lycopersicon esculentum	Garden tomato
Malephora crocea	Mesemb
Melaleuca species	Melaleuca
Mesembryanthemum nodiflorum	Iceplant
Osteoapermu fruticosum	African daisy
Oxalis corniculata	Woodsorrel
Paspalum dilatatum	Dallis grass
Pinus halepensis	Alepppo pine
Plantago major	Plantain
Poa annua	Bluegrass
Polygonum arenastrum	Knotweed
Senecio vulgaris	Groundsel
Silene gallica	Common catchfly
Triticum aestivum	Cultivated wheat
Urtica urens	Dwarf nettle
Veronica anagallis-aquatica	Water speedwell
Yucca species	Spanish bayonet

Appendix D8

2014 Photos

Targeted Exotic Removal Program for Plants (TERPP)

AA_EuTe_01

AC_EuTe_01

AC_EuTe_03

AC_EuTe_05

AC_EuTe_05

AV_EuTe_01

AV_EuTe_02

AV_EuTe_04

AV_EuTe_05

PB_EuGl and AcCy_01

PB_EuTe_01

PB_EuTe_03

PB_EuTe_04

PB_EuTe_04

PB_EuTe_07

PB_EuTe_08

PB_EuTe_08

SR_EuTe_01

TS_EuTe_01

TS_EuTe_02

TS_EuTe_05

VB_EuTe_01

VB_EuTe_02

VB_EuTe_03

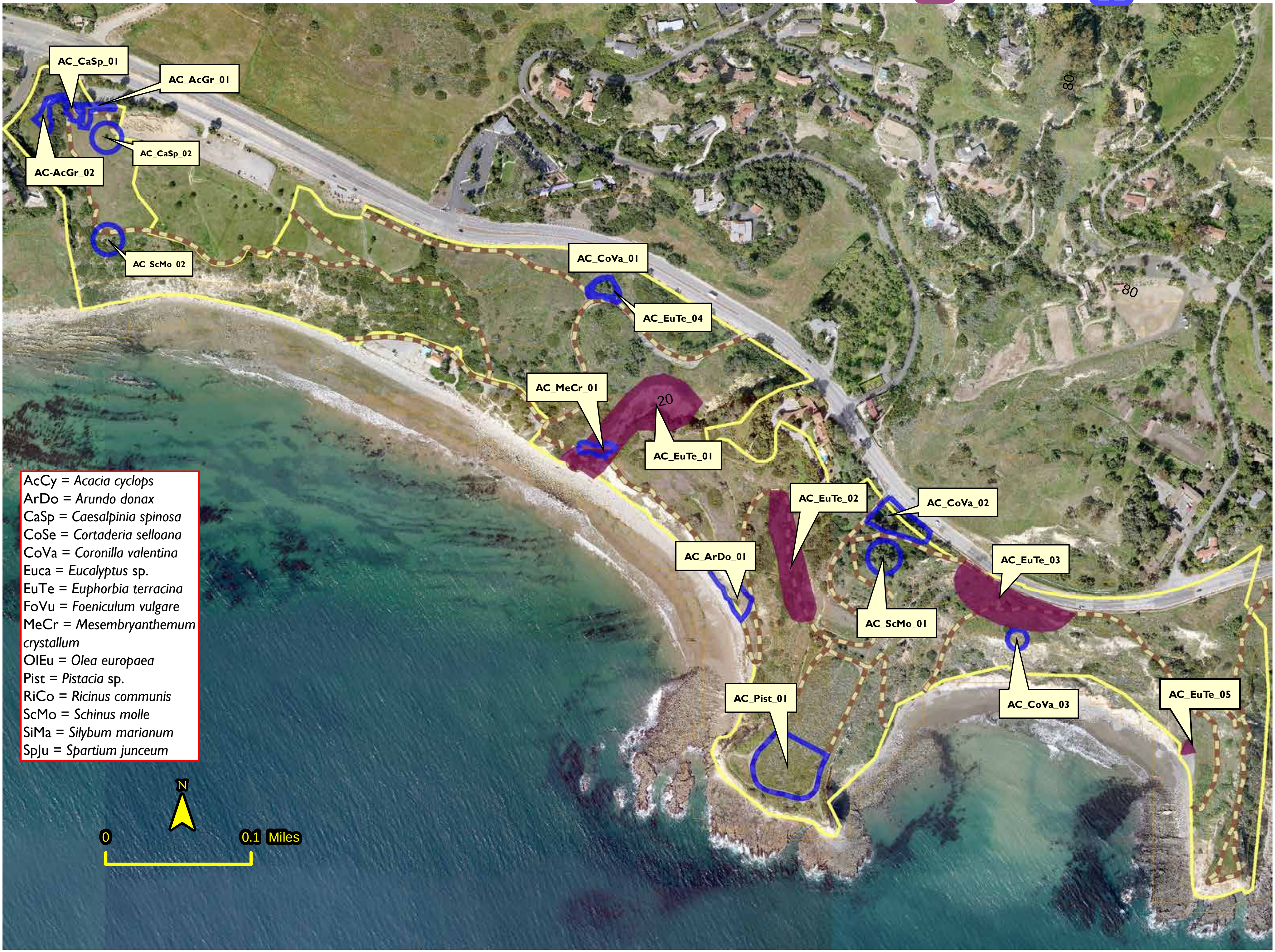
VB_AcCy_05 and VB_CoSe_04 Before

VB_CoSe_04 and VB_CoSe_04 After

TERPP Sites: ***ABALONE COVE*** (AC)

■ 2014 TERPP

□ Former TERPP



AcCy = *Acacia cyclops*
ArDo = *Arundo donax*
CaSp = *Caesalpinia spinosa*
CoSe = *Cortaderia selloana*
CoVa = *Coronilla valentina*
Euca = *Eucalyptus* sp.
EuTe = *Euphorbia terracina*
FoVu = *Foeniculum vulgare*
MeCr = *Mesembryanthemum crystallum*
OlEu = *Olea europaea*
Pist = *Pistacia* sp.
RiCo = *Ricinus communis*
ScMo = *Schinus molle*
SiMa = *Silybum marianum*
SpJu = *Spartium junceum*

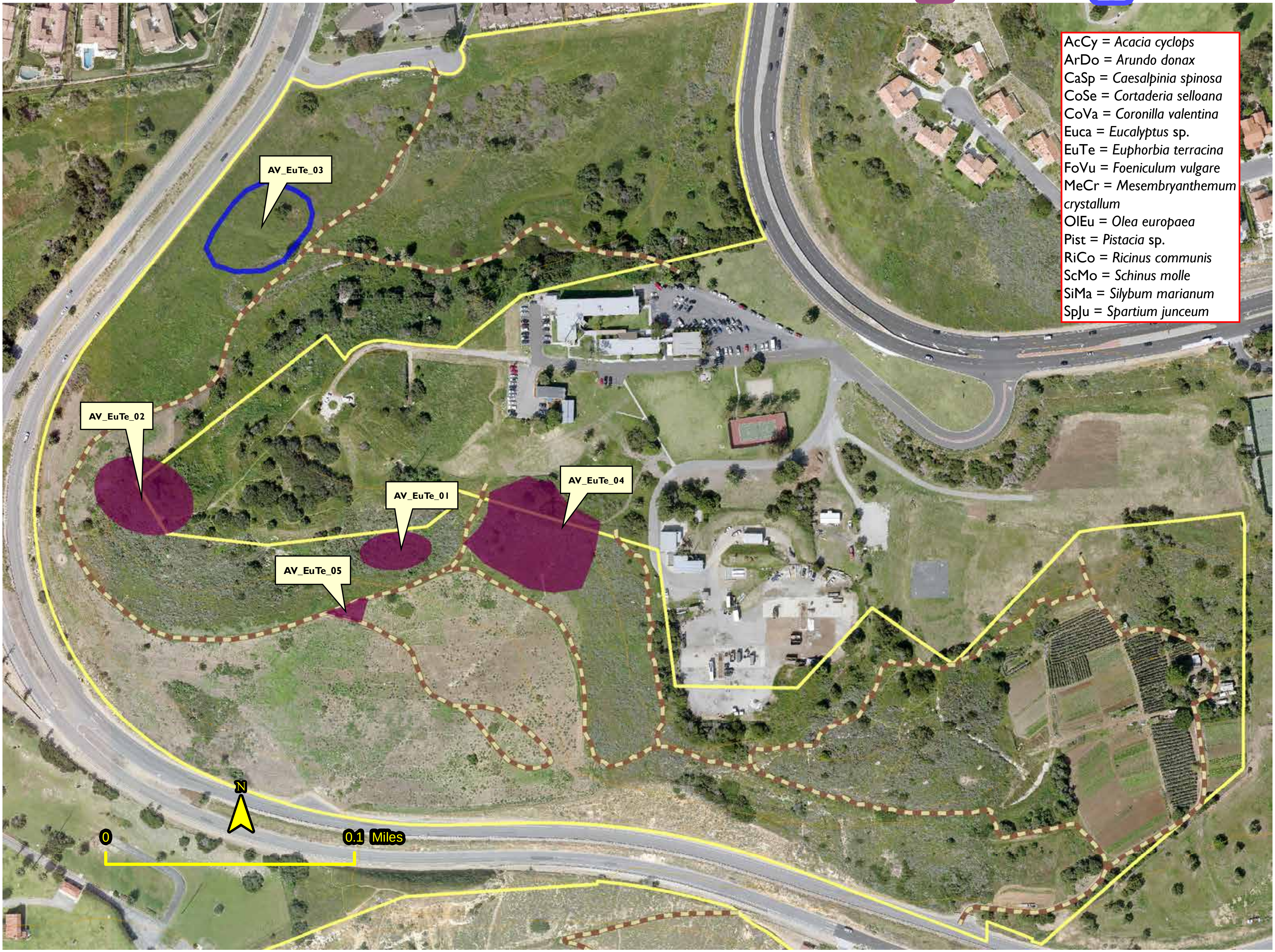
TERPP Sites: *AGUA AMARGA*

● 2014 TERPP ▢ Former TERPP

TERPP Sites: ***ALTA VICENTE*** (AV)

■ 2014 TERPP

□ Former TERPP



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OlEu = *Olea europaea*
Pist = *Pistacia* sp.
RiCo = *Ricinus communis*
ScMo = *Schinus molle*
SiMa = *Silybum marianum*
SpJu = *Spartium junceum*

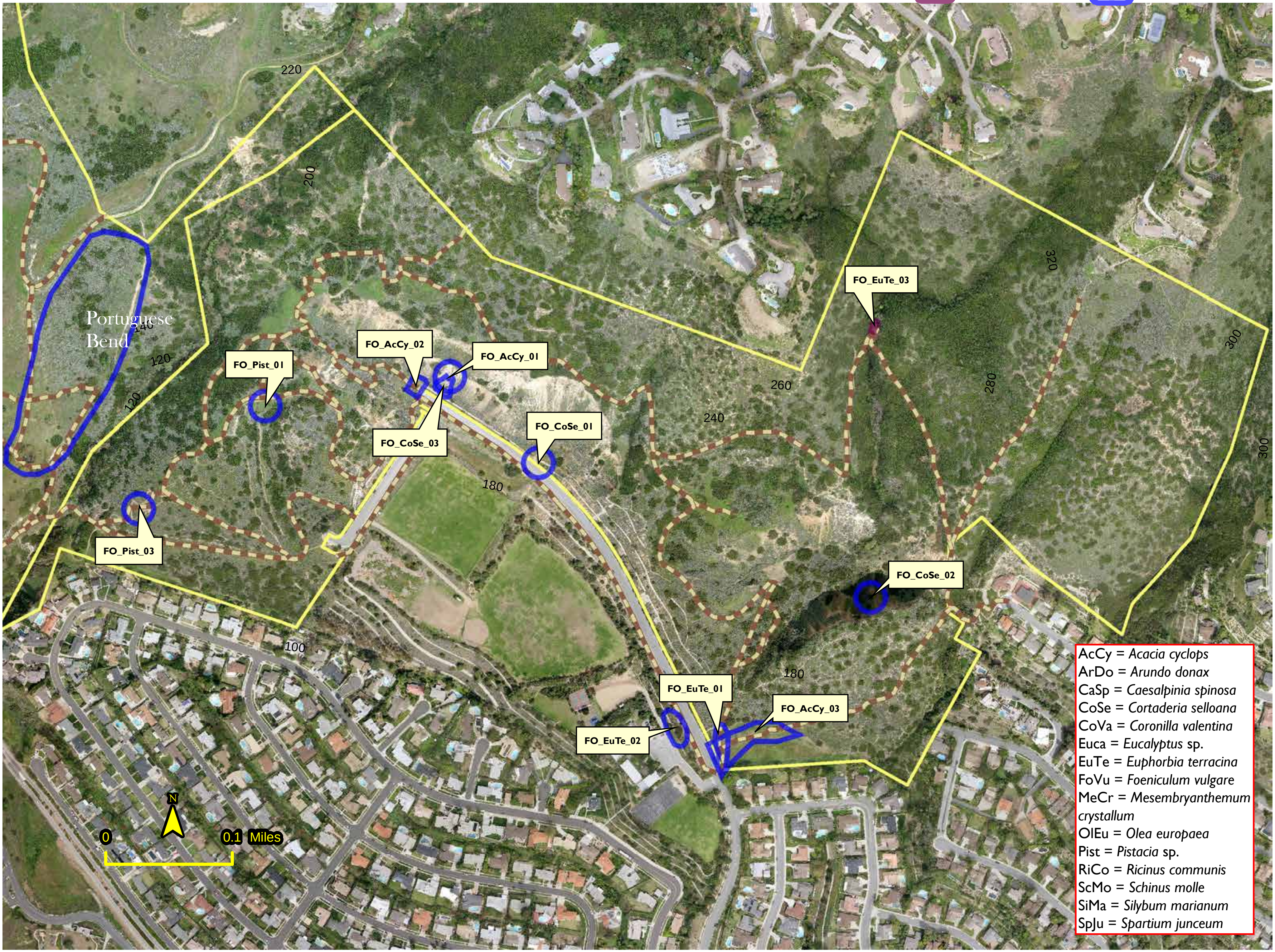
TERPP Sites: ***FILIORUM*** (FI)

▬ 2014 TERPP ▢ Former TERPP

AcCy = *Acacia cyclops*
ArDo = *Arundo donax*
CaSp = *Caesalpinia spinosa*
CoSe = *Cortaderia selloana*
CoVa = *Coronilla valentina*
Euca = *Eucalyptus* sp.
EuTe = *Euphorbia terracina*
FoVu = *Foeniculum vulgare*
MeCr = *Mesembryanthemum crystallum*
OlEu = *Olea europaea*
Pist = *Pistacia* sp.
RiCo = *Ricinus communis*
ScMo = *Schinus molle*
SiMa = *Silybum marianum*
SpJu = *Spartium junceum*

TERPP Sites: ***FORRESTAL*** (FO)

■ 2014 TERPP ▢ Former TERPP



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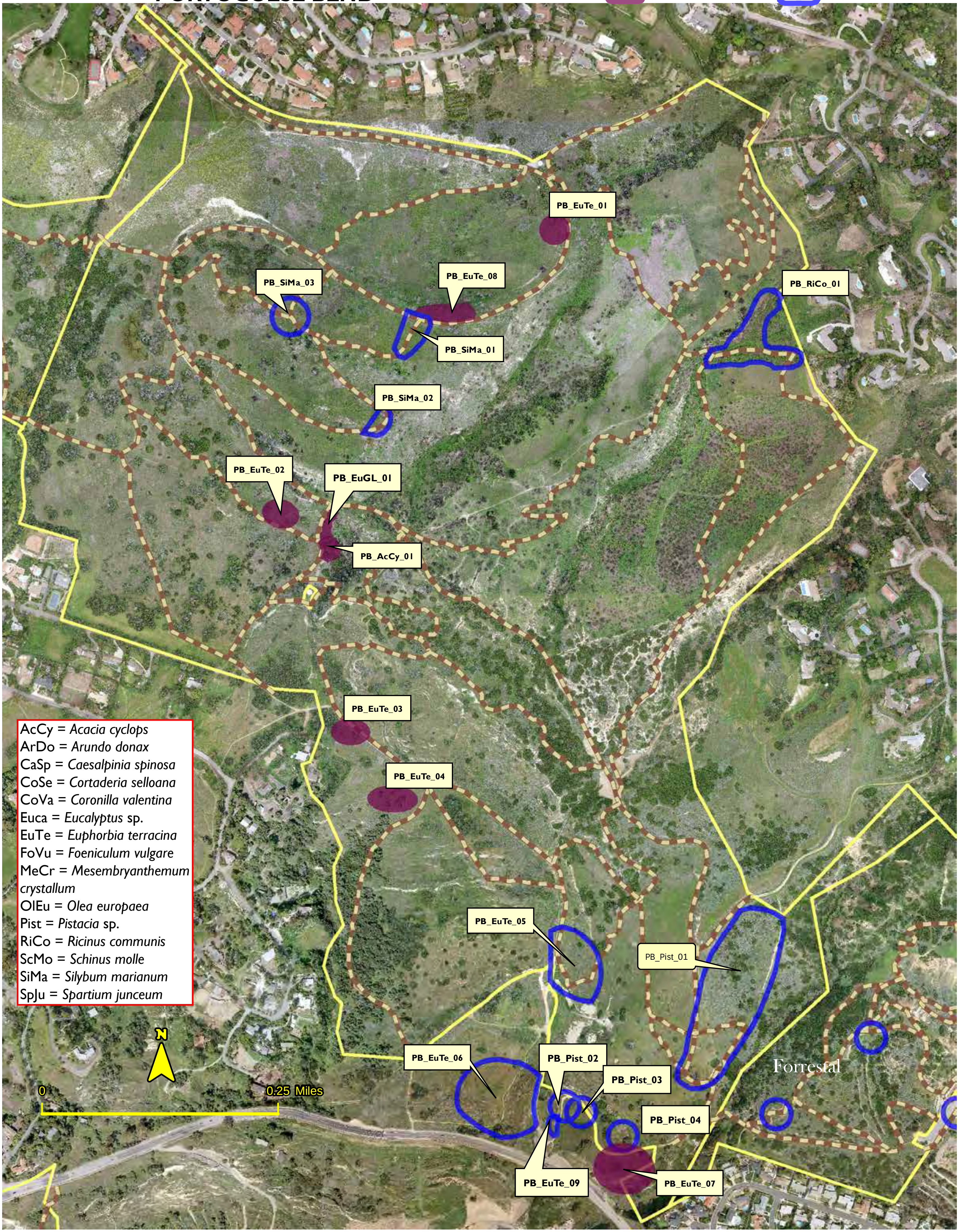
CoSe = *Cortaderia selloana*
CoVa = *Coronilla valentina*
Euca = *Eucalyptus* sp.
EuTe = *Euphorbia terracina*
FoVu = *Foeniculum vulgare*
MeCr = *Mesembryanthemum crystallum*
OlEu = *Olea europaea*
Pist = *Pistacia* sp.
RiCo = *Ricinus communis*
ScMo = *Schinus molle*
SiMa = *Silybum marianum*
SpJu = *Spartium junceum*

TERPP Sites: ***PORTUGUESE BEND*** (PB)

● 2014 TERPP ○ Former TERPP



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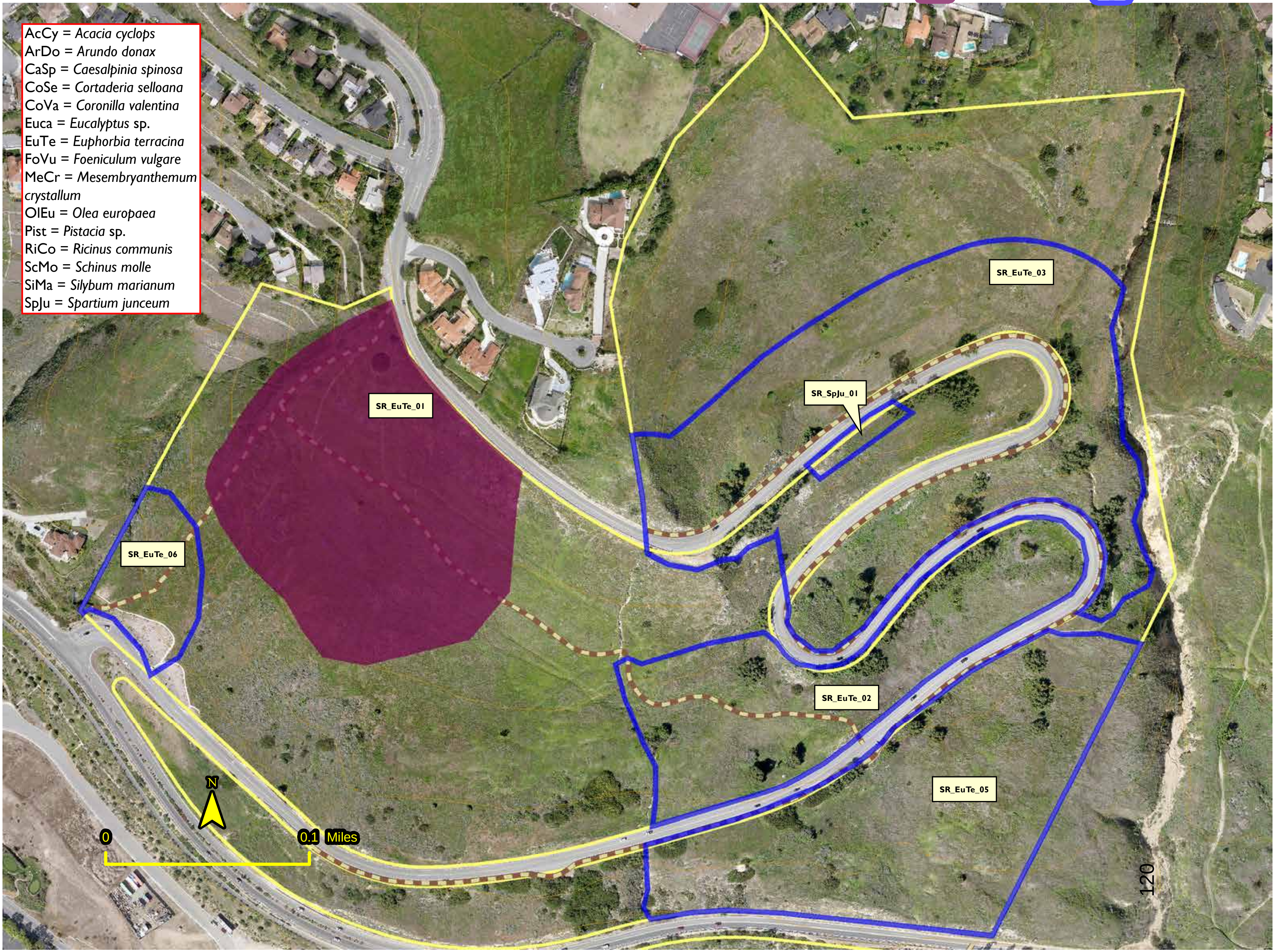
CaSp = *Caesalpinia spinosa*
CoSe = *Cortaderia selloana*
CoVa = *Coronilla valentina*
Euca = *Eucalyptus* sp.
EuTe = *Euphorbia terracina*
FoVu = *Foeniculum vulgare*
MeCr = *Mesembryanthemum crystallum*
OlEu = *Olea europaea*
Pist = *Pistacia* sp.
RiCo = *Ricinus communis*
ScMo = *Schinus molle*
SiMa = *Silybum marianum*
SpJu = *Spartium junceum*

TERPP Sites: ***SAN RAMON*** (SR)

🟪 2014 TERPP

☐ Former TERPP



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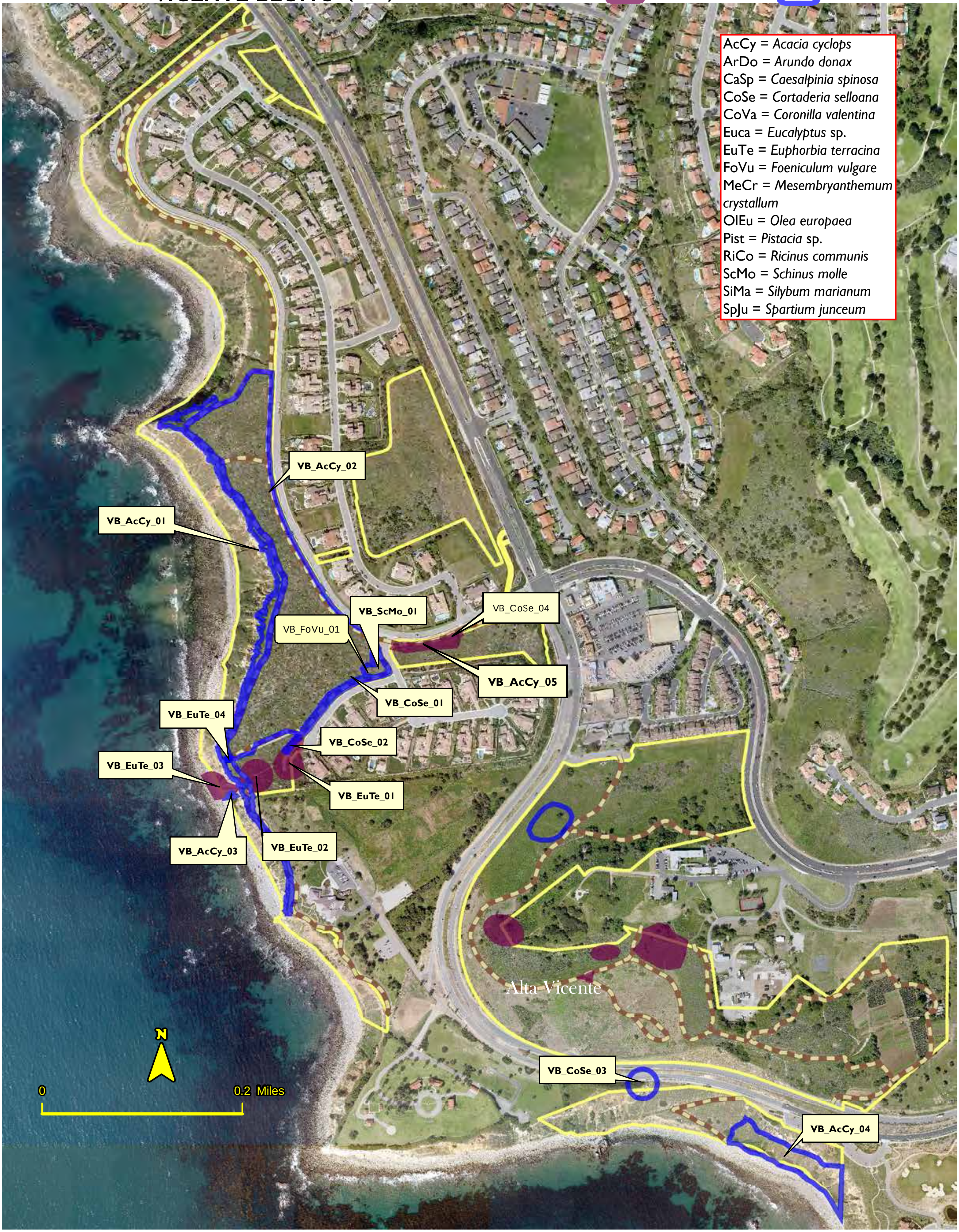
CoVa = *Coronilla valentina*
Euca = *Eucalyptus* sp.
EuTe = *Euphorbia terracina*
FoVu = *Foeniculum vulgare*
MeCr = *Mesembryanthemum crystallum*
OlEu = *Olea europaea*
Pist = *Pistacia* sp.
RiCo = *Ricinus communis*
ScMo = *Schinus molle*
SiMa = *Silybum marianum*
SpJu = *Spartium junceum*

TERPP Sites: *VICENTE BLUFFS* (VB)

🟪 2014 TERPP

▢ Former TERPP



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ArDo = *Arundo donax*
CaSp = *Caesalpinia spinosa*
CoSe = *Cortaderia selloana*
CoVa = *Coronilla valentina*
Euca = *Eucalyptus* sp.
EuTe = *Euphorbia terracina*
FoVu = *Foeniculum vulgare*
MeCr = *Mesembryanthemum crystallum*
OlEu = *Olea europaea*
Pist = *Pistacia* sp.
RiCo = *Ricinus communis*
ScMo = *Schinus molle*
SiMa = *Silybum marianum*
SpJu = *Spartium junceum*

APPENDIX E

RESEARCH AND EDUCATION PROGRAM

1.0 INTRODUCTION

The Research and Education Program at the Palos Verdes Peninsula Land Conservancy (PVPLC) began in 2006 with a grant from Alcoa Foundation and Alcoa Fastening Systems that concluded in May 2010. This initial grant enabled PVPLC to develop a robust research program centered on improving our conservation efforts while extending learning opportunities within our community.

Since 2010, PVPLC has invoked a more integrated approach by involving students and community volunteers for investigating specific questions related to our restoration work that concurrently provide a hands-on research experience to the students (Table 1). In 2014, high school and university students participated in research in the preserves for satisfying their educational goals. Also, the Long Family Foundation Conservation Research Scholarship provided funds for a CSULB student to conduct field research on coastal cactus wrens in 2014. Finally, a Citizen Science Program, initiated in Fall 2013, has brought volunteers to PVPLC for focused studies in the preserves.

University professors are crucial for the success of research, because they provide expertise and technical guidance, including managing several research projects. Land Conservancy staff provides access to the preserves as well as technical support to participants. The Science Advisory Panel meets annually to offer feedback on restoration projects and covered plant and animal questions in the Preserve.

This report covers the Research and Education Program's activities via the major categories:

- High School Research
- University Research
- Community Researchers

Table 1. List of ongoing research projects in the Preserve.

PVPLC Citizen Science Research

These two projects were designed to inform management under the NCCP.

Wild Animal Surveys – Community volunteers track coyote and fox use of the preserves and their diets.

Cactus Wren Territory Size Survey – Community volunteers study cactus wren use of cactus patches and territory size during the breeding season.

2.0 HIGH SCHOOL RESEARCH

High school and college students are important elements in PVPLC's field research. By participating in PVPLC's research program with professionals and university researchers, students obtain field and analytical skills in the natural science fields. Additionally, students increase their appreciation of nature while expanding their awareness of opportunities that the natural science fields have to offer. As a result, PVPLC students often win top honors in science fairs and are able to leverage their experience for gaining entrance into top universities, satisfying course credits, or obtaining paid internships (Table 2 and Figure 1).

3.0 UNIVERSITY STUDENTS

College students from local universities participate in research under the umbrella of the Conservancy's Intern program. They participate in programs that are integral with habitat restoration, which provides the students valuable hands-on experience (Table 3.).

Table 2. 2015 Science Fair Results for PVPLC high school researchers

Student	Award	Project Title
Dustin Hartuv	Honorable Mention in Zoology, Air Force Award, & Arizona State University Walton Sustainability Award at PV Science Fair Second place in Animal Biology at Los Angeles County Science Fair	Correlation Between Habitat Quality & Abundance/Diversity of California Birds
Sarina Liu and Madison Westergaard	Honorable Mention at PV Science Fair	Are PVPLC Trails More Environmentally Impacted by Users on Holidays vs. Non-holidays?
Stephanie Yong	First Place in Botany & Association of Women Geoscientists Award at PV Science Fair	Observing the Effects of TerraSorb on *Astragalus trichopodus*, Year2

PVPLC's stewardship staff conducts a variety of surveys throughout the preserves for assessing habitat quality as well as documenting the progress of our restoration efforts. The Conservancy's Interns participated in all the vegetation assessment surveys as well as entered the resulting data into the database. They also developed data tables for reports and conducted the initial stages of the report writing.

In addition to gaining work experience, many students leverage their internships for entrance into a professional job or graduate school. While the Conservancy benefits from their work, the students benefit from experience and training that will benefit them in future careers.

Table 3. 2014 University Research Projects

Student	Project Title
Nonso Edijike	CSU Dominguez Hills Master's project investigating soil types for optimal growth of outplanted deerweed (*Acmispon glaber*) at restoration sites conducted at the Linden H. Chandler Preserve.
Courtney McCammon	Loyola Marymount Master's project "Wildlife Trophic Dynamics and Implications in an Urban Nature Preserve" conducted at the White Point Nature Preserve

4.0 CITIZEN SCIENCE

Volunteers are important for PVPLC, not only helping with growing plants, habitat restoration, guiding walks, and special events, but also with science research and education. Our volunteers are terrific and travel from throughout the Peninsula and surrounding areas to help out.


Figure 2. Volunteers learn the basics of cactus wren observations before starting the first Citizen Science Cactus Wren monitoring season.

The Citizen Science program blossomed in 2014 with the initiation of the Cactus Wren Program along with the ongoing Wildlife Tracking Program. The initial Cactus Wren Program began in the spring and resulted in detailed analysis of how the birds utilize their habitat, which included incursions into the newly restored habitat. In addition, the volunteers were able to obtain detailed documentation of a single pair of cactus wrens as they built a nest, incubated eggs, and successfully fledged three chicks.

The second season of Wildlife Tracking Community took place in the fall, beginning with training the volunteers for tracking wild coyotes, red fox, and gray fox in the preserves. Then they individually conducted regular surveys along specific routes in the preserves. The data were submitted to the Conservancy for use in its management reports.

Another community researcher, Diane Dobbos-Bubno was a significant participant in developing a systematic long-term tracking system for the Conservancy's Invasive Weed Management Program. Diane developed the worksheet, Excel template, database, and GIS maps for tracking weed management.

2014 nesting survey of the Coastal Cactus Wren

Alta Vicente Reserve,
Palos Verdes Peninsula
California

October 2014

Palos Verdes Peninsula Land Conservancy
Rolling Hills Estates, CA

Daniel S. Cooper, Cooper Ecological Monitoring, Inc.

Oak Park, CA

The Coastal Cactus Wren

Mid-sized songbird.

Restricted to patches of cactus on the coastal slope of southern California/northwest Baja California, Mexico.

Same habitat occupied by California Gnatcatcher.

Highly imperiled, yet receives scant legal protection.

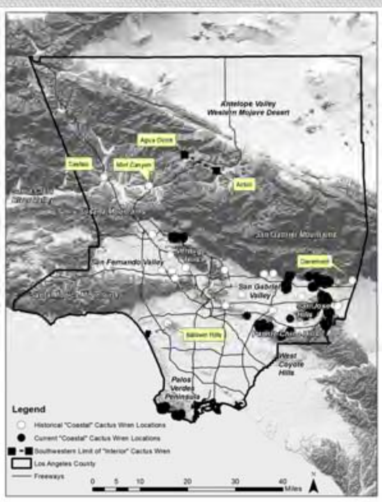
Distribution

Los Angeles County birds in three areas:

- East San Gabriel Vly
- Palos Verdes
- Big Tujunga Wash (*<10 pr.)*

Recently lost from Baldwin Hills, Claremont

San Joaquin Hills (Orange Co.) has nearest population to south



From Cooper et al. 2012

2014 Study

In 2014, PVPLC contracted with Cooper Ecological Monitoring to provide planning and volunteer training services for a nesting study of the Cactus Wren subpopulation at Alta Vicente Reserve.

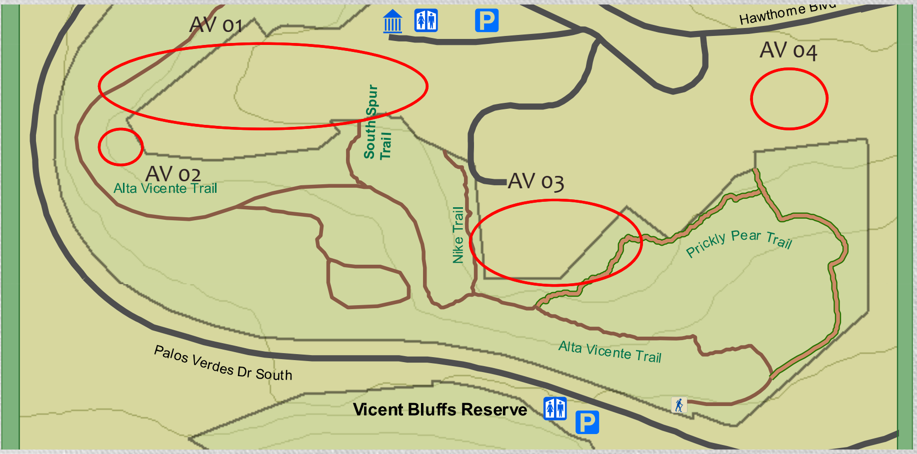
- 3 training sessions held in late winter 2014 (February/March);
- 13 volunteers recruited, mainly from prior bird survey efforts by PVPLC (Three Sisters Reserve);
- Organized into 5 teams, which would commit to 1x/week surveys from March – July;
- Volunteer organization by Ann Dalkey, PVPLC

Unique challenges for study

- Cactus Wrens build and maintain multiple nests through spring
- Individual Cactus Wrens at Alta Vicente were missed more often than recorded
- Birds often make long flights from nesting territories to foraging areas, and paired birds often forage separately from each other (esp. during drought)
- Nest failure/abandonment is common during extreme drought

Step 1. Map cactus

4 "POLYGONS"



Yellow lines denote cactus patches/"sites"

Red pins = nests observed (DSC) in early March 2014

13 sites within 4 polygons in 2 main areas

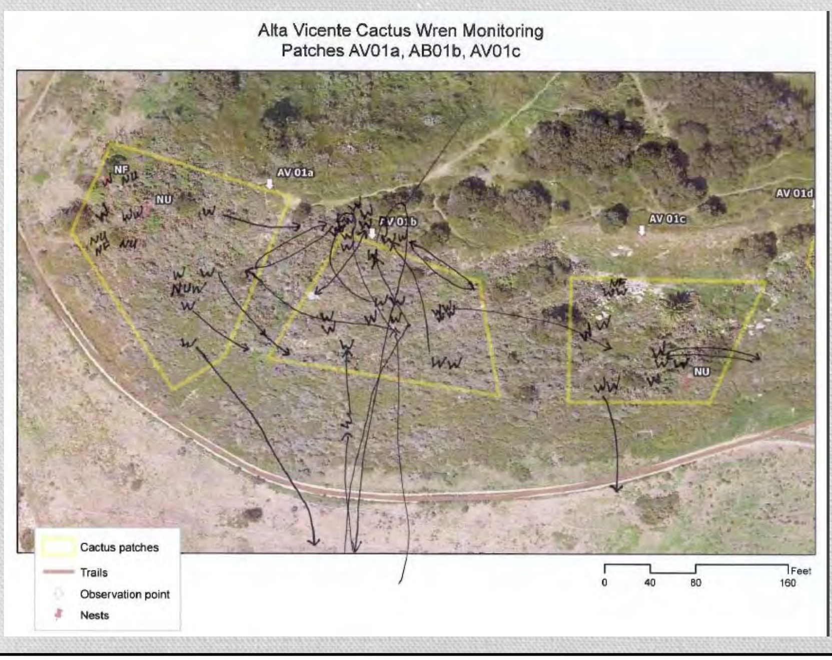
- Large block in **west** (steep slope just south of RPV City Hall)
- Smaller blocks on **east** side, with "cactus farm" (Indian fig) in center

Summary of effort:

- 20-minute, weekly visits ("rounds") to each of 13 sites
- Recording and mapping locations of *all* Cactus Wrens heard or seen onto aerial maps and data sheets*.
- Ultimately c. 20 rounds at each of 13 sites (plus more intensive observation by one team to known active nest).
- 400+ data sheets, dozens of maps (organized/corrected)

* Most observers did not denote individual rounds on maps

Example of last (= cumulative) data map, sites AV01a-c



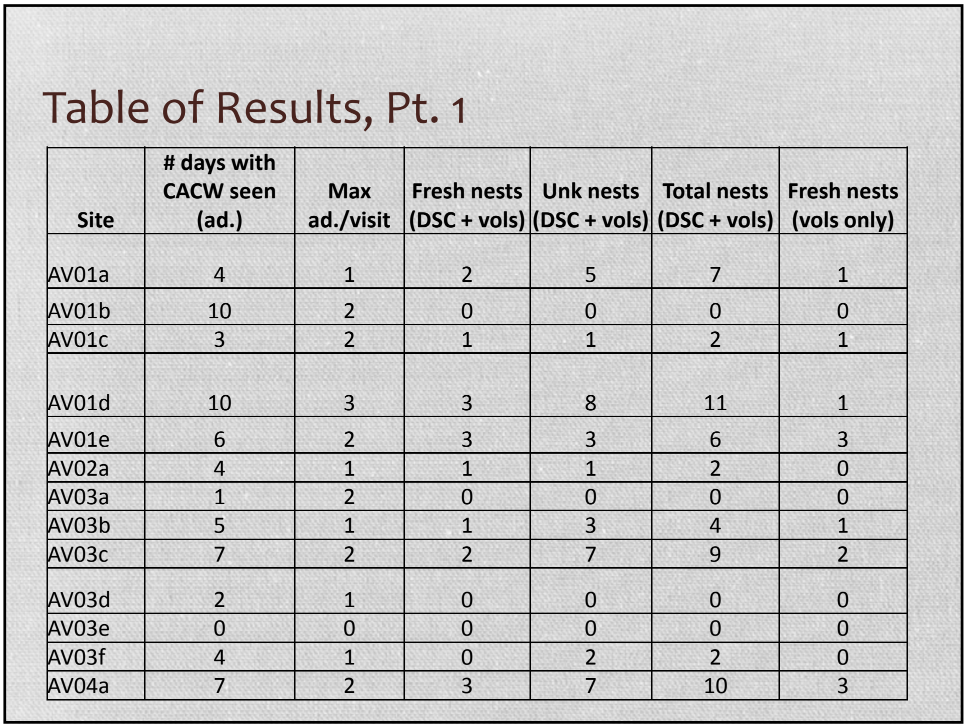


Table of Results, Pt. 1

Site	# days with CACW seen (ad.)	Max ad./visit	Fresh nests (DSC + vols)	Unk nests (DSC + vols)	Total nests (DSC + vols)	Fresh nests (vols only)
AV01a	4	1	2	5	7	1
AV01b	10	2	0	0	0	0
AV01c	3	2	1	1	2	1
AV01d	10	3	3	8	11	1
AV01e	6	2	3	3	6	3
AV02a	4	1	1	1	2	0
AV03a	1	2	0	0	0	0
AV03b	5	1	1	3	4	1
AV03c	7	2	2	7	9	2
AV03d	2	1	0	0	0	0
AV03e	0	0	0	0	0	0
AV03f	4	1	0	2	2	0
AV04a	7	2	3	7	10	3

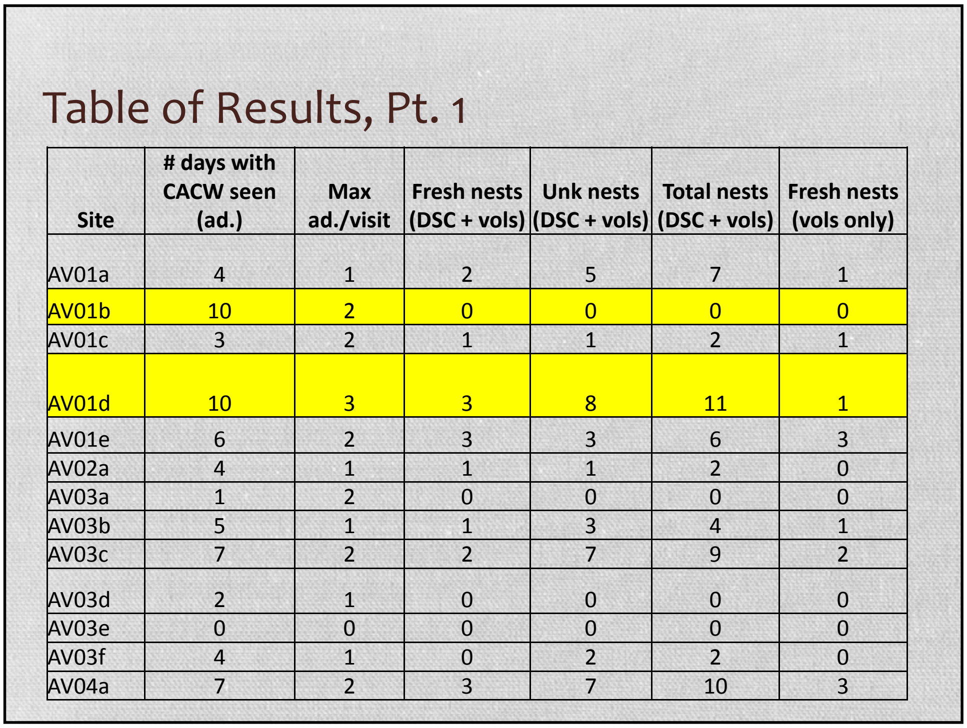


Table of Results, Pt. 1

Site	# days with CACW seen (ad.)	Max ad./visit	Fresh nests (DSC + vols)	Unk nests (DSC + vols)	Total nests (DSC + vols)	Fresh nests (vols only)
AV01a	4	1	2	5	7	1
AV01b	10	2	0	0	0	0
AV01c	3	2	1	1	2	1
AV01d	10	3	3	8	11	1
AV01e	6	2	3	3	6	3
AV02a	4	1	1	1	2	0
AV03a	1	2	0	0	0	0
AV03b	5	1	1	3	4	1
AV03c	7	2	2	7	9	2
AV03d	2	1	0	0	0	0
AV03e	0	0	0	0	0	0
AV03f	4	1	0	2	2	0
AV04a	7	2	3	7	10	3

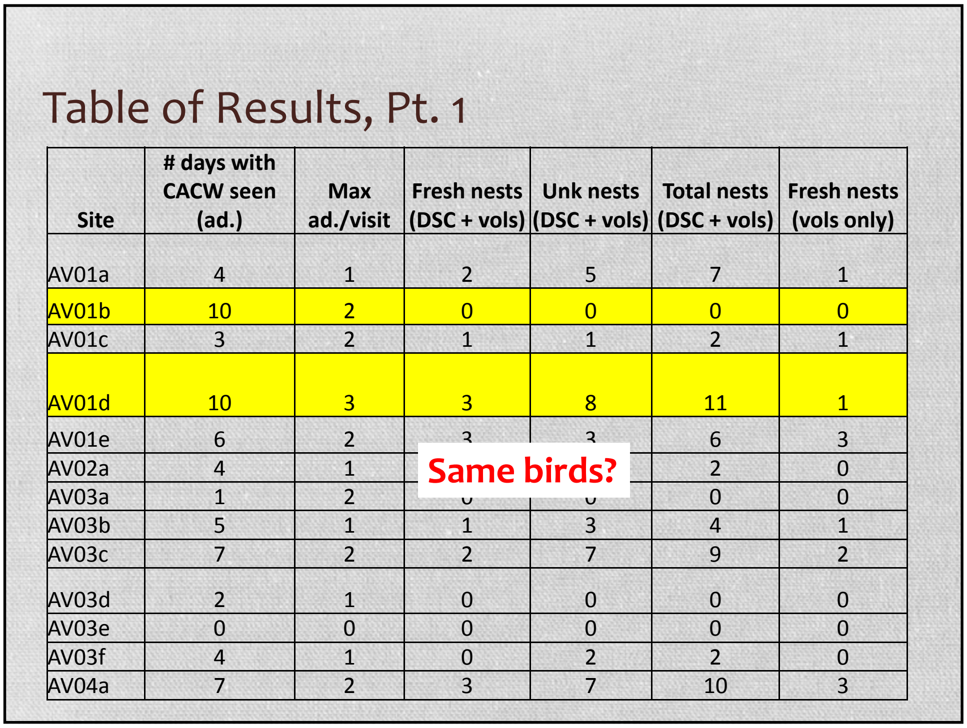


Table of Results, Pt. 1

Site	# days with CACW seen (ad.)	Max ad./visit	Fresh nests (DSC + vols)	Unk nests (DSC + vols)	Total nests (DSC + vols)	Fresh nests (vols only)
AV01a	4	1	2	5	7	1
AV01b	10	2	0	0	0	0
AV01c	3	2	1	1	2	1
AV01d	10	3	3	8	11	1
AV01e	6	2	3	3	6	3
AV02a	4	1	[illegible]	[illegible]	2	0
AV03a	1	2	0	0	0	0
AV03b	5	1	1	3	4	1
AV03c	7	2	2	7	9	2
AV03d	2	1	0	0	0	0
AV03e	0	0	0	0	0	0
AV03f	4	1	0	2	2	0
AV04a	7	2	3	7	10	3

Same birds?

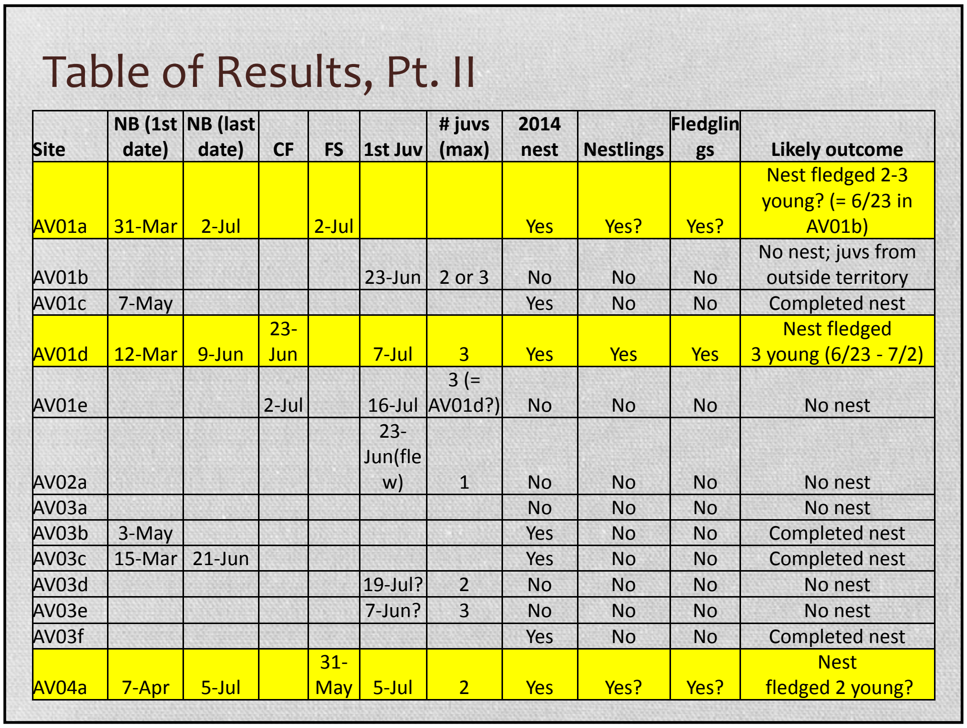


Table of Results, Pt. II

Site	NB (1st date)	NB (last date)	CF	FS	1st Juv	# juvs (max)	2014 nest	Nestlings	Fledglings	Likely outcome
AV01a	31-Mar	2-Jul		2-Jul			Yes	Yes?	Yes?	Nest fledged 2-3 young? (= 6/23 in AV01b)
AV01b					23-Jun	2 or 3	No	No	No	No nest; juvs from outside territory
AV01c	7-May						Yes	No	No	Completed nest
AV01d	12-Mar	9-Jun	23-Jun		7-Jul	3	Yes	Yes	Yes	Nest fledged 3 young (6/23 - 7/2)
AV01e			2-Jul		16-Jul	3 (= AV01d?)	No	No	No	No nest
AV02a					23-Jun(few)	1	No	No	No	No nest
AV03a							No	No	No	No nest
AV03b	3-May						Yes	No	No	Completed nest
AV03c	15-Mar	21-Jun					Yes	No	No	Completed nest
AV03d					19-Jul?	2	No	No	No	No nest
AV03e					7-Jun?	3	No	No	No	No nest
AV03f							Yes	No	No	Completed nest
AV04a	7-Apr	5-Jul		31-May	5-Jul	2	Yes	Yes?	Yes?	Nest fledged 2 young?

So to summarize…

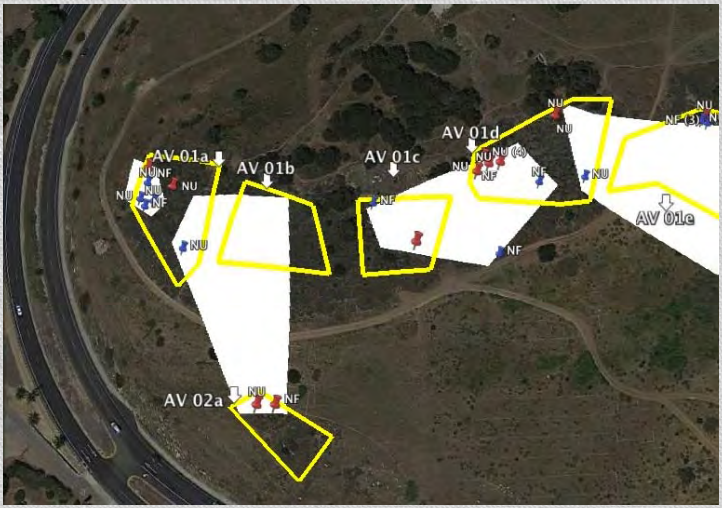
Of 13 potential territories (= intact cactus patches, called "sites", located within four main polygons)…

- 12 (92%) had adult Cactus Wren on at least 1 survey day
  - Range: 0-10 days with detection of 1+ ad. wren
  - Ave.: 4.8 days (c. 1 in 4 chance of detection)
  - Ave. max. = 1.5 ad. birds (range 0-3 adults)

- 7 (54%) had completed nests being used in 2014
  - *Note: pairs will build/maintain more than one nest!*

- Fledglings confirmed at 1 (AV01d), suspected at 2 more (AV01a, AV04a) (Max. = 23-43% success in 7 territories)

Potential modifications (based on 2014 usage)



Calculating the same metrics using "new" territories…

- Of 8-10 potential territories, 5-6 had completed nests used in 2014 (one nest was initiated late in the season away from area of normal wren usage, btwn two territories)
- Fledglings confirmed at 1 nest/territory, suspected at 2

Since pairs may build/maintain multiple nests scattered around their territories, and frequently fly into other pairs' territories to forage, it's difficult to estimate pairs based on # of nests, or even usage areas.

Thus, easiest to estimate productivity based on nestlings/fledglings (= 1-3 nesting pairs by late July at AV in 2014)

Lessons/Insights I

- Nesting activity probably fairly high during spring/summer 2014, but productivity probably fairly low (no more than 3 broods by end of July)

- Predicted territory boundaries roughly similar in number to actual ones, but:
  - Most predicted territories appeared to be "split" by 2-3 (pairs?) of birds
    - AV02a used by birds from territories to the north
    - AV01c and AV01d were adjacent and could have been combined, etc.

Lessons/Insights II

Future surveys could identify most active territories early (e.g., with nest being actively built in early spring), and concentrate observations here, essentially ignoring little-used areas.

Supplementary visits to these other areas to confirm inactivity.

Or…

Maybe it's best to repeat the same methods every (year)…?

But, with more training to improve observational skills (i.e., how to recognize food-carrying, etc.) and overall data collection.

Correlation between Habitat Quality, Abundance and Diversity of California Birds

Abstract

Past studies have been contradictory in whether the abundance and diversity of a species is positively correlated with habitat quality. One study showed that of the 80 species of birds counted before and after a fire in a Coastal sage scrub habitat (CSS), almost 100% of the species had higher numbers in the developed habitat. Another study on land snails found that there were species that did not correlate the same way. As such, in an eight week period between November 30, 2014 to January 25, 2015, I observed ten different species of common birds native to the CSS habitat in three different qualities of habitats: highly degraded, restoration in progress and existing native habitat, all found along the Palos Verdes Peninsula. After the eight weeks, I averaged the amount of birds counted and found that with the exception of the house finch and the spotted towhee, all of the species of birds had the highest numbers in the restoration in progress habitat. These results prove that not all species have the highest numbers in a native habitat. These results can be used in several ways, including increasing the numbers of an endangered species if it is known whether the species prefers a native habitat or restoration in progress habitat. In addition, nature preserves can determine what habitat quality to insert specific species into in order to have that species thrive satisfactorily.

Introduction

When a species is downlisted or listed onto the Endangered Species List, the major concern is the reason for the occurrence. During a study on the abundance and diversity of several species of birds such as Say's Phoebe (*Sayornis saya*) and Wilson's warbler (*Wilsonia pusilla*), compared between a developed Coastal sage scrub (CSS) habitat, and the same habitat after it had been incinerated, it was found that the majority of the 80 species conducted had their numbers highly decreased in the burned habitat. The study had concluded that there was a definite correlation to the quality of the Sage Scrub Habitat and the number of birds found there for those 80 specific species.

Reviewing the results of studies like this, seeing that a burned habitat does correlate with the abundance and diversity of 80 specific species of birds, inclined me to ask the question: Is there a correlation between habitat quality and the abundance and diversity of the common species of birds in southern California? While the previous research suggests that increase in habitat quality certainly means an increase in the abundance and diversity of a species, a study on the northern spotted owl (*Strix occidentalis caurina*) proved otherwise. This study found that the diversity of the owls came from an entirely different factor- reproductive output.

Nevertheless, the common tendency for the correlation between habitat quality and the abundance/diversity of birds in particular, as shown by the study on birds in the CSS habitat by Patricia Stanton, was that abundance and diversity would increase with habitat quality, and so it led me to form the hypothesis that if habitat quality is increased, then the abundance and diversity of the common species of birds in southern California will increase as well.

The California gnatcatcher (*Polioptila californica)* is a native species of the CSS habitat that has been considered a threatened species based on the U.S. Endangered Species Act since 1993. Around that time, several studies were conducted to see the reason for the decrease in numbers. One study, conducted in 1993, showed that the Laguna Canyon Fire, a devastating catastrophe that occurred in the San Joaquin Hills in October 1993, had damaged many CSS habitats within the area, lowering the quantity of California Gnatcatchers there heavily. Based on information from research like this, the California gnatcatcher may potentially be downlisted from the U.S. Endangered Species List after over two decades of it being threatened. Even if only two species are discovered to thrive in different levels of habitat quality, with the results of this study, other endangered species could potentially be downlisted as well if the right habitat quality is grown.

Materials

The following materials were used to gather data for this experiment: A copy of Peterson Field Guide to Birds of Western North America, Fourth Edition, by Roger Tory Peterson (used to correctly identify each the various species of birds within the CSS habitat), one pair of Bushnell Falcon 7x35 Binoculars (used to differentiate species that have similar features to other species, as well as identify species not within close proximity), a Casio FX-260 Solar Scientific Calculator to calculate the statistics after identifying the birds, a Nikon D40 DSLR to take photographs of the birds for further observation and analysis, and a scientific notebook to record data and observations.

Highly Degraded Habitat

Restoration in Progress Habitat

Existing Native Habitat

Methods

The following steps were taken in order to successfully conduct the experiment:

1) The whole study took place at the local Coastal sage scrub habitat on the Palos Verdes Peninsula. Here, every Sunday from 8:00 a.m. to 9:00 a.m., beginning on 11/30/14 and ending on 1/25/15, I observed three different habitats of differing qualities for twenty minutes each (8 weeks in total). The highly degraded habitat was observed from between 8:00-8:20, the restoration in progress habitat was observed from between 8:20-8:40, and the existing native habitat was observed from between 8:40-9:00.

2) Ten species were observed during the trials. These species are the house finch (*Carpodacus mexicanus*), California towhee (*Melozone crissalis*), lesser goldfinch (*Carduelis psaltria*), spotted towhee (*Pipilo maculatus)*, Anna's hummingbird (*Calypte anna*), white-crowned sparrow (*Zonotrichia leucophrys*), bushtit (*Aegithalidae*), western meadowlark (*Sturnella neglecta)*, mourning dove (*Zenaida macroura*), and the American crow (*Corvus brachyrhynchos)*. According to the Peterson Field Guide to Birds of Western North America, these birds are all considered "common" species. Throughout each twenty minute period, with the use of the Peterson Field Guide and the Bushnell Binoculars, I counted each bird I spotted in the specific habitat I was observing. If I saw a bird in a different habitat that was not located in the specific habitat being observed, it was not calculated.

3) At the end of the eight week period, the number of birds counted for each species in each habitat were averaged, and those numbers were written down. Finally, the averages were compared and analyzed to determine the correlation between habitat quality and the abundance and diversity of the ten specific common birds chosen for the study. In addition, the observation written down for each week was taken into account when analyzing the averages

Results: Tables and Graphs

Species	Trial # 1	Trial # 2	Trial # 3	Trial # 4	Trial # 5	Trial # 6	Trial # 7	Trial # 8
House Finch	0	1	0	0	1	0	0	2
California Towhee	0	0	0	2	1	1	0	2
Lesser Goldfinch	0	0	0	4	0	0	0	4
Spotted Towhee	0	0	0	1	1	0	5	0
Anna's Hummingbird	0	0	0	0	2	0	0	0
White-Crowned Sparrow	1	0	1	4	0	0	0	0
Bushtit	0	0	0	1	0	0	0	1
Western Meadowlark	0	0	0	0	0	0	0	0
Mourning Dove	0	0	0	4	0	0	1	1
American Crow	0	0	0	0	0	0	0	0

Table 1: Highly Degraded Habitat Raw Data

Species	Trial # 1	Trial # 2	Trial # 3	Trial # 4	Trial # 5	Trial # 6	Trial # 7	Trial # 8
House Finch	3	0	2	0	1	4	0	4
California Towhee	3	12	4	6	3	2	2	10
Lesser Goldfinch	2	2	0	0	2	1	0	6
Spotted Towhee	1	10	4	3	6	2	1	2
Anna's Hummingbird	0	4	2	9	2	12	11	7
White-Crowned Sparrow	2	0	2	6	7	3	0	9
Bushtit	2	11	4	5	8	2	0	17
Western Meadowlark	2	0	0	0	2	0	0	5
Mourning Dove	4	3	5	2	3	3	8	4
American Crow	8	0	2	2	4	0	0	0

Table 2: Restoration in Progress Habitat Raw Data

Species	Trial # 1	Trial # 2	Trial # 3	Trial # 4	Trial # 5	Trial # 6	Trial # 7	Trial # 8
House Finch	3	0	8	4	4	12	0	11
California Towhee	0	8	2	3	5	7	7	4
Lesser Goldfinch	0	0	0	0	5	5	0	0
Spotted Towhee	0	0	3	3	2	3	5	5
Anna's Hummingbird	0	7	0	6	1	19	13	10
White-Crowned Sparrow	1	0	7	3	5	4	0	6
Bushtit	3	10	5	5	6	10	3	22
Western Meadowlark	5	0	1	0	6	5	0	3
Mourning Dove	4	0	6	2	5	5	9	4
American Crow	3	0	10	26	6	1	2	0

Table 3: Existing Native Habitat Raw Data

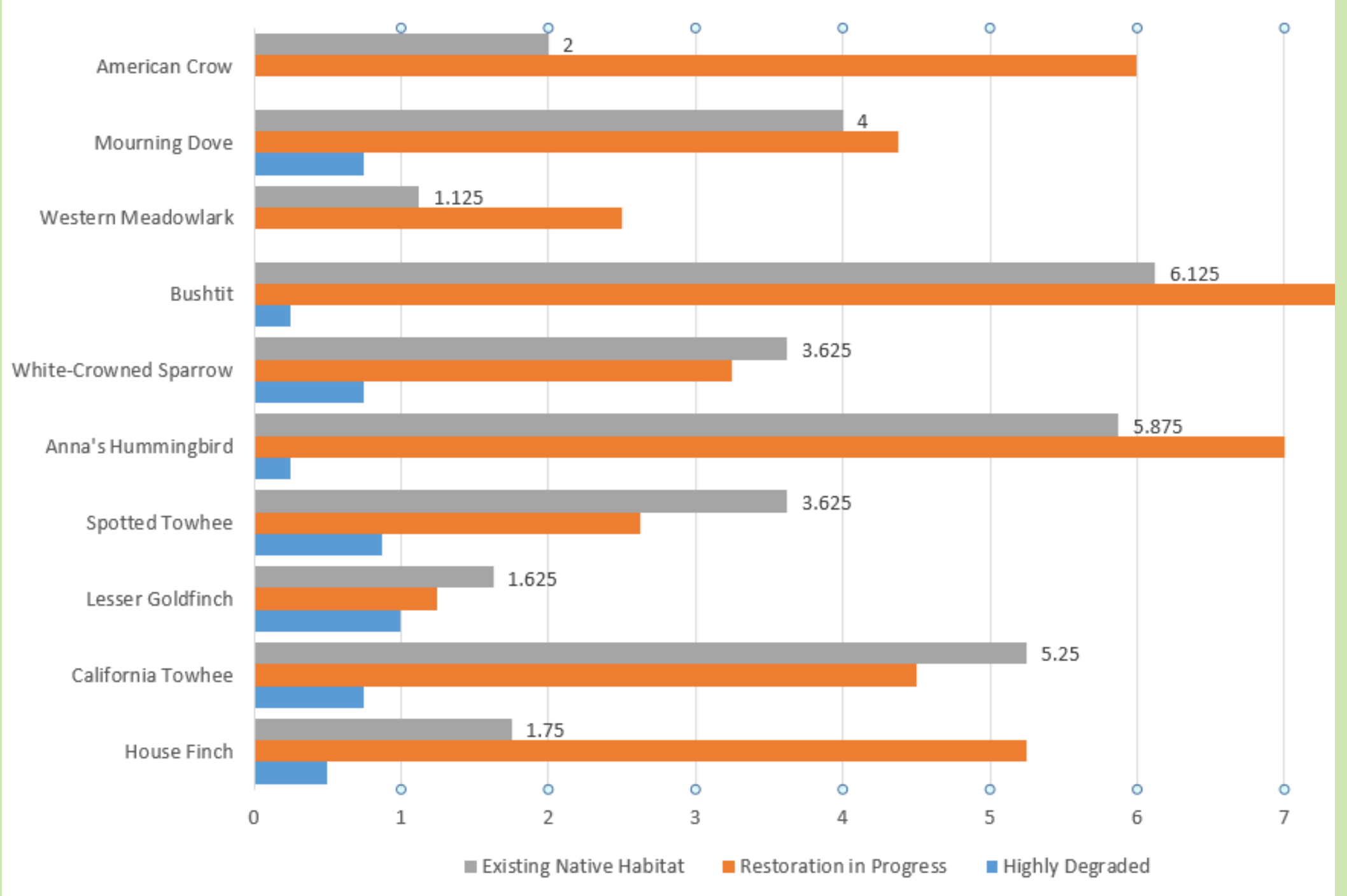


Table 4: Habitat Averages

Species	Highly Degraded	Restoration in Progress	Existing Native Habitat
House Finch	0.5	5.25	1.75
California Towhee	0.75	4.5	5.25
Lesser Goldfinch	1	1.25	1.625
Spotted Towhee	0.875	2.625	3.625
Anna's Hummingbird	0.25	7	5.875
White-Crowned Sparrow	0.75	3.25	3.625
Bushtit	0.25	8	6.125
Western Meadowlark	0	2.5	1.125
Mourning Dove	0.75	4.375	4
American Crow	0	6	2

Talbe 5: Habitat Averages

Discussion

After analyzing the results, I must deny my hypothesis.

The majority of species examined did not have an increase as habitat quality increased. On average, only the lesser goldfinch and white-crowned sparrow had the highest numbers in the existing native habitat, and it was only an increase of +0.375 each from the restoration in progress habitat to the existing native habitat. While it is unusual that the majority of species have this correlation, it makes sense keeping in mind that there were species from Stanton's research, as well as Vergeer, Rengelink, Copal and Osburg's research that had the correlation of having the greatest numbers in a restoration in progress habitat. Perhaps the species chosen for this study in particular mainly had this correlation.

The easiest explanation for this conclusion is as follows: during the first few weeks of experimentation, when the weather was cooler, (max of 23.8 degrees Celsius on the day of the first trial) the birds had most likely stayed in their native habitat where there was a higher chance of survival and less open space. In the latter trials, the weather got warmer, (about 28.8 degrees Celsius) and the birds may have gone to the restoration in progress habitat (as the conditions were still desirable with many species of plants). Reasons for traveling to the restoration in progress are searching for a new shelter, an easier source of food (as there are less plants and more open space in a restoration in progress habitat than an existing native habitat), or solely curiosity.

Looking at diversity, as it ties in heavily with abundancy, the variation of species correlated roughly the same as the numbers of each species, as in the restoration in progress habitat there was the most variation of species, with the highly degraded habitat having the least variation. Reasons for this may be the same as with abundancy.

Keeping in mind that experimental errors may have occurred, this information could benefit nature reserves in numerous ways. Knowing that not all species are most abundant in an existing native habitat, a study must be done on each specific species in order to discover what habitat is right for that species. In addition, a reserve that is looking for high abundance and diversity must have knowledge on the species contained there in order to know where a specific species would thrive.

Future Research

This study brings room for future questions, such as: How does habitat quality affect mortality rates of the common species of birds in southern California? In addition, this study can be expanded to further species in order to identify which specific species have this exact correlation, as well as if it applies to every species within the same genus, family, or even order. As more species' preferred habitat quality is identified, then more species can hopefully be preserved and thrive prosperously.

A California gnatcatcher in its native habitat, the Coastal sage scrub habitat.
Source: Los Angeles Times

Observing the Effects of Terra Sorb on *Astragalus trichopodus Year II*

Statement of Problem

- California is currently in a drought. The cost of water supply is slowly increasing, yet we need to take care of our environment.
- How can our plants be in a healthy condition without the expensive cost of irrigation?

Introduction

• Water, an essential in the entire world, is absolutely necessary in plant survival.

• It is known that plants need water in order to take on the process of “transpiration, which is the loss of water from plants in the form of vapor (95%)” (Why Plants Need Water) and “ photosynthesis for producing the carbohydrates necessary for plant growth (5%)” (Why Plants Need Water). Besides water being a part of these processes, plants also need water in order to germinate its seeds and have proper growth. In addition, water is beneficial to plants by “providing firmness.” (What is the role of water in Plants?).

•The Palos Verdes Peninsula Land Conservancy manages the habitats within Rancho Palos Verdes, a small city within the state of California, which is one of the many cities suffering from California’s deadly drought.

•Many homeowners and conservancies are aware that water is one of the main sources that a plant needs in order to survive.

•That is why for my project, I chose to investigate the possibility of saving water; by doing so, people will be able to plant many plants and not worry about the expensive cost of watering them.

The photo to the left displays how fine the Terra Sorb is. Before adding water, the Terra Sorb is small in size, like tiny salt crystals. Although small in size, Terra Sorb has the ability to expand in order to store the water needed for the plant’s future needs.

- Last year’s research project, which was mainly observing the canopy volume of the varying treatment groups.
- No water and Terra Sorb, No Water No Terra Sorb, Water and Terra Sorb, Water and No Terra Sorb
- After collecting the data, I had found that the average canopy volume of *Astragalus richopodus* gradually increased throughout the months of data collection.
- From the initial measurement to the last data collection in February, it was found that the Astragalus trichopodus had grown the most and effectively when given water and Terra Sorb.

Hypothesis

- My objective of this experimentation was to find out if the substance Terra Sorb had the ability to actually store the water needed for the plant’s survival.
- My hypothesis is that with the presence of Terra Sorb, the species Artemisia californica and *Astragalus trichopodus* will have a greater average dry weight than the treatment group that does not contain any Terra Sorb.

Methods and Materials

- To get the data regarding Photosynthesis and Gas Exchange, primarily collected to understand the plant’s condition, we used a machine LI6400 (Li-COR Inc) which has the ability to measure the CO_2 uptake and water vapor concentrations in respect to various factors such as temperature and more.
- To find the water potential measurements, branches of 4-7 cm were cut off and placed into plastic bags which were put into a cooler in order to minimize the amount of transpiration.
- After placing the cut branches into the Shcolander-type pressure chamber, data will be collected.

The photograph above is the Li-Cor instrument which we used in order to get the data for CO_2 uptake of the individual species.

The photograph above displays the No Watered plot . Similar in design, the Water plot is to the left of the No Water plot.

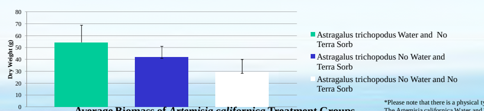
- All plants first must be excavated from the site and put into plastic bags with the ID number attached . Measurements of the tap roots, fine roots, stems, leaves, and fruits were made by separating each of the categories into paper bags and using a tape measurer and were later dried and weighed in grams.
- The root to shoot and tap root to fine root ratio was also calculated for and noted for as well. Data measurements were noted, and later used for calculations. The averages and standard deviations of the biomasses of the species were calculated and noted.

The photograph to the left is when the species were being excavated in the beginning of the experimentation.

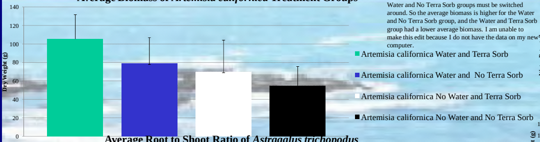
Photo taken by: Ann Dalkey

The photograph above shows the Pressure Chamber being in use.

Data

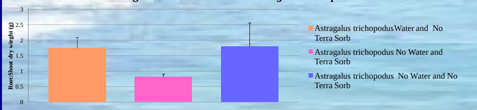


Average Biomass of *Astragalus trichopodus* Treatment Groups

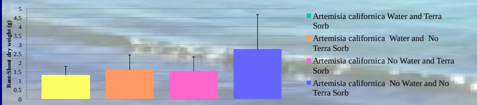


Average Biomass of *Artemisia californica* Treatment Groups

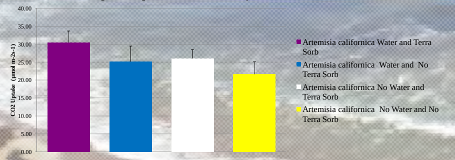
*Please note that there is a physical typing error here. The Artemisia californica Water and Terra Sorb and the Water and No Terra Sorb groups must be switched around. So the average biomass is higher for the Water and No Terra Sorb group, and the Water and Terra Sorb group had a lower average biomass. I am unable to make this edit because I do not have the data on my new computer.



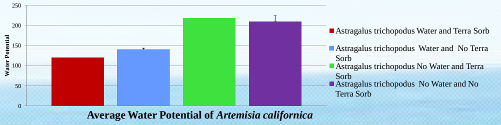
Average Root to Shoot Ratio of *Astragalus trichopodus*



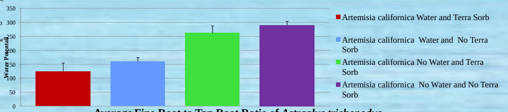
Average Root to Shoot Ratio of *Artemisia califorinca*



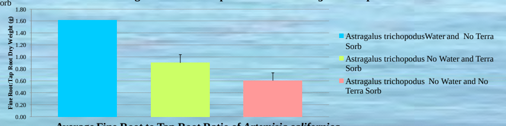
Average CO_2 Uptake of *Artemisia californica*



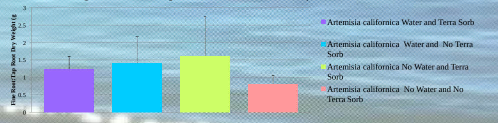
Average Water Potential of Astraglus Trichopodus



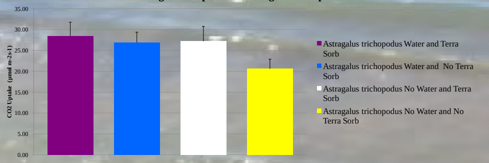
Average Water Potential of *Artemisia californica*



Average Fine Root to Tap Root Ratio of *Astraglus trichopodus*



Average Fine Root to Tap Root Ratio of *Artemisia californica*



Average CO_2 Uptake of Astraglus trichopodus

Results

- After collecting the data, I have found that the average canopy volume of *Astragalus trichopodus* gradually increased throughout the months of data collection.
- From the initial measurement to the last data collection in February, it was found that the *Astragalus trichopodus* had grown the most and effectively when given water and Terra Sorb.
- Comparing the two groups Water and Terra Sorb and Water and No Terra Sorb, it is observed that the estimated canopy volume is much greater in the Water and Terra Sorb treatment group.
- When comparing the No Water and Terra Sorb and the No Water and No Terra Sorb, it is seen that the treatment group with No Water and Terra Sorb has a greater estimated canopy volume than the treatment group of No Water and No Terra Sorb.
- In Table 1, it was found that the Watered and Terra Sorb and the No Water and Terra Sorb group both had CO_2 uptakes that were greater than both the No Watered and No Terra Sorb and No Water and Terra Sorb groups
- In Table 2, it is seen that the average for water stress was greatest in the No Water treatments, whereas the water stress was not as high for the species in the Water treatment.
- In the Water treatment, it can be seen that the water stress is greater in the Water and No Terra Sorb treatment group than the Water and Terra Sorb treatment group.
- For the data obtained on the no watered treatment groups, the water stress seems to be greater in the no watered with Terra Sorb category than the No water and No Terra Sorb.
- However, this conclusion cannot be made so easily because the sample size of this test is very small. Because we had only tested two plants as a part of our sample size in the No Water category, absolute conclusions about the average and standard deviation water stress cannot be made

Discussion and Conclusions

- From the data collected, I can conclude that my hypothesis is correct.
- From Figure 1, we are able to conclude that there is a general trend appearing; that is, if Terra Sorb is present in the treatment group, then it is seen that the average canopy volume is greater than the treatment groups that do not contain any Terra Sorb.
- As more data is collected over the months, it is expected that our data will eventually become statistically significant with very little variation.
- When the Water and Terra Sorb group was compared to the Water and No Terra Sorb, the Water and Terra Sorb group had a larger estimated canopy volume.
- When comparing the No Water and Terra Sorb group to the No Water and No Terra Sorb group, the estimated canopy volume is still greater in the No Water and Terra Sorb group.
- From these results, we can conclude that Terra Sorb has affected both the Water and No Water groups, but it is seen to be most effective when water is present.
- As for the No Water and No Terra Sorb group compared to the No Water and Terra Sorb group, the treatment group with Terra Sorb from the No Water groups has the greater CO_2 uptake.
- From such results, it can be seen that the Terra Sorb itself has the ability to retain and utilize the water given every week.
- The water stress is larger in the Water and No Terra Sorb group when compared to the Water and Terra Sorb group.
- For the No Water and No Terra Sorb group compared to the No Water and Terra Sorb group, the water stress is much greater in the Water and No Terra Sorb group. By having more have a negative value, it can be seen that the plant’s health is experiencing more water stress, which is detrimental to the plant.

Future Research

I will be continuing this project next year to see the continued growth of both the *Astragalus trichopodus* and *Artemisia californica*. By doing so, I believe that the estimated canopy volumes will increase greatly. This also applies to the data collected for the Li-COR results and the Water Potential results found this year. From the data and the general trend found this year, I believe that the trend will continue, and future data collected will be able to display as statistically significant.

Photo by Evi Meyer
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Measuring Cactus Wren's Tolerance to Human Recreation on the Palos Verdes Peninsula using Flight Initiation Distance for Conservation and Management

Funded by the Long Family Foundation
Prepared for Palos Verdes Peninsula Land Conservancy

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Abstract

Predators and prey have coevolved through evolutionary time in an arms race upon which disturbances in the normal prey activity by a predator can evoke costly anti-predator responses. These disturbances can negatively influence reproductive success, survival and habitat usage. For at risk populations, understanding how a species will acclimate to predator presences by either habituating or sensitizing may determine how their habitat is managed. The Coastal Cactus Wren, *Campylorhynchus brunneicapillus,* is a threatened species on the Palos Verdes Peninsula. Flight initiation distance surveys were conducted to determine the species response to predation risk by human recreation. Alta Vicente Reserve is used for a GIS analysis which provides information to management authorities for minimizing the impact of human disturbances.

Two methods determined the minimum approach distance, the distance at which humans should be separated from wildlife to minimize behavioral disturbances. The methods produced very different estimates. Method 1 determined the distance when 95% of Cactus Wren Individuals become alert is 97.36 meters with 95% of individuals fleeing at 96.38 meters. Method 2 determined the minimum approach distance as 62.64 meters. The variability maybe due to different assumptions. Flight Initiation Distance is positively correlated with wind speed and alert distance. The GIS analysis provided locations of buffer areas and high trail encroachment. Alta Vicente Trail had the largest area of impact with 2014 nest for both methods with Alert Distance having the most impact at 0.96 hectares. Alert Distance is the most conservative estimate of minimum approach distance for trail impact.

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Introduction

Predators and prey have coevolved through evolutionary time in an arms race in which one evolutionary trait change in one evokes an evolutionary change in the other, "which then changes the original trait of the first species" (Janzen, 1980). A great example of this race is the effects of a predators' presence on their prey. Their presence causes a "disruption of normal activities or states and often evokes anti-predator behaviors, [such as] vigilance, flight, retreat to refuge, freezing behavior, or hiding" (Hockin et al., 1992). The consequences of the disturbance responses are not obvious at first because they are shaped on "two different time scales - over evolutionary time and within lifetimes" (Weston & Stankowich, 2014).

Gill et al., (1996) demonstrated that there is "population-level effects of disturbance, essentially because disturbance effectively lowers habitat quality and thus reduces carrying capacities." In other words, disturbance can evoke negative effects on average reproductive success, recruitment, survival, and habitat use (Weston & Stankowich, 2014). The magnitude of the population-level effects is dependent on the amount of area that the prey can to flee to during the disturbance. Species with limited habitat to flee to will habituate meaning that their fearful responses will decrease overtime and they will stop responding to the stimuli. While species with alternative habitat to flee to will sensitize overtime with their fearful responses increasing (Blumstein et al., 2010).

Measuring individuals fearful responses will help infer the potential impacts at the population level especially for at risk populations that are in constrained areas, such as coasts and recreational parks. One assumption of the Risk Disturbance Theory is that individuals perceive humans as a threat and therefore will respond to them accordingly. The distance at which an individual flushes away from a human is known as Flight Initiation Distance (FID) and is used in wildlife management to determine the species minimal buffer area of critical habitat. The buffer area acts to minimize the external direct or indirect disturbances (Ried & Miller, 1989) because encroachment within the buffer area will trigger negative effects (Blumstein et al., 2010) that result in a species habituating or sensitizing.

In 1980 the population of Los Angeles County was 7,477,503 and by 2013 it had increased to 10,017,068 (Forstall, 1995), which is an increase by thirty four percent! Unfortunately, before the population increase over ninety percent of the California coastline was developed into prime real estate by 1980 (SDZ, 2013). This demolished many unique plant communities and quickly put endemic species at risk of becoming extinct. The Coastal Sage Scrub remnants, one of the endangered plant communities, "provides habitat for nearly 100 species of plants and animals that are classified as *rare, threatened* or *endangered* by Federal or State agencies" (Davis et al., 1994). An obligate, endemic species of the Coastal Sage Scrub is the coastal Cactus Wren, *Campylorhynchus brunneicapillus.* This species population trend is "declining," but it is only listed by the International Union for Conservation of Nature and Natural Resources (IUCN) as species of *Least Concern* due to its wide range (BirdLife International, 2012). Although, the coastal Cactus Wrens have historically maintained a limited distribution in southern California, with a slow recovery rate that is attributed to the lengthy recovery time of the Coastal Sage Scrub (Mitrovich & Hamilton, 2007) making the southern California coastal population's survival to be considered one of the greatest challenges in bird conservation (Unitt, 2004).

On the Palos Verdes Peninsula, located within Los Angeles County, several Reserves have patches of Coastal Sage Scrub that remain or were restored by the Palos Verdes Peninsula Land Conservancy (PVPLC) and support a small population of coastal Cactus Wrens. While the Reserves are surrounded by an urban matrix and have the potential to be highly impacted by habitat fragmentation and degradation, they still offer a location for the unique flora and fauna to survive. Within the Reserves there is a series of a public trail systems that weaves through the sensitive habitat. Therefore increasing the probability of encroachment disturbances that could cause negative effects on the Cactus Wren population (Wheeler, 1997; Blumstein et al., 2010).

It is not ideal to shut down the entire trail system in order to reduce the probability of potential negative impacts on the Cactus Wren population due to human disturbance. This study seeks to provide information about the coastal Cactus Wrens anti-predator responses to enable management solutions to balance human recreation and the probability of encroachment impacts. The following questions are researched in this study:

1. At what distance do the coastal Cactus Wrens flee at? What factors influence this distance?
2. What is the size of the critical habitat buffer area for coastal Cactus Wrens?
3. Using Alta Vicente Reserve, as a site example, where are the critical trail locations that could cause negative effects from encroachment?

Methodology

Study Locations

Flight Initiation Distance surveys were conducted on two Reserves owned by the PVPLC in Palos Verdes, California (Figure 1). Other Reserves previously known to have Cactus Wrens were surveyed with little to no success at finding the Cactus Wren population for this study. Alta Vicente Reserve (33°45'07. 26" N 118°23'08.09" W) is a 55-acre parcel with 15 acres of restored coastal sage scrub habitat (PVPLC, 2011) and Three Sisters Reserve (33°44'35.06" N 118°24'21.57" W) is a 99-acre parcel with 21-acres restored coastal sage scrub habitat (PVPLC, 2011).

Approach Methods

In order to stimulate the same type of disturbance experienced daily by the Cactus Wrens, the birds were approached only by walking along the trail system (tangential approaches). Two sampling techniques were implemented during this study in order to gather the data. In the first technique, the Principle Investigator (PI) approached the Cactus Wren (Appendix L). In the second technique, the PI informed a walker through a two way Walkie Talkie (Motorola MT352TPR) when a Cactus Wren was in view and when to begin walking along the trail. In both techniques, weighted flags were dropped at the starting distance (SD), alert distance (AD) and the Flight Initiation Distance (FID) (Appendix A & M). Distance fled (DF) was also recorded. The distance from the flags to the Cactus Wren were recorded using a Bushnell Scout Arc1000 Laser Rangefinder and the trail distances from flag to flag were recorded using a Stanley FatMax Blade Armor tape measure.

Abiotic factors that were recorded for each approach included temperature, wind speed and humidity using a Fisher Scientific Traceable Enviro-Meter (Appendix B). Initial and post approach perch height, substrate and behavior were recorded (Appendix C). In order to determine if the same Cactus Wren was approached multiple times, the trail name and grid location were recorded (Appendix D). Thirty samples were collected at Alta Vicente from September 2013 to April 2014 between 7:30am – 2:00pm. Twelve samples were collected at Three Sisters from March 2014 to April 2014 between 8:00-10:00am (Appendix N). There was a total of forty-two samples collected. Two samples were excluded from the analysis due to missing information (Appendix E).

GIS Mapping of Critical Buffer Areas

Alta Vicente Reserve was selected as an example for locating intersection areas between the trail system and the Cactus Wren's critical buffer area. These locations have the potential to have the most encroachment impact on the species population. Alta Vicente was selected because of the Citizen Mapping Project for the Cactus Wrens that was conducted for the same 2014 breeding season. The Cactus Wren's estimated territories and bird identification number were derived from the Citizen Mapping Project data (Figure 2). This will allow for a comparison of management information from two separate sources.

To accurately represent the critical trail locations at Alta Vicente for the 2014 breeding season, new data for nest locations (fresh and old) and trails were collected on May 9, 2014 using a Trimble 2007 GeoXH GPS unit. The unit was connected by bluetooth to the TruPulse Laser Rangefinder, which offsets the location of the point based on the distance and inclination, therefore allowing the PI to never leave the trail system. The trail polylines were important to collect because new trails had been created since the last time GPS locations were collected for this Reserve. The width of the trails was measured at various locations and averaged to determine the trail width for each trail (Appendix F). All GPS data was post processed using the base provider UNAVCO, Palos Verdes, California (33°44'35.86006"N, 118°24'15.30259"W, 71.05 m).

In order to determine the size of the buffer area and the locations of the intersections a python script was written that uses all of the collected data (Appendix G, H) and the additional AD and FID calculations for each sample, an ArcMap document with the appropriate data frames and the Python excel modules (Appendix J).

Using the FID and AD calculations the minimum approach distance (MAD) (distance at which humans should be separated from wildlife to minimize behavioral disturbances) and the buffer area (areas where humans should not encroach to avoid displacing wildlife) were calculated (Fernandez-Juricic et al., 2009). MAD was calculated using the following two methods:

> **Method 1:** calculates MAD by plotting the "cumulative percentage of fleeing individuals against alert distance and Flight Initiation Distance to determine the point at which 95% of the individuals become alert (M1AD) and take flight (M1FID)" (Stalmaster & Newman, 1978; McGarigal et al., 1991; Anthony et al., 1995; Swarthout & Steidl, 2001).
>
> **Method 2:** calculates MAD by using the mean distance from the FID and multiplying that by 1.5(Fox & Madsen, 1997) (Appendix I).

Fernandez-Juricic et al. (2005) evaluated several methods and their assumptions and determined that Method 2 is the "most sensitive and the most conservative method for the estimation for the minimum approach distance and buffer areas." The buffer areas for Method 1 and 2 were calculated using (π * MAD^2), with the center point of the buffer areas as the location of the Cactus Wren nests.

Statistical Analysis

All statistical tests were completed in IBM SPSS Statistical software using an alpha of 0.05. LSD post hoc tests were used in all applicable analyses. Alert distance, Flight Initiation Distance, and distance fled were checked for equal variance and normality. Alert distance and Flight Initiation Distance were natural log transformed to meet the assumptions of the Univariate Analysis of Variance and Pearson's product-moment correlation coefficient. Alert distance is composed of cases in which the Cactus Wren were alert prior and not alert prior to the approach.

The Cactus Wren responses were assessed to determine if there were any relationships with the abiotic factors (temperature, wind speed, humidity, sex and site) using Pearson's product-moment correlation coefficient. The responses were then analyzed to determine what influences Alert, Flight Initiation, and Distance Fled distances by using the Univariate Analysis of Variance. In order to account for potential differences between individual Cactus Wren responses, bird identification was set as a random factor for all tests.

Results

Statistical Analysis

Alert distance and distance fled is not correlated with temperature, wind speed or humidity (Table 1). Flight Initiation Distance is positively correlated with wind speed (r= 0.339, n= 40, p=0.339) but is not correlated with temperature or humidity (Table 1). Flight Initiation Distance is positively correlated with alert distance (r= 0.82, n= 40, p<0.001) (Table 1), while distance fled is not correlated with alert distance or Flight Initiation Distance (Figure 3).

Table 1. Table reporting the Pearson's product-moment correlation coefficient results for abiotic factors.

		df	**Pearson Correlation**	**P**
(a) Ln(Alert Distance)				
	Temperature	1,39	-0.165	0.308
	Wind Speed	1,39	0.259	0.107
	Humidity	1,39	0.153	0.345
(b) Ln(Flight Initiation Distance)				
	Temperature	1,39	-0.062	0.702
	Wind Speed	1,39	0.339	0.032*
	Humidity	1,39	0.032	0.846
	Ln(Alert Distance)	1,39	0.82	<0.001*
(c) Distance Fled				
	Temperature	1,39	0.036	0.846
	Wind Speed	1,39	-0.194	0.289
	Humidity	1,39	0.19	0.297

There is no significant relationships between alert distance or distance fled with site, sex, prior disturbance, aware prior to approach or bird individuals (Table 2). There are no significant relationships between Flight Initiation Distance with site, sex, aware prior to approach and disturbance (Table 2), but there is a significant relationship with bird individuals ($F_{6,28}$= 4.267, p=0.004) (Figure 4) (Appendix K1).

Table 2. Table reporting the Univariate Analysis of Variance results for relationships with categorical variables.

		df	F Value	P	Partial Beta Strength
(a) Ln(Alert Distance)					
	Site	0,0	~	~	~
	Sex	1,28	0.106	0.747	0.004
	Aware Prior to Approach	1,28	0.005	0.956	0
	Disturbance	1,28	1.434	0.241	0.049
	Bird Identification	6,28	1.554	0.198	0.25
(b) Ln(Flight Initiation Distance)					
	Site	0,0	~	~	~
	Sex	1,28	1.239	0.275	0.042
	Aware Prior to Approach	1,28	0.471	0.498	0.017
	Disturbance	1,28	0	0.995	0
	Bird Identification	6,28	4.267	0.004*	0.478
(c) Distance Fled					
	Site	1,20	0.035	0.854	0.002
	Sex	1,20	3.633	0.071	0.154
	Aware Prior to Approach	7,20	1.803	0.194	0.083
	Disturbance	1,20	3.407	0.08	0.146
	Bird Identification	6,20	0.95	0.483	0.222

Alert distance is significantly influenced by the initial behavior of the Cactus Wren ($F_{4,19}$= 6.209, p=0.002) (Figure 5) (Appendix K2), but is not influenced by initial perch height, initial substrate or individual bird (Table 3). Although, the relationship with initial substrate was fairly close to significance ($F_{4,19}$= 2.672, p=0.064). Flight Initiation Distance is significantly influenced by initial substrate ($F_{4,24}$= 3.226, p=0.03) (Figure 6) (Appendix K3), but was not influenced by initial perch height, initial behavior, or individual bird (Table 3). Distance fled results were examined for patterns using scatterplot (Figure 7), there were no clear differences between the variables and it was not examined further.

Table 3. Table reporting the Univariate Analysis of Variance results for relationships between height, initial behavior, substrate and bird identification.

		df	F	P	Partial Beta Strength
(a) Ln(Alert Distance)					
	Initial Perch Height	3,19	1.997	0.149	0.24
	Initial Substrate	4,19	2.672	0.064	0.36
	Initial Behavior	4,19	6.209	0.002*	0.567
	Bird Identification	8,19	1.232	0.334	0.342
(b) Ln(Flight Initiation Distance)					
	Initial Perch Height	1,24	0.111	0.742	0.005
	Initial Substrate	4,24	3.226	0.03*	0.35
	Initial Behavior	2,24	0.027	0.973	0.002
	Bird Identification	8,24	0.747	0.65	0.199
(c) Distance Fled					
	Post Perch Height	Looked at scatterplot matrix for relationships, there are no clear relationships. This was not investigated further.			
	Post Substrate				
	Post Behavior				

GIS Mapping for Applied Science

In Method 1 Alert Distance, the nests (new and old) are buffered at 97.36 meters, which is equal to the distance when 95% of individuals are alert (Figure 8). There are 38 intersections between the trail buffers and 9 of the 2014 nest buffers (Table 5) (Figure 9). Nest 1 and 7 were the top two most impacted (Table 5). The total impacted area (sum of all intersections) is 17288.74 m^2 which is equal to 1.73 hectares.

There are 218 intersections between trail buffers and 23 old nest buffers (Table 5) (Figure 10). Nest 9 and 34 were the top two most impacted (Table 5). The total impacted area (sum of all intersections) is 53339.32m^2 which is equal to 5.55 hectares.

For Method 1 Flight Initiation Distance, the nests (new and old) are buffered at 96.38 meters which is equal to the distance at which 95% of individuals take flight (Figure 11). This resulted in 38 intersections between trail buffers and 9 of the 2014 nests (Table 5) (Figure 12). Nest 1 and 7 were the top two most impacted. The total impacted area (sum of all intersections) is 16733.3m^2 which is equal to 1.67 hectares.

There are 233 intersections between trail buffers and 23 of the old nest buffers (Table 5) (Figure 13). Nest 9 and 34 were the top two most impacted (Table 5). The total impacted area (sum of all intersections) is equal to 52064.60m^2 which is equal to 5.20 hectares.

For Method 2 Flight Initiation Distance, the nests (new and old) are buffered at a distance of 62.6377 meters which is equal to the minimum approach distance (MAD) (Figure 14). This resulted in 12 intersections between trail buffers and 4 of the 2014 nest buffers (Figure 15). Nest 1 and 7 were the top two most impacted (Table 5). The total impacted area (sum of all intersections) is equal to 4727.29m^2 which is equal to 4.73 hectares.

There are 39 intersections between trail buffers and 15 of the old nests (Table 5) (Figure 16). Nest 30 and 34 were the top two most impacted (Table 5). The total impacted area (sum of all intersections) is equal to 20832.75m^2 which is equal to 2.08 hectares.

The most impacted trail for all of the different methods used is Alta Vicente Trail (Table 4). Followed by the unnamed Upper trail and lastly Prickly Pear Trail (Table 4). North and South Spur trail and Nike Trail have no intersections with nest buffers. Intersections with the 2014 nests had the highest impact on Alta Vicente trail for Method 1 Alert Distance (9551.66 m^2) followed by Method 1 Flight Initiation Distance (9393.42 m^2) (Table 4) (Figure 17). Intersections with old nests had a much greater area of intersection for all methods, with Alert Distance Method 1 having the most impacted area on Alta Vicente Trail (23188.89 m^2) followed by Method 1 Flight Initiation Distance (22873.03 m^2) (Table 4) (Figure 18).

Table 4. Table reporting the intersection results between buffered trails and new and old nests for the different Methods by trail area impact.

Nest Age	Distance Used and Analysis Method	Trail Name	Sum on Intersects (meters squared)	Sum on Intersects (hectares)
New	**Alert Distance Method 1**	Alta Vicente Trail	9551.66	0.955166
		Prickly Pear Trail	218.54	0.021854
		Upper Trail (unnamed)	2303.78	0.230378
	Flight Initiation Distance Method 1	Alta Vicente Trail	9393.42	0.939342
		Prickly Pear Trail	195.91	0.019591
		Upper Trail (unnamed)	2247.8	0.22478
	Flight Initiation Distance Method 2	Alta Vicente Trail	2879.86	0.287986
		Upper Trail (unnamed)	654.08	0.065408
Old	**Alert Distance Method 1**	Alta Vicente Trail	23188.89	2.318889
		Prickly Pear Trail	12.038	0.0012038
		Upper Trail (unnamed)	3098.81	0.309881
	Flight Initiation Distance Method 1	Alta Vicente Trail	22873.03	2.287303
		Prickly Pear Trail	13.86	0.001386
		Upper Trail (unnamed)	1377.52	0.137752
	Flight Initiation Distance Method 2	Alta Vicente Trail	12418.59	1.241859
		Upper Trail (unnamed)	860.43	0.086043

Table 5. Table reporting the intersection results between buffered trails and new and old nests for the different Methods

Nest Age	Distance Used and Analysis Method	Nest Name	Sum on Intersects (meters squared)	Sum on Intersects (hectares)
New	Alert Distance Method 1	1	3420.89	0.34
		2	1010.35	0.10
		3	3088.47	0.31
		4	3317.09	0.33
		5	1124.13	0.11
		6	1488.46	0.15
		7	3408.13	0.34
		8	212.68	0.02
		9	218.54	0.02
		Total	**17288.74**	**1.73**
	Flight Initiation Distance Method 1	1	3378.47	0.34
		2	992.71	0.10
		3	3035.77	0.30
		4	3208.09	0.32
		5	994.11	0.10
		6	1377.50	0.14
		7	3361.52	0.34
		8	189.22	0.02
		9	195.91	0.02
		Total	**16733.30**	**1.67**
	Flight Initiation Distance Method 2	1	1912.19	0.19
		2	354.93	0.04
		3	730.37	0.07
		7	1730.30	0.17
		Total	**4727.79**	**0.47**
Old	Alert Distance Method 1	1	1077.83	0.11
		2	977.75	0.10
		3	972.05	0.10
		4	1020.22	0.10
		5	953.85	0.10
		6	1487.49	0.15
		7	1122.57	0.11

Nest Age	Distance Used and Analysis Method	Nest Name	Sum on Intersects (meters squared)	Sum on Intersects (hectares)
Old	Alert Distance Method 1	9	5483.43	0.55
		10	926.88	0.09
		11	3510.10	0.35
		12	3532.69	0.35
		13	3374.98	0.34
		14	821.84	0.08
		15	890.73	0.09
		16	2000.19	0.20
		17	3298.54	0.33
		18	1231.66	0.12
		24	12.04	0.00
		30	4022.36	0.40
		31	3483.32	0.35
		32	2827.91	0.28
		33	3893.93	0.39
		34	6416.96	0.64
		Total	**53339.32**	**5.33**
	Flight Initiation Distance Method 1	1	1041.89	0.10
		2	960.54	0.10
		3	934.58	0.09
		4	890.07	0.09
		5	917.05	0.09
		6	1454.69	0.15
		7	1097.51	0.11
		9	5384.31	0.54
		10	902.47	0.09
		11	3470.25	0.35
		12	3495.63	0.35
		13	3332.10	0.33
		14	729.91	0.07
		15	797.17	0.08
		16	1947.61	0.19
		17	3211.39	0.32
		18	1096.54	0.11

Nest Age	Distance Used and Analysis Method	Nest Name	Sum on Intersects (meters squared)	Sum on Intersects (hectares)
Old	Flight Initiation Distance Method 1	24	2.41	0.00
		30	3982.11	0.40
		31	3431.30	0.34
		32	2787.10	0.28
		33	3854.85	0.39
		34	6342.93	0.63
		Total	**52064.40**	**5.21**
	Flight Initiation Distance Method 2	1	251.79	0.03
		2	277.40	0.03
		6	281.32	0.03
		7	84.49	0.01
		9	1845.69	0.18
		10	90.23	0.01
		11	2072.22	0.21
		12	2225.93	0.22
		13	1878.96	0.19
		17	1760.37	0.18
		30	2534.13	0.25
		31	1674.58	0.17
		32	996.43	0.10
		33	1304.70	0.13
		34	3554.51	0.36
		Total	**20832.75**	**2.08**

Discussion

The average alert distance for Cactus Wren's is 36.67 meters and the average Flight Initiation Distance is 31.03 meters. Method 1 and 2 produced very different estimates of the minimum alert distance and buffer distance. For Method 1 calculations the distance when 95% of Cactus Wren Individuals become alert is 97.36 meters with 95% of individuals fleeing at 96.38 meters, both of these distances are estimates of the minimum approach distance. Fernandez-Juricic et al (2005) stated that "Alert Distance is a more conservative indicator of tolerance than Flight Initiation Distance, because it includes an area (the difference between AD and FID) in which birds may adapt their reaction to the behavior of visitors." In this study there seems to be less than one meter difference between these two measures. This may be due to the direction of all of the approaches, which were tangential (on the trails only) and not direct (Figure 19).

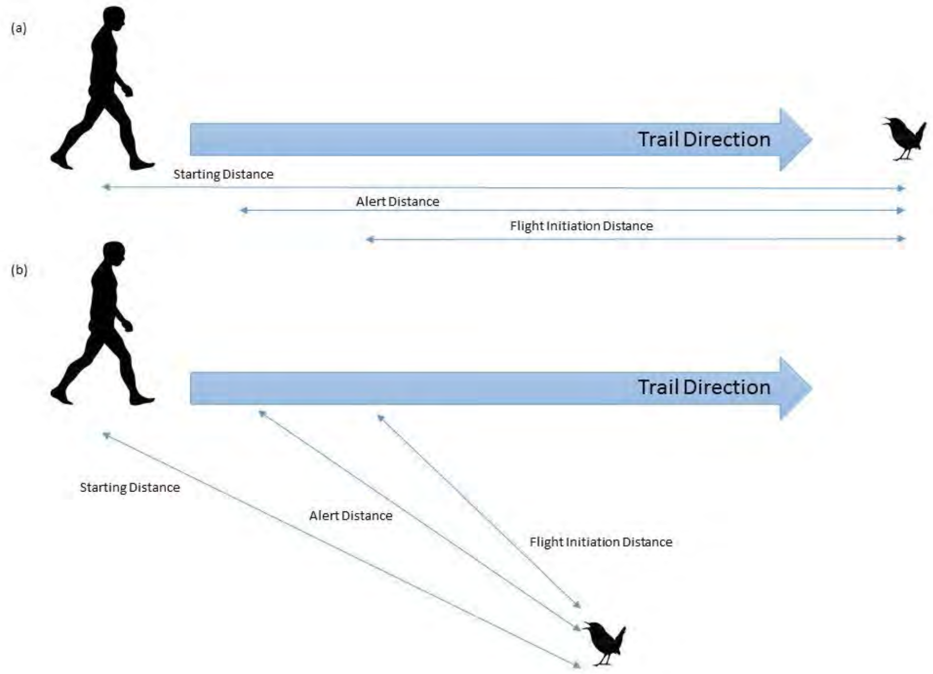

Figure 19. Figure depicting the difference between direct (a) and tangential (b) approaches.

Tangential approaches show a greater Flight Initiation Distance response than direct approaches in four out of five species in Fernandez-Juricic et al's. (2005) study. This might also be supported by previous research that states that species flush at greater distances as the starting distance of the intruder increases (Blumstein, 2003). Therefore, the Cactus Wrens may be flushing sooner to avoid the higher energetic costs of a later flight, even though the tangential approach is a lower risk situation because the predators may not have detected them yet and the rate of approach is slower (Fernandez-Juricic et al., 2005).

In Method 2 calculations the mean Flight Initiation Distance is equal to 41.75 meters, with a minimum approach distance equal to 62.64 meters. This is an interesting result because Method 2 produced a smaller minimum approach distance than Method 1 even though it is stated to be the "most sensitive and the most conservative method for the estimation for the minimum approach distance and buffer areas" (Fernandez-Juricic et al., 2005). The variability in the estimates of MAD may be due to the different assumptions of Method 1 and Method 2 calculations. These differences are very well documented in Fernandez-Juricic et al's., (2005) study, but one explanation maybe that Method 1 was proven to be the "least sensitive method to the difference between tangential and direct approaches."

There was other factors that were investigated that influence the Alert Distance and Flight Initiation Distance of the Cactus Wrens. Alert distance is significantly influenced by the initial behavior of the Cactus Wren (Figure 5), but this is due to small sample sizes for the behaviors of hopping and foraging. When all behaviors were grouped into three categories, there was no significant relationship ($F_{2,24}$= 0.53, p=0.943).

Flight Initiation Distance is positively correlated with wind speed, stating that with higher wind speeds the birds flee sooner (Table R). Flight Initiation Distance is also negatively influenced by initial substrate (Figure 6). Specifically, when the Cactus Wrens were on a Telephone wire (man-made material) they allowed the intruder to approach closer before fleeing. There are several observations for why the Cactus Wrens are allowing for a closer approach when on the Telephone wire. One observation is that the wire is much taller than all of the surrounding vegetation allowing for a vantage point, but the specific location where the Cactus Wren was found on the telephone wire was on the unnamed Upper Trail. This Upper Trail has many switch backs between tall vegetation that maybe obstructing the view of the Cactus Wren, allowing for a closer approach. The second observation is that all of the samples collected when the Cactus Wren was on the telephone wire was from the same individual. This individual, Bird 6, is one of the main culprits for the significant relationship between Flight Initiation Distance and bird individuals (Figure 5). But this relationship could also be due to small sample sizes for two bird individuals (number 4 and 5) and the large sample size from Bird 6. Bird 6 is statistically different than all other birds ($p<0.001$) with a negative relationship with Flight Initiation Distance, meaning that this particular bird allows the intruder to approach closer before fleeing. Bird 6 was always found in the AV01B territory on the unnamed Upper Trail (Figure 2). This trail is not a main trail and is relatively new, possibly making a predator's presence novel and allowing for a closer approach. Although, the Ydenberg and Dill (1986) model predicted that Flight Initiation Distance was variable among individuals within a species. This suggests that with a larger sample size there could be statistical individual differences for Cactus Wrens on the Reserves, more samples per Cactus Wrens and over all will clarify what is truly significant and not an anomaly in this case.

Flight Initiation Distance is also positively correlated with alert distance, stating that at a larger alert distance the birds flee sooner (Table R). This is consistent with previous studies that determined that there was a positive relationship between starting distance of intruder and Flight Initiation Distance (Blumstein, 2003).

The GIS spatial analysis provided some insights into the locations of the buffer areas and locations of high trail encroachment. Alta Vicente Trail had the largest area of 2014 nest buffers and trail intersections for both methods. This could be due to this trail being the major trail on the Alta Vicente Reserve and due to its largest width at almost nine meters. Method 1 Alert Distance has the largest impact area on Alta

Vicente Trail for 2014 nests at 0.96 hectare and for old nests at 2.32 hectare. Method 1 Alert Distance appears to the most conservative when looking at trail impact.

All of the buffer areas show a smaller intersection area for both methods in new nests, because the “new nests” were only determined by the 2014 breeding season, even though Cactus Wrens build rousting nests through-out the year. 2014 nest number 1 and 7 were the most impacted nests for both methods. This is due to their proximity to the trail entrance on Alta Vicente Trail and their proximity to each other in the AV01D territory. Method 2 did produce the largest total impact area for 2014 nests at 4.73 hectare.

The old nest buffers and trail intersections did produce staggeringly high impact areas. Method 1 Alert Distance produced the largest impact area at 5.55 hectare. Nest number 34 was the second most impacted nest for all of the methods used. Nest number 9 was the most impacted for Method 1 and nest 30 was the most impacted for Method 2. These nest locations are also in close proximity to the Alta Vicente Trail head, with the exception of nest 30 which is roughly in the AV03C territory.

Management Implications

Although Flight Initiation Distance research cannot establish whether a species is threatened due to recreation activities, it can provide insights into mechanics underlying human-wildlife interactions by analyzing them with theoretical context of anti-predator behaviors (Blumstein et al., 2010). That said, the major goal of “protected area management is to promote coexistence between wildlife and people” (Fernandez-Juricic et al., 2005). Finding solutions that work together but also preserve the wildlife at risk is not an easy task. One way that managers protect wildlife from human activity is by creating a setback zone using buffers. This study provided the preliminary data for learning about how management can take actions to create setback zones. If management decides to implement and establish the minimum approach distance and buffer zones on the Reserves, it is important to use the precautionary principle and overestimate the recommended buffer areas despite the fact that the effects of human disturbance on this species breeding and survival parameters have not been fully established (Groom et al., 2006).

The GIS spatial analysis provides a visual to where encroachment could displace wildlife at one particular site, Alta Vicente. Understanding more about the local populations will enable more informed decisions about how to preserve the longevity of the Cactus Wren populations. The major advantage to this study is the Python script that was used to calculate the minimal approach distance, buffer areas and create maps that indicate locations of encroachment using two known methods. This script standardized the calculations that will allow for the encroachment trail locations to be analyzed on a yearly basis and to help to establish hot spots throughout time. This study was only conducted during the breeding season of 2014, but Cactus Wrens may vary seasonally in their flight initiation responses warranting a seasonal impact location analysis. Another advantage of the script is that it was built to be used for different species as well, allowing for flexibility in the Reserve management analysis. This will help to make informed decisions for the land management as a whole system, instead of specific for one species. There are some limitations of the script. If the data is not properly organized prior to execution, the script will fail requiring one to start over. Another disadvantage is that there are several entries required by the user, allowing for human error and if incorrect information is entered the script will fail to execute.

Future Directions

Despite several setbacks during this study, the final results produced some great primarily data. Future studies should collect more samples at various locations on the Palos Verdes Peninsula Reserves or collect a more even number of samples per bird. This should allow for a more accurate estimation of the various distances sampled. Other studies have shown that several bird species vary in their Flight Initiation Distances seasonally, this may want to be addressed in a future study. From my experience searching for the Cactus Wrens during the non-breeding season, this will not be an easy task as without the males singing it is hard to locate this species. Another topic to be addressed in future studies is the approach type, direct or tangential and which type of approach the Cactus Wren is more sensitive too.

After several observations of Cactus Wrens fleeing at larger distances when approached with a dog, I researched into the topic and found some very interesting results. According to Lafferty (2001) and Sastre et al., (2009) “unrestrained dogs often move ‘unpredictably’ and harass wildlife,” not promoting habituation by the species. Also, a “high usage of natural areas by dog walkers, their high numbers and mobility, and their high potential to cause disturbance means that in some areas they may represent a high management priority for mitigating disturbance to wildlife” (Le Corre et al., 2009; Underhill-Day and Liley, 2007).

While this topic is another research project in itself and should be researched to determine quantitative results as to the effects of dogs on the Cactus Wren, Bloor (2005) states that “leashing [the dog] reduces the speed, degree of roaming, and chasing and generally decreases response rates and disturbance among wildlife.” The Reserves on the Peninsula all have signs that state that dogs must be leashed on the trail, yet from my observations visitors do not always follow the rules. The “key to the success of restriction is achieving adequate compliance, which can be promoted through the provision of ‘dog-areas’ that allow off-leash exercise for dogs and educational initiatives” (Williams et al., 2009). At the Alta Vicente Reserve there is a fenced ‘dog-area’ for off leash exercises, yet without enforcement, visitors will continue to use the Reserve for their dogs off leash exercises.

Lastly, future modifications to the script will improve its usability. The major modification that should occur is turning the script into an ArcMap tool, making it easier to use. Other modifications should include user input for where the data is organized in the excel sheet which would allow the user to use a different format of data organization. Another modification would be to give the user the choice to directly enter in values for the FID, AD, and mean AD, instead of having the script take the raw data and make its own calculations. The last modification to the script would be to add an area column for each of the intersect files and have it auto-generate allowing the user to preform less repetitive tasks.

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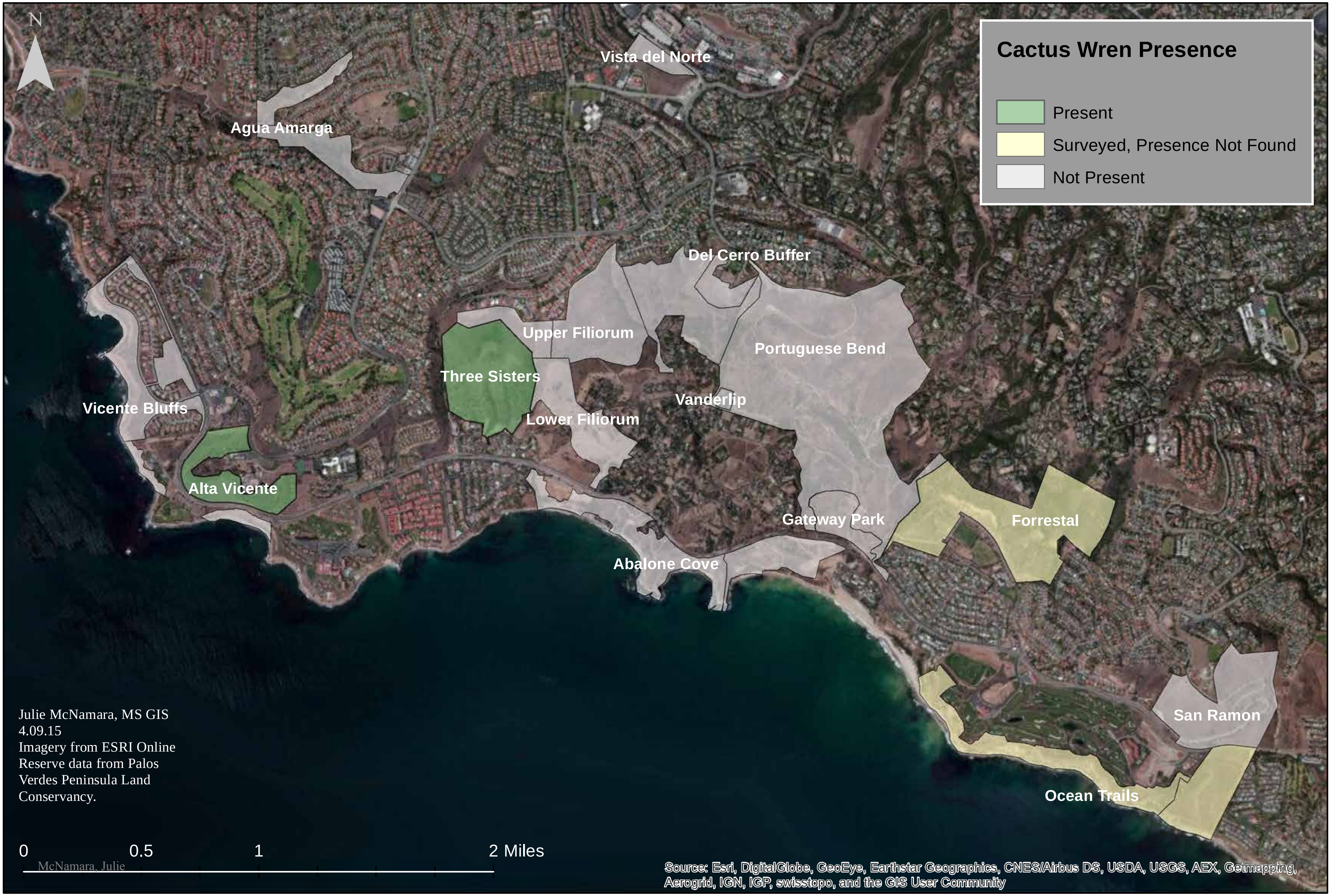
Figures

Figure 1. Map depicting the locations of the two reserves surveyed in this study.

Reserves Surveyed for Cactus Wren Presence

For 2014 Breeding Season, Palos Verdes Peninsula CA



Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Reserve data from Palos Verdes Peninsula Land Conservancy.

McNamara, Julie

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 2. Map depicting the locations of the estimated Cactus Wren territories at Alta Vicente Reserve.

Estimated Cactus Wren Territories for 2014 Breeding Season

Alta Vicente Reserve, Palos Verdes Peninsula CA

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

The estimated Cactus Wren Terriories were derived from the 2014 breeding season Citizens Project that was run by the Palos Verdes Peninsula Land Conservancy.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Figure 3. Scatterplot matrix for relationships between flight initiation distance, alert distance, and distance fled.

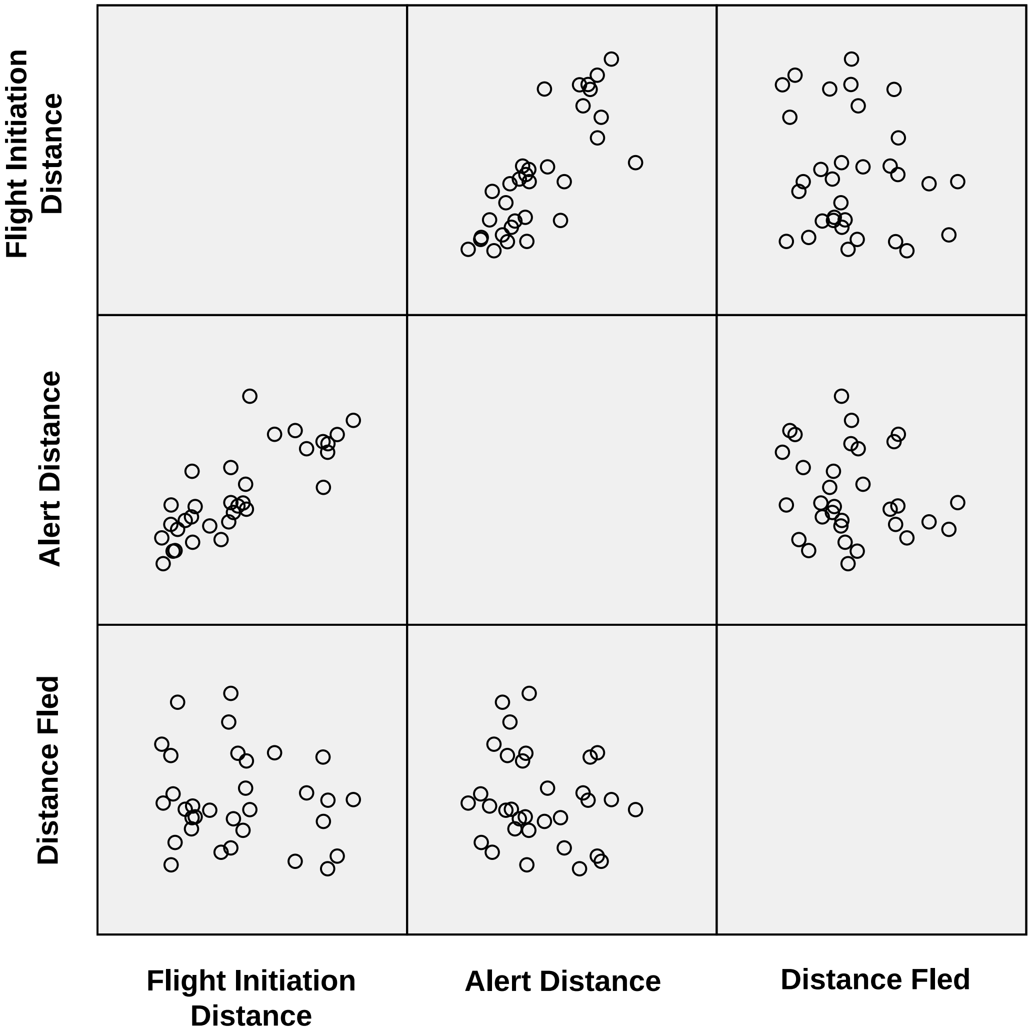

Flight Initiation Distance
Alert Distance
Distance Fled
Flight Initiation Distance
Alert Distance
Distance Fled

Figure 4. Mean bar chart for relationships between flight initiation distance and bird identification. Means that do not share a letter are significantly different (Appendix K1).

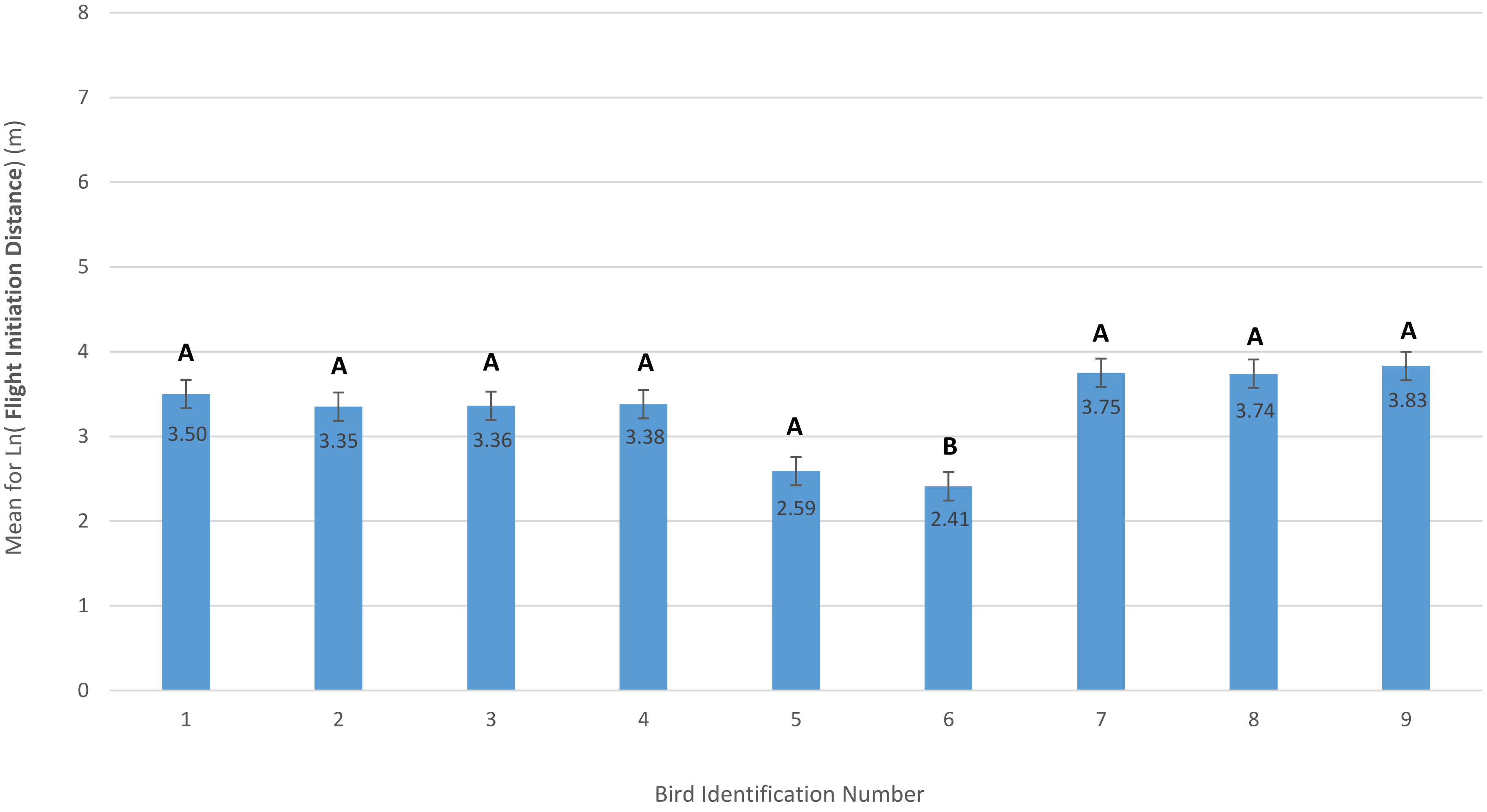

Mean for Ln(**Flight Initiation Distance**) (m)
0
1
2
3
4
5
6
7
8
A
3.50
A
3.35
A
3.36
A
3.38
A
2.59
B
2.41
A
3.75
A
3.74
A
3.83
1
2
3
4
5
6
7
8
9
Bird Identification Number

Figure 5. Mean bar chart for relationships between alert distance and initial behavior. Means that do not share a letter are significantly different (Appendix K2).

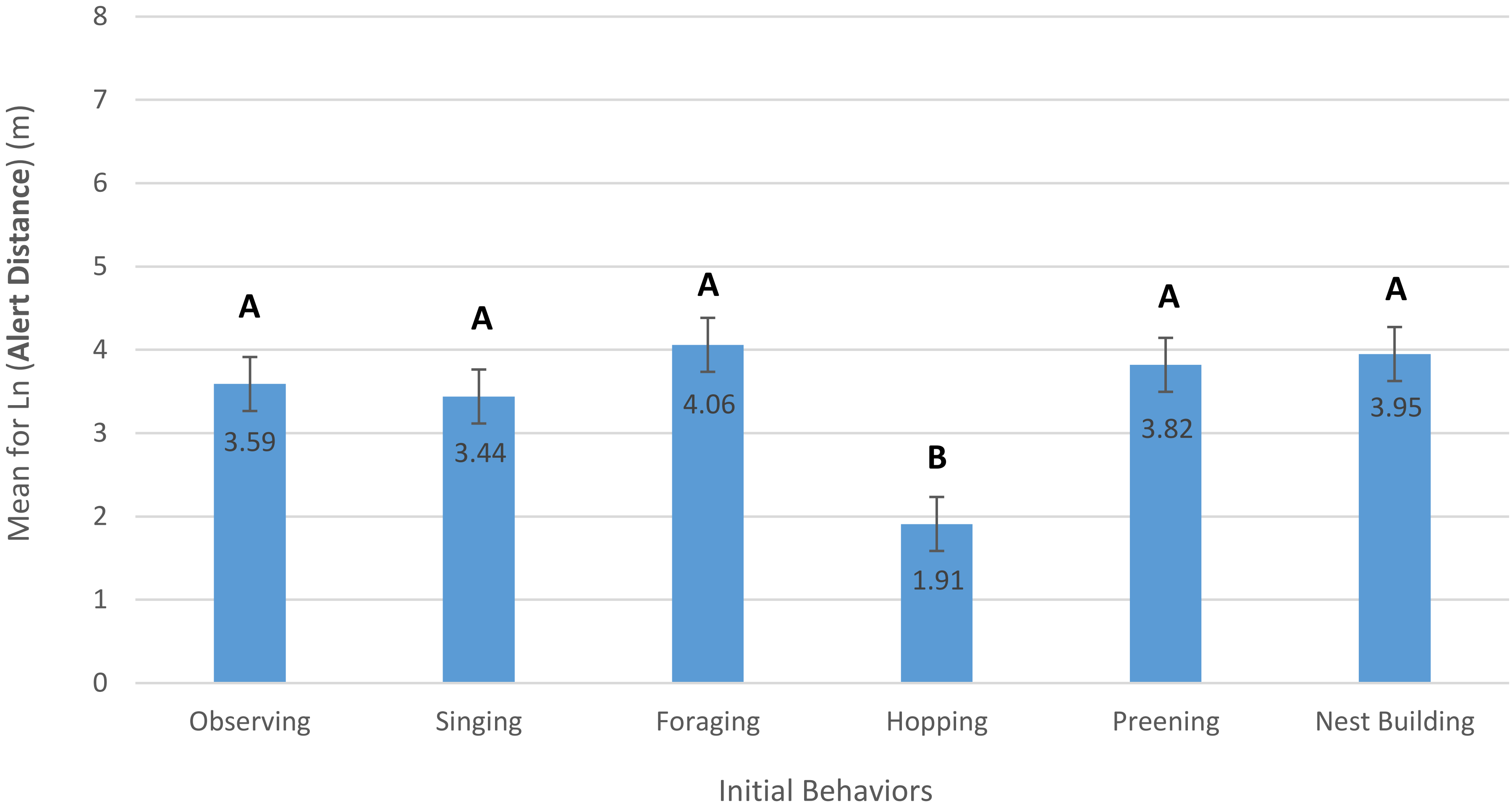

Mean for Ln (Alert Distance) (m)
8
7
6
5
4
3
2
1
0
A
A
A
B
A
A
3.59
3.44
4.06
1.91
3.82
3.95
Observing
Singing
Foraging
Hopping
Preening
Nest Building
Initial Behaviors

Figure 6. Mean bar chart for relationships between flight initiation distance and initial substrate. Means that do not share a letter are significantly different (Appendix K3).

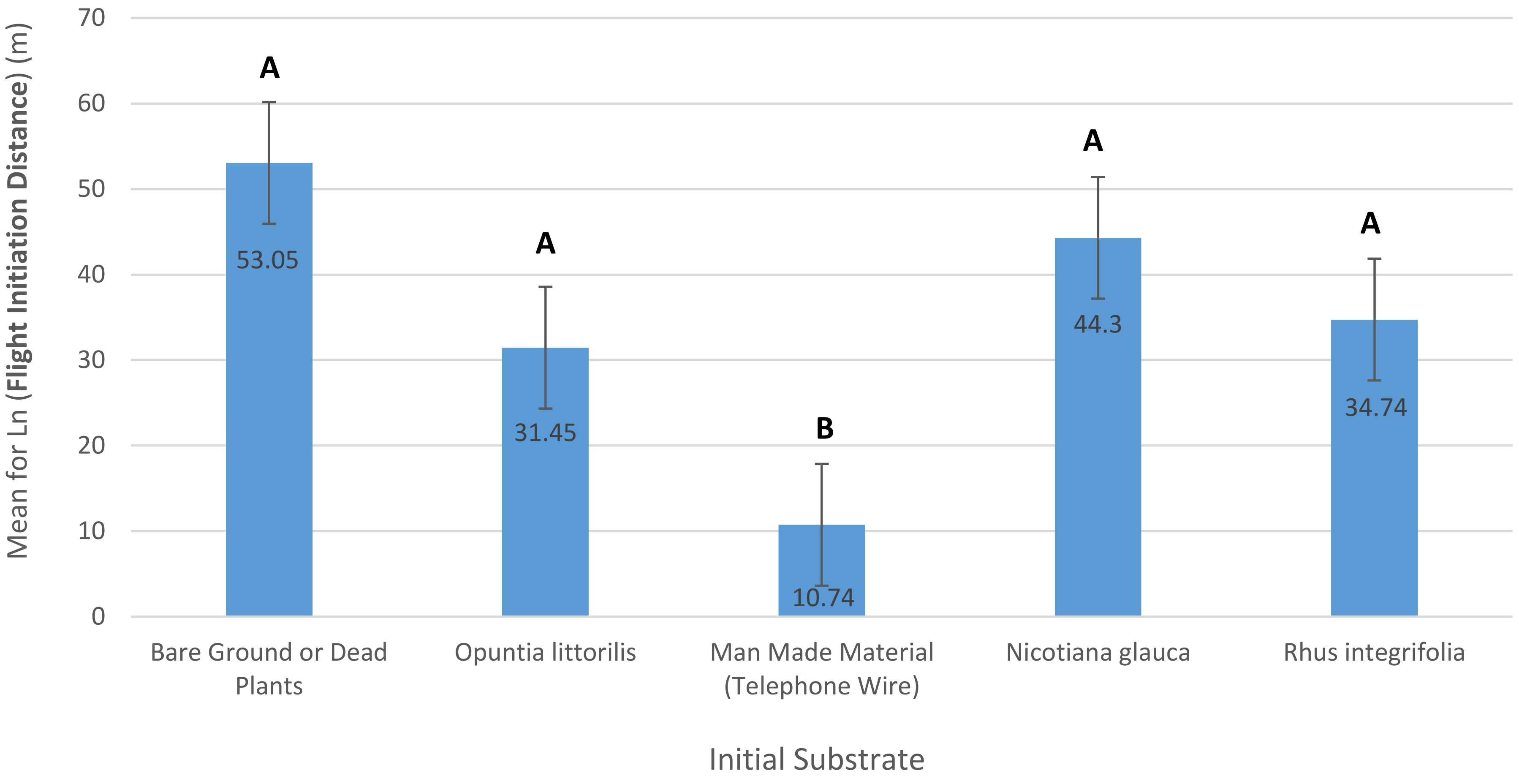

70
60
50
40
30
20
10
0
Mean for Ln (Flight Initiation Distance) (m)
A
53.05
A
31.45
B
10.74
A
44.3
A
34.74
Bare Ground or Dead Plants
Opuntia littorilis
Man Made Material (Telephone Wire)
Nicotiana glauca
Rhus integrifolia
Initial Substrate

Figure 7. Scatterplot matrix for relationships between distances fled, post perch height, post substrate, and post behavior.

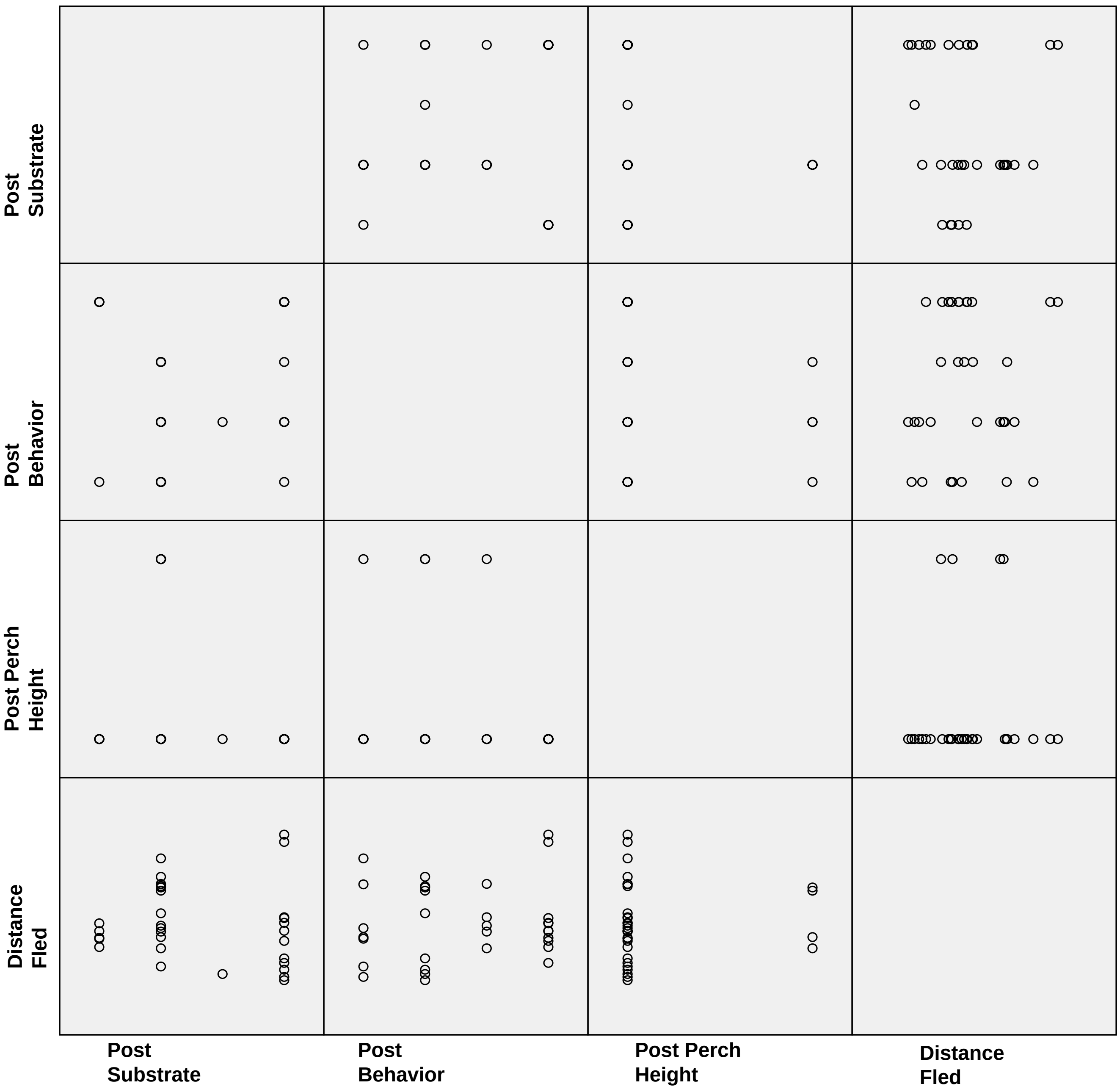
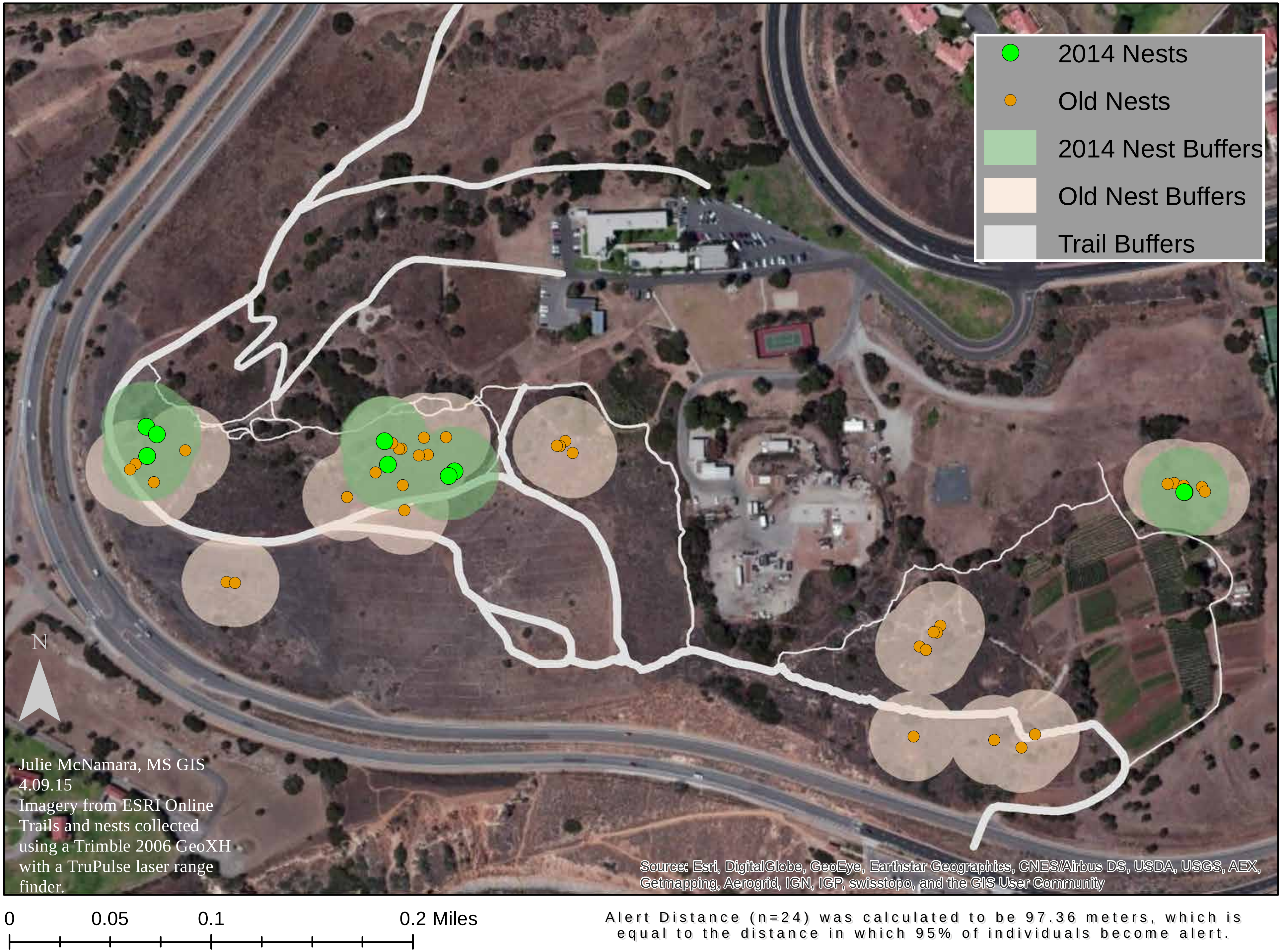

Post Substrate
Post Behavior
Post Perch Height
Distance Fled
Post Substrate
Post Behavior
Post Perch Height
Distance Fled

Figure 8. Map showing nests and trail buffers for Method 1 Alert Distance.

Alert Distance Buffers for Nests Using Method 1

For the Coastal Cactus Wren on the Palos Verdes Peninsula



Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

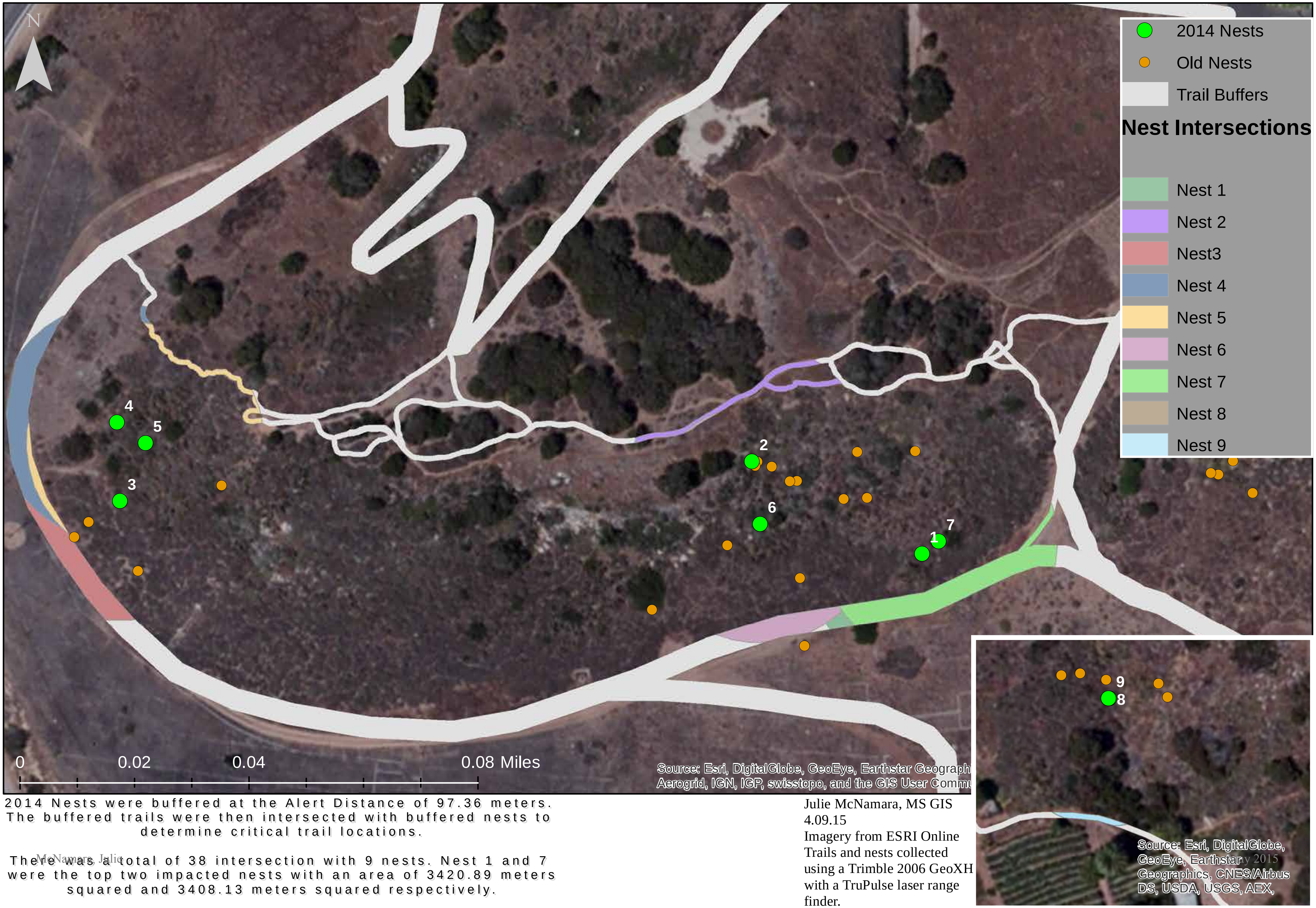
Alert Distance (n=24) was calculated to be 97.36 meters, which is equal to the distance in which 95% of individuals become alert.

The buffer area for each Cactus Wren nest is equal to 29781.36 meters squared or 2.97 hectares.

Figure 9. Method 1 Alert Distance map depicting the intersection areas for trail buffers and 2014 nests.

2014 Cactus Wren Nest and Trail Intersections

Using Method 1 Alert Distance



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geograph
Aerogrid, IGN, IGP, swisstopo, and the GIS User Commu

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX,

2014 Nests were buffered at the Alert Distance of 97.36 meters. The buffered trails were then intersected with buffered nests to determine critical trail locations.

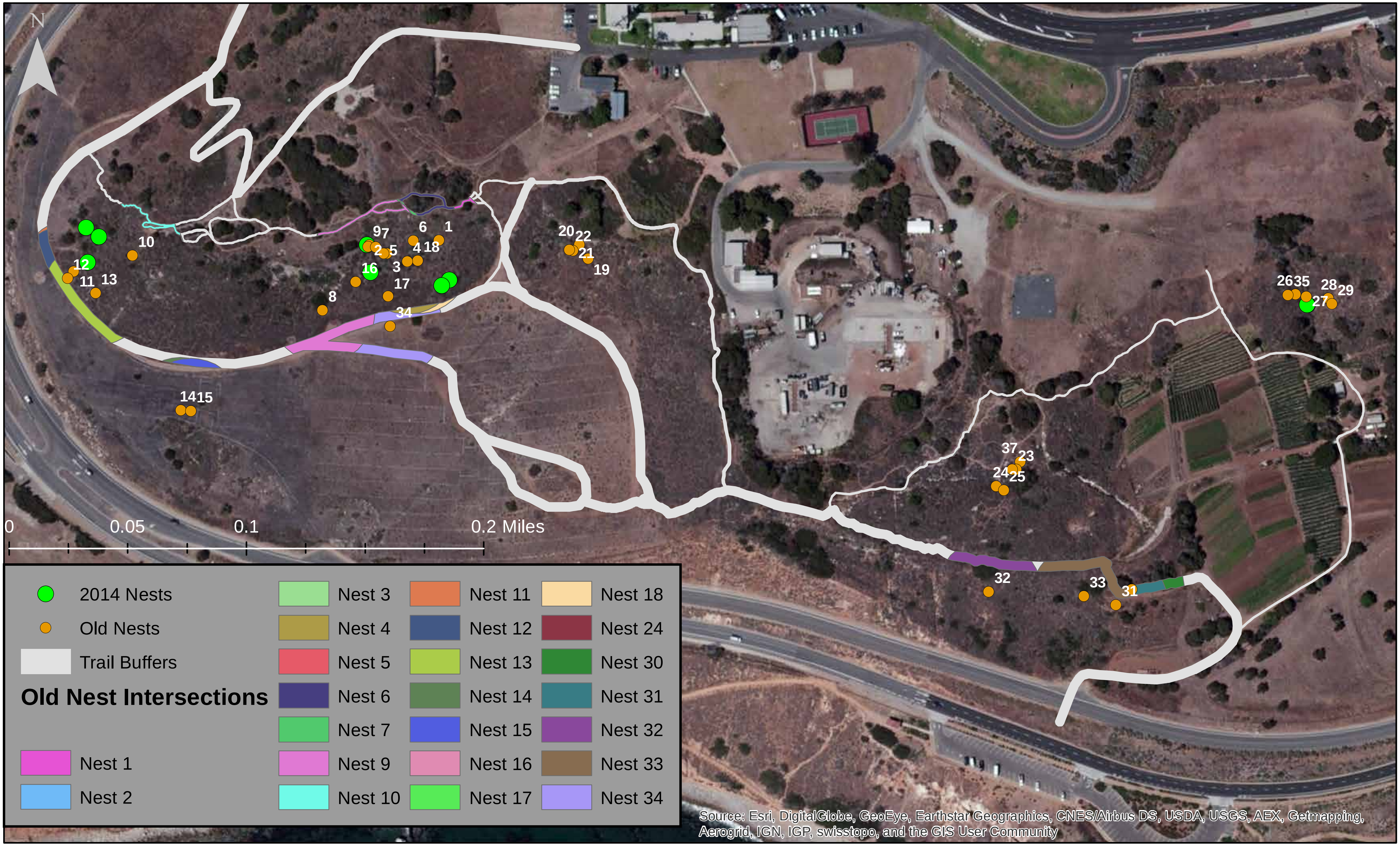
There was a total of 38 intersection with 9 nests. Nest 1 and 7 were the top two impacted nests with an area of 3420.89 meters squared and 3408.13 meters squared respectively.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected
using a Trimble 2006 GeoXH
with a TruPulse laser range
finder.

Figure 10. Method 1 Alert Distance map depicting the intersection areas for trail buffers and old nests.

Old Cactus Wren Nest and Trail Intersections

Using Method 1 Alert Distance



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Old Nests were buffered at the Alert Distance of 97.36 meters. The buffered trails were then intersected with buffered nests to determine critical trail locations.

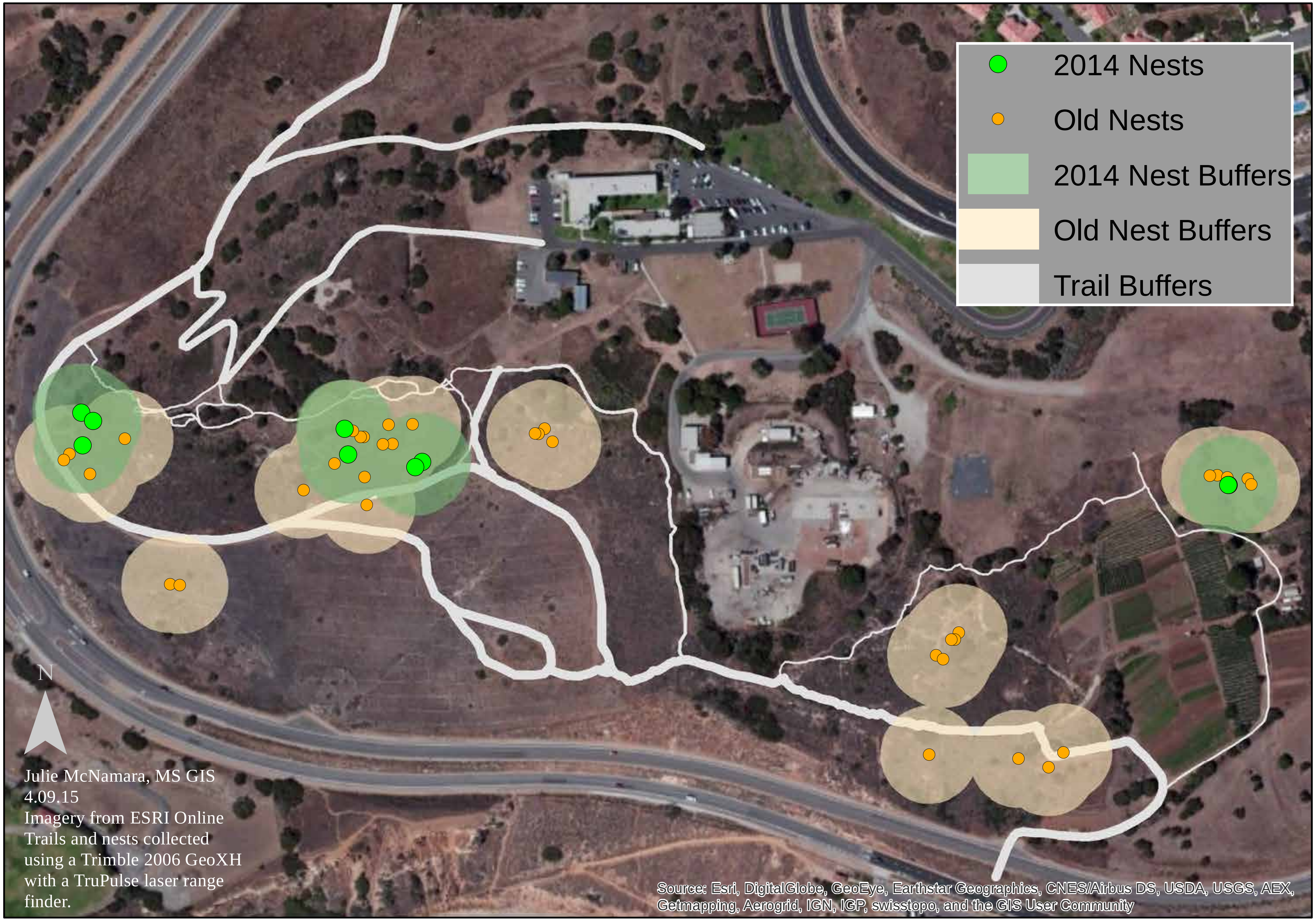
There was a total of 218 intersection with 23 nests. Nest 9 and 34 were the top two impacted nests with an area of 5483.425 meters squared and 6416.95 meters squared respectively.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Figure 11. Map showing nests and trail buffers for Method 1 Flight Initiation Distance.

Flight Initiation Distance Buffers for Nests Using Method 1

For the Coastal Cactus Wren on the Palos Verdes Peninsula



Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

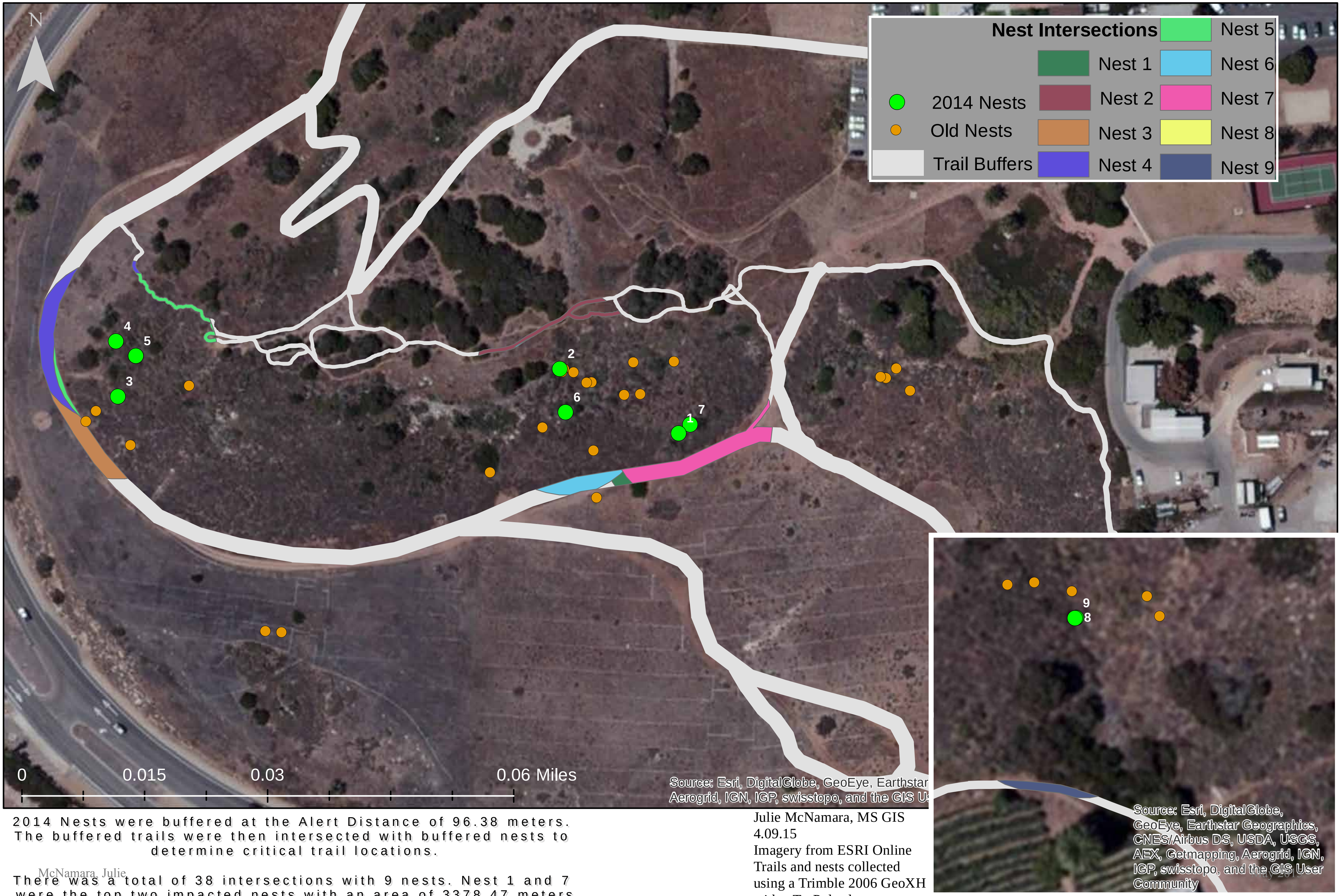
Flight Initiation Distance (n=40) was calculated to be 96.38 meters, which is equal to the distance in which 95% of individuals take flight.

The buffer area for each Cactus Wren nest is equal to 29184.42 meters squared or 2.92 hectares.

Figure 12. Method 1 Flight Initiation Distance map depicting the intersection areas for trail buffers and 2014 nests.

2014 Cactus Wren Nest and Trail Intersections

Using Method 1 Flight Initiation Distance



Source: Esri, DigitalGlobe, GeoEye, Earthstar Aerogrid, IGN, IGP, swisstopo, and the GIS U

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

2014 Nests were buffered at the Alert Distance of 96.38 meters. The buffered trails were then intersected with buffered nests to determine critical trail locations.

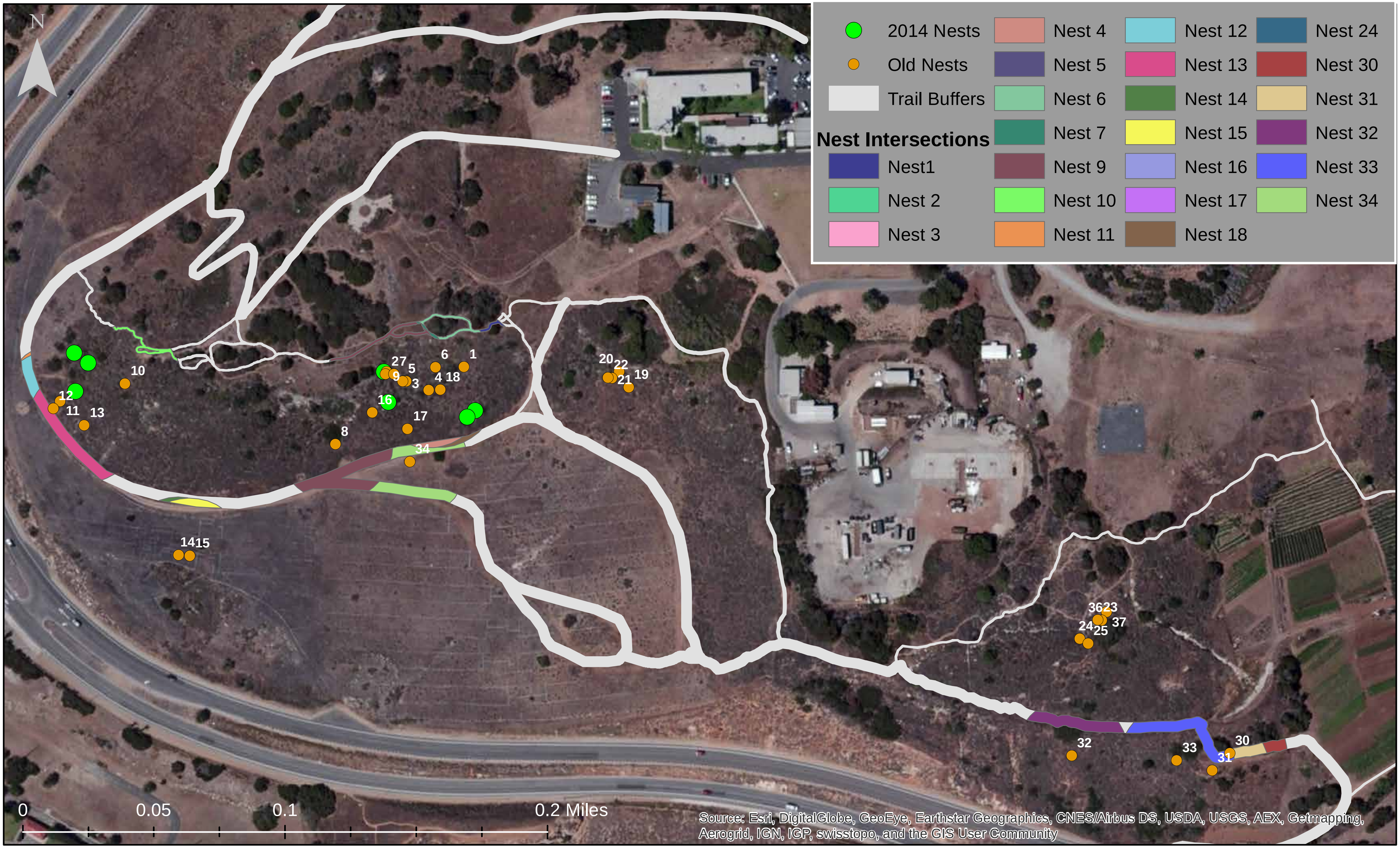
There was a total of 38 intersections with 9 nests. Nest 1 and 7 were the top two impacted nests with an area of 3378.47 meters squared and 3361.52 meters squared respectively.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Figure 13. Method 1 Flight Initiation Distance map depicting the intersection areas for trail buffers and old nests.

Old Cactus Wren Nest and Trail Intersections

Using Method 1 Flight Initiation Distance



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

2014 Nests were buffered at the Alert Distance of 96.38 meters. The buffered trails were then intersected with buffered nests to determine critical trail locations.

There was a total of 233 intersections with 23 nests. Nest 9 and 34 were the top two impacted nests with an area of 5384.30 meters squared and 6342.92 meters squared respectively.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Figure 14. Map showing nests and trail buffers for Method 2 Flight Initiation Distance.

Flight Initiation Distance Buffers for Nests Using Method 2

For the Coastal Cactus Wren on the Palos Verdes Peninsula

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected
using a Trimble 2006 GeoXH
with a TruPulse laser range
finder.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Flight Initiation Distance (n=40) was calculated to be 62.64 meters, which is equal to the distance in which 95% of individuals take flight.

The buffer area for each Cactus Wren nest is equal to 12325.99 meters squared or 1.23 hectares.

Figure 15. Method 2 Flight Initiation Distance map depicting the intersection areas for trail buffers and 2014 nests.

2014 Cactus Wren Nest and Trail Intersections

Using Method 2 Flight Initiation Distance

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

2014 Nests were buffered at the Flight Initiation Distance of 62.64 meters.The buffered trails were then intersected with buffered nests to determine critical trail locations.

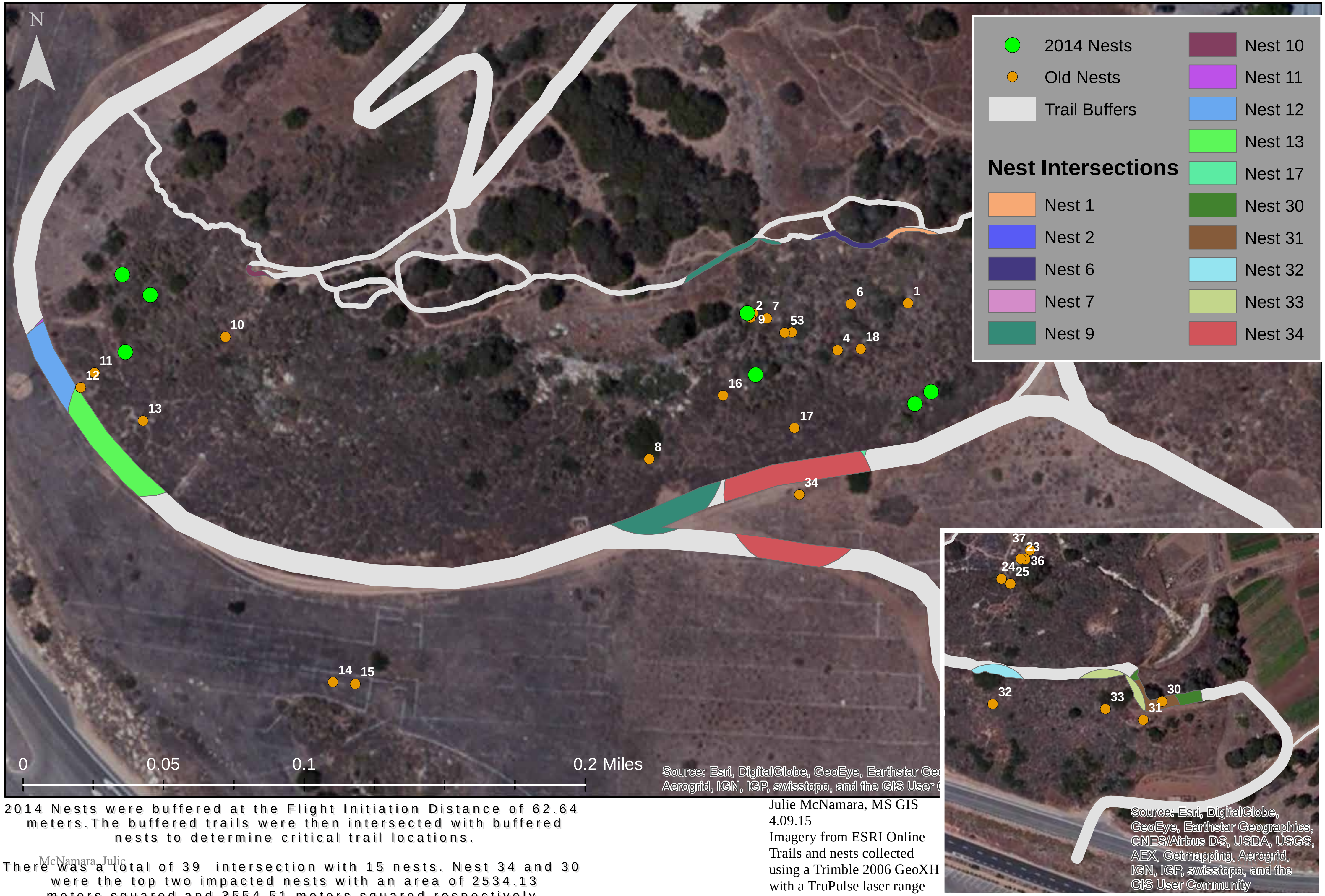
There was a total of 12 intersection with 4 nests. Nest 1 and 7 were the top two impacted nests with an area of 1912.19 meters squared and 1730.3 meters squared respectively.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Figure 16. Method 2 Flight Initiation Distance map depicting the intersection areas for trail buffers and old nests.

Old Cactus Wren Nest and Trail Intersections

Using Method 2 Flight Initiation Distance



Source: Esri, DigitalGlobe, GeoEye, Earthstar Ge
Aerogrid, IGN, IGP, swisstopo, and the GIS User C

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

2014 Nests were buffered at the Flight Initiation Distance of 62.64 meters.The buffered trails were then intersected with buffered nests to determine critical trail locations.

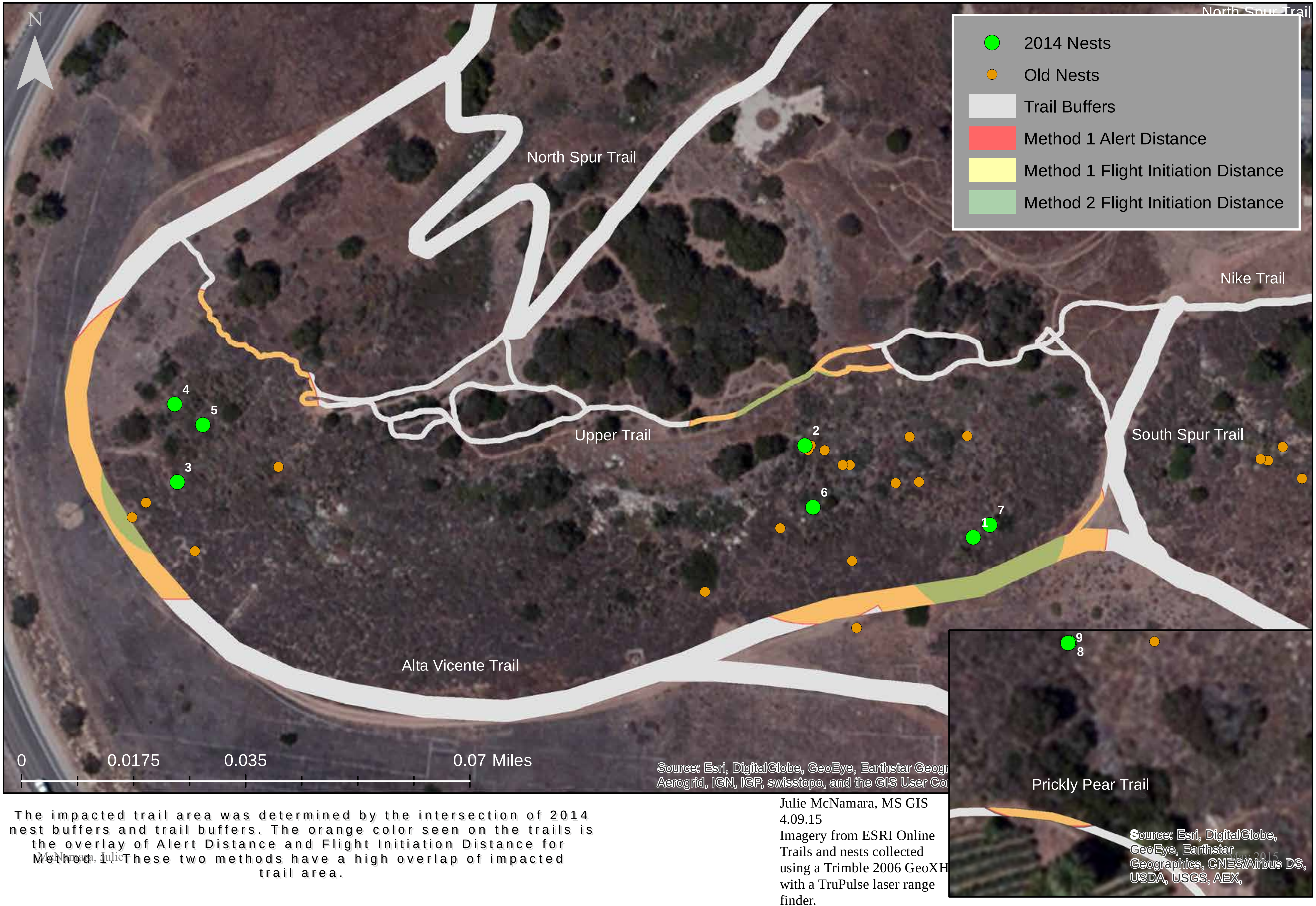
There was a total of 39 intersection with 15 nests. Nest 34 and 30 were the top two impacted nests with an area of 2534.13 meters squared and 3554.51 meters squared respectively.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Figure 17. Map depicting the intersection areas for trail buffers and 2014 nests based off of trail area impacted.

Impacted Trails for 2014 Cactus Wren Nests

Alta Vicente Reserve, Palos Verdes Peninsula CA



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geogr Aerogrid, IGN, IGP, swisstopo, and the GIS User Co

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX,

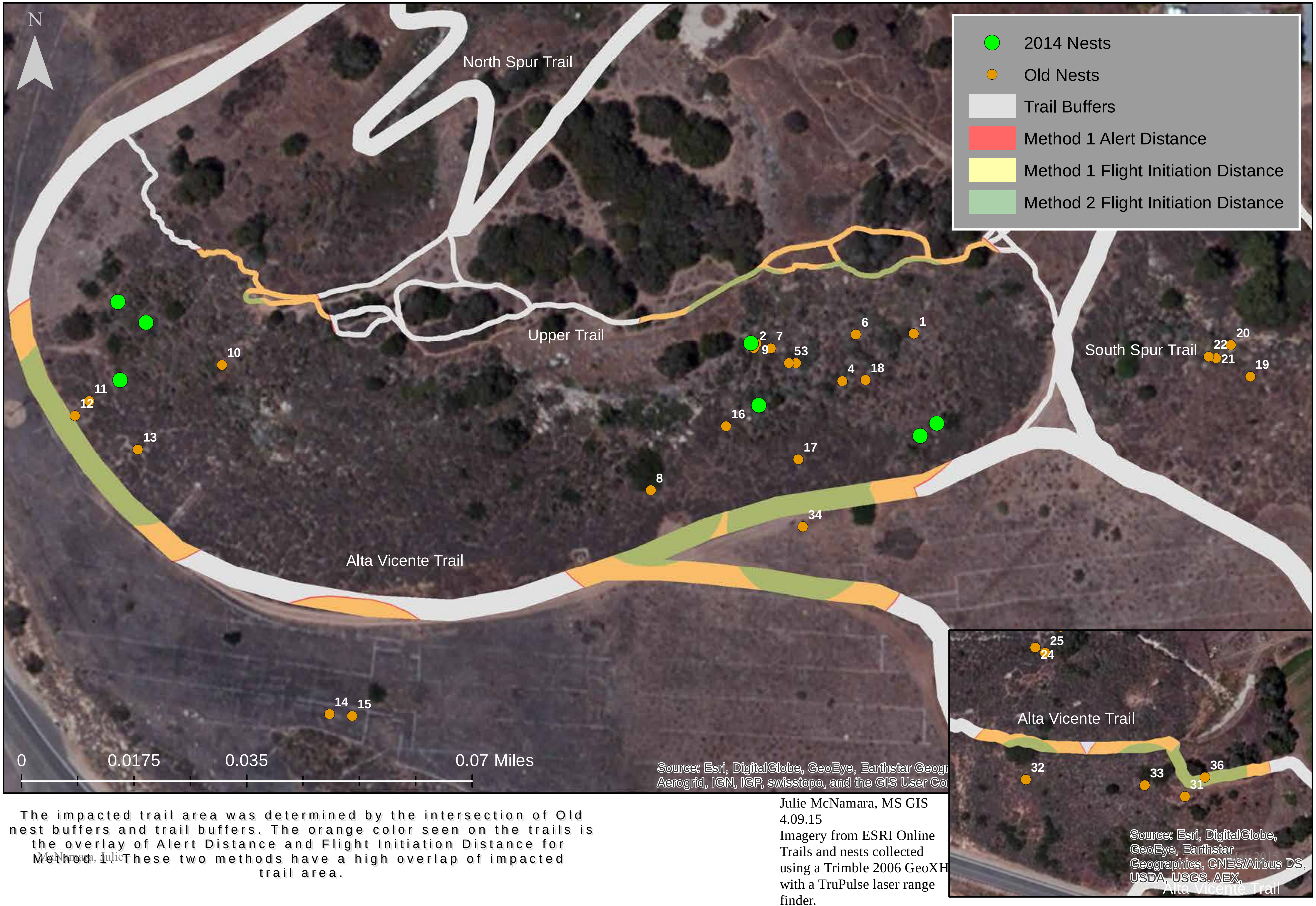
The impacted trail area was determined by the intersection of 2014 nest buffers and trail buffers. The orange color seen on the trails is the overlay of Alert Distance and Flight Initiation Distance for Method 1. These two methods have a high overlap of impacted trail area.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Figure 18. Map depicting the intersection areas for trail buffers and Old nests based off of trail area impacted.

Impacted Trails for Old Cactus Wren Nests

Alta Vicente Reserve, Palos Verdes Peninsula CA



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geogr
Aerogrid, IGN, IGP, swisstopo, and the GIS User Co

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX,

The impacted trail area was determined by the intersection of Old nest buffers and trail buffers. The orange color seen on the trails is the overlay of Alert Distance and Flight Initiation Distance for Method 1. These two methods have a high overlap of impacted trail area.

Julie McNamara, MS GIS
4.09.15
Imagery from ESRI Online
Trails and nests collected using a Trimble 2006 GeoXH with a TruPulse laser range finder.

Appendices

Appendix A. Chart classifying Cactus Wren behaviors associated with approach distances.

Approach	**Behaviors Exhibited by Cactus Wrens**
Starting Distance (SD)	Cactus Wrens are unaware of presence and is partaking in normal activities, such as singing and foraging.
Alert Distance (AD)	Cactus Wren becomes aware of presence. Behaviorally, the Cactus Wren will move it head frequently to observe the human and is actively looking for an escape. It was observed that the Cactus Wren will hop and move body position for fast flee.
Flight Initiation Distance (FID)	Cactus Wren flees from original perch.
Distance Fled (DF)	The distance from the original perch to the perch fled too.

Appendix B. Chart stating units for measured abiotic features.

Abiotic Feature	**Units**
Temperature	Degrees Celsius
Wind Speed	Meters per second
Humidity	Percent

Appendix C. Categorical Variables

C1. Perch heights

Knee height	< 0.5m
Waist height	0.5-1m
Shoulder height	1-1.5m
Over head	>1.5m

C2. Substrates

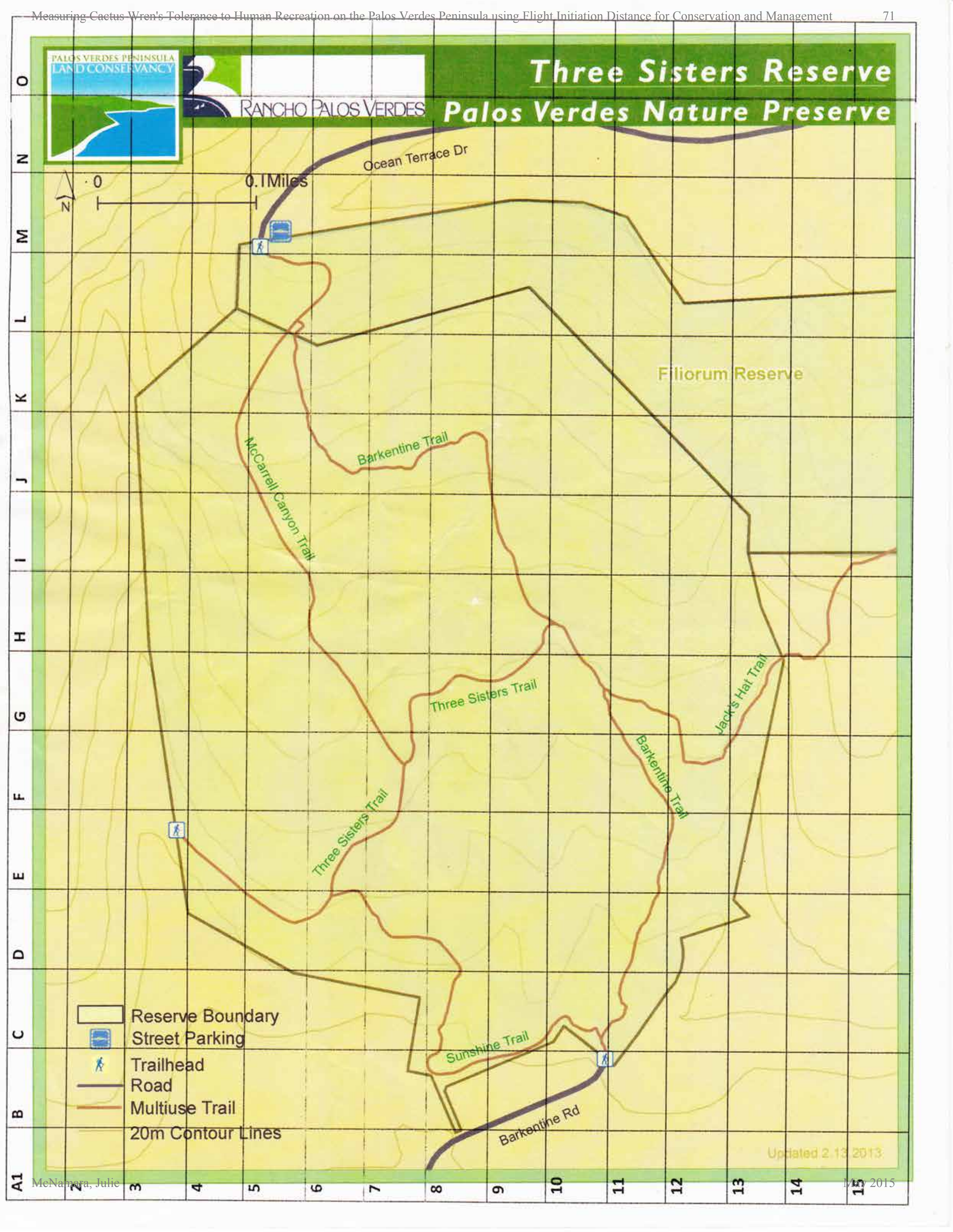
Substrates	**Definition**
ac	**ac** Artemisia californica
bg	**bg** bare ground
cc	**cc** cholla cacti
ec	**ec** Encelia californica
gc	**gc** ground cover
mmm	**mmm** man made material
ol	**ol** Opuntia littorilis
pa	**pa** Peritoma aborea
rk	**rk** rock
ri	**ri** Rhus integrifolia
sa	**sa** Salvia apiana
tt	**tt** tobacco tree
dd	**dd** dead plant
unk	**unk** unknown

C3. Behaviors

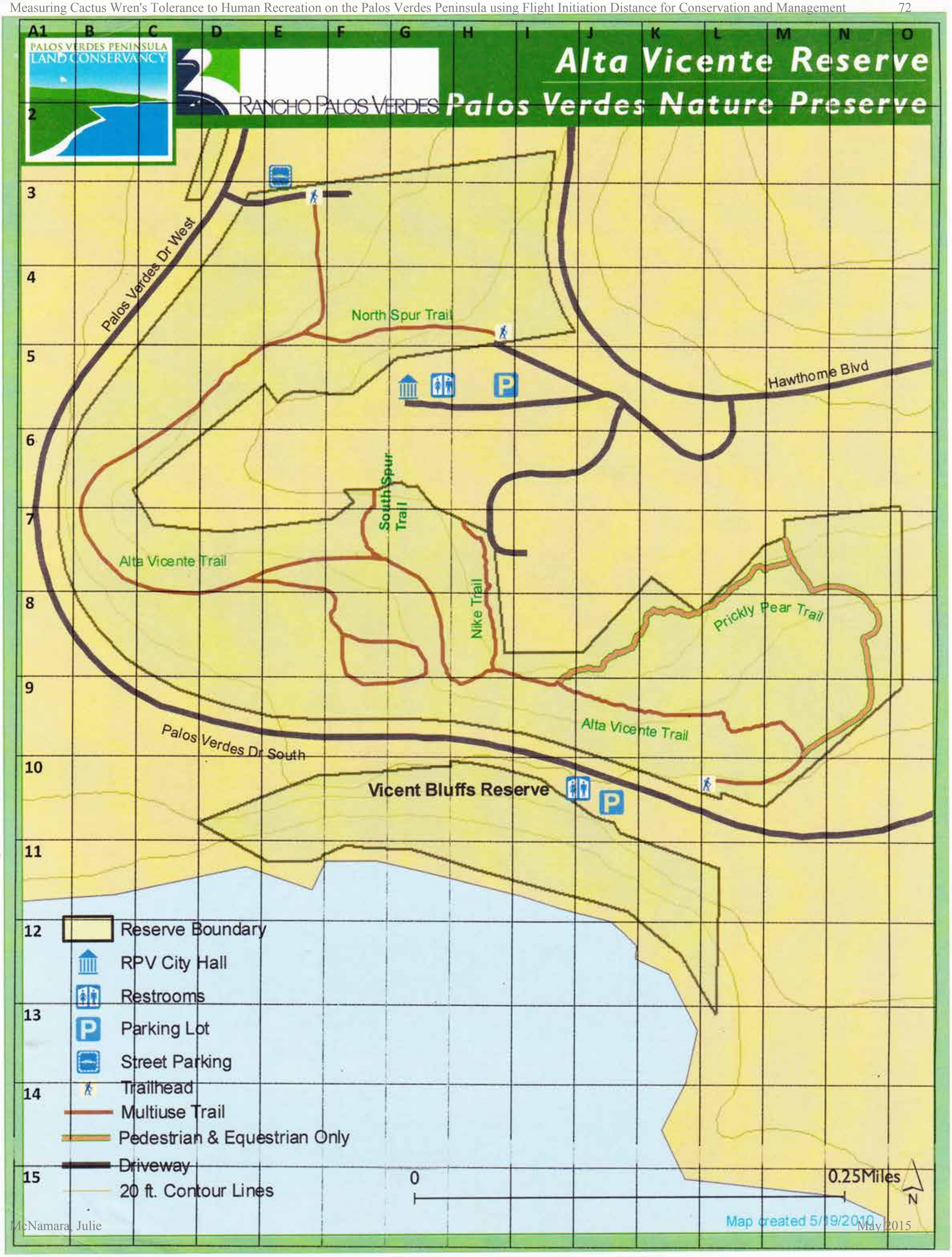
Actions	**Definition**
DB	**DB** dust bathing
DFT	**DFT** defending territorial
F	**F** flight
FIN	**FIN** flight into nest
FON	**FON** flight out of nest
FD	**FD** feeding
FDS	**FDS** feeding self
FDY	**FDY** feeding young
FG	**FG** foraging
H	**H** hopping
M	**M** mating
NB	**NB** nest building
ND	**ND** nest destroying
OBS	**OBS** observing
OF	**OF** overflight
PR	**PR** preening
R	**R** resting
S	**S** singing
SW	**SW** singing warning
BKS	**BKS** beak scraping
TF	**TF** tail fanning

Appendix D. Site map grid classifications.

D1. Three Sisters Reserve



D2. Alta Vicente Reserve



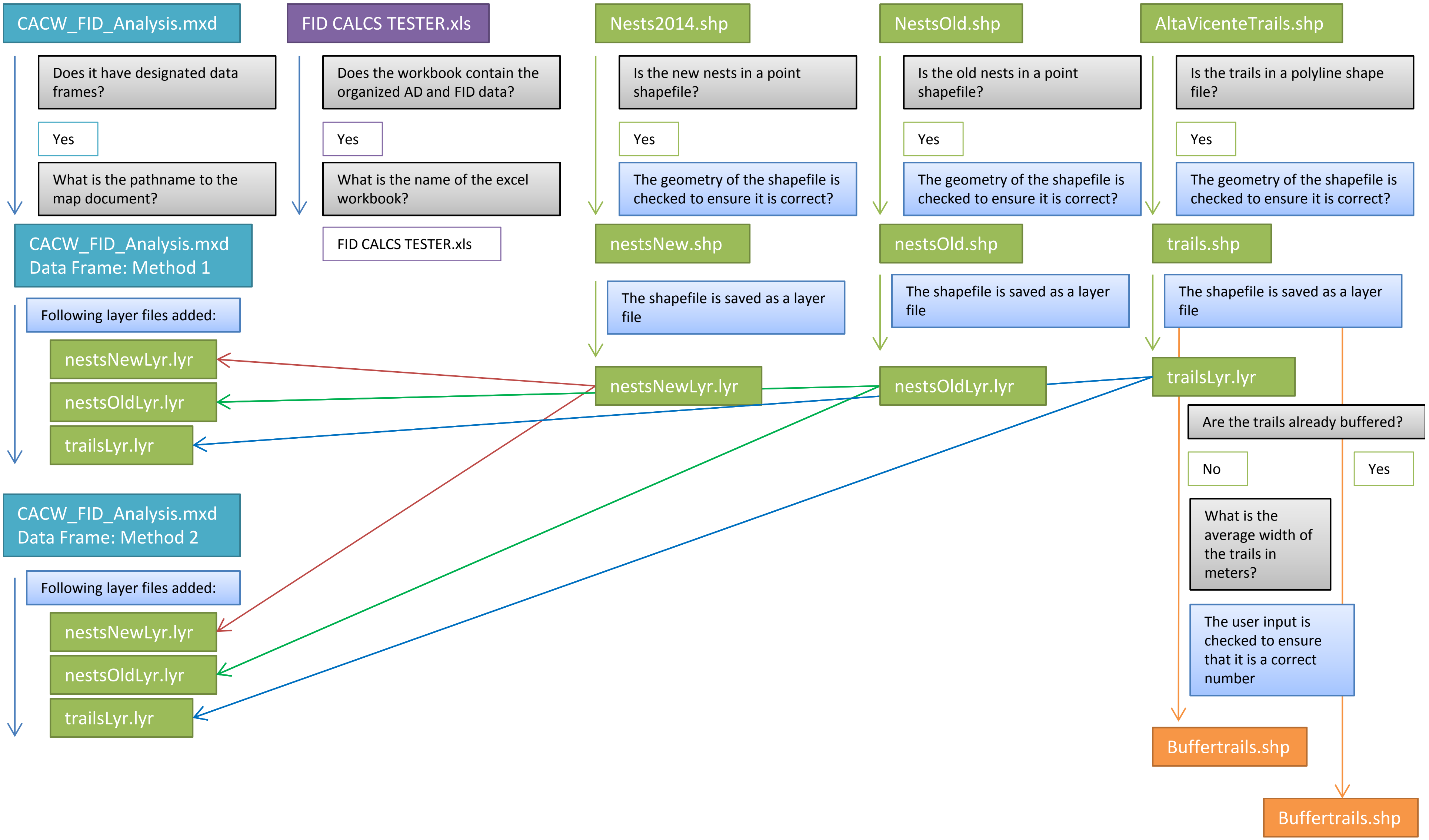
Appendix E. Chart of the number of samples taken per bird.

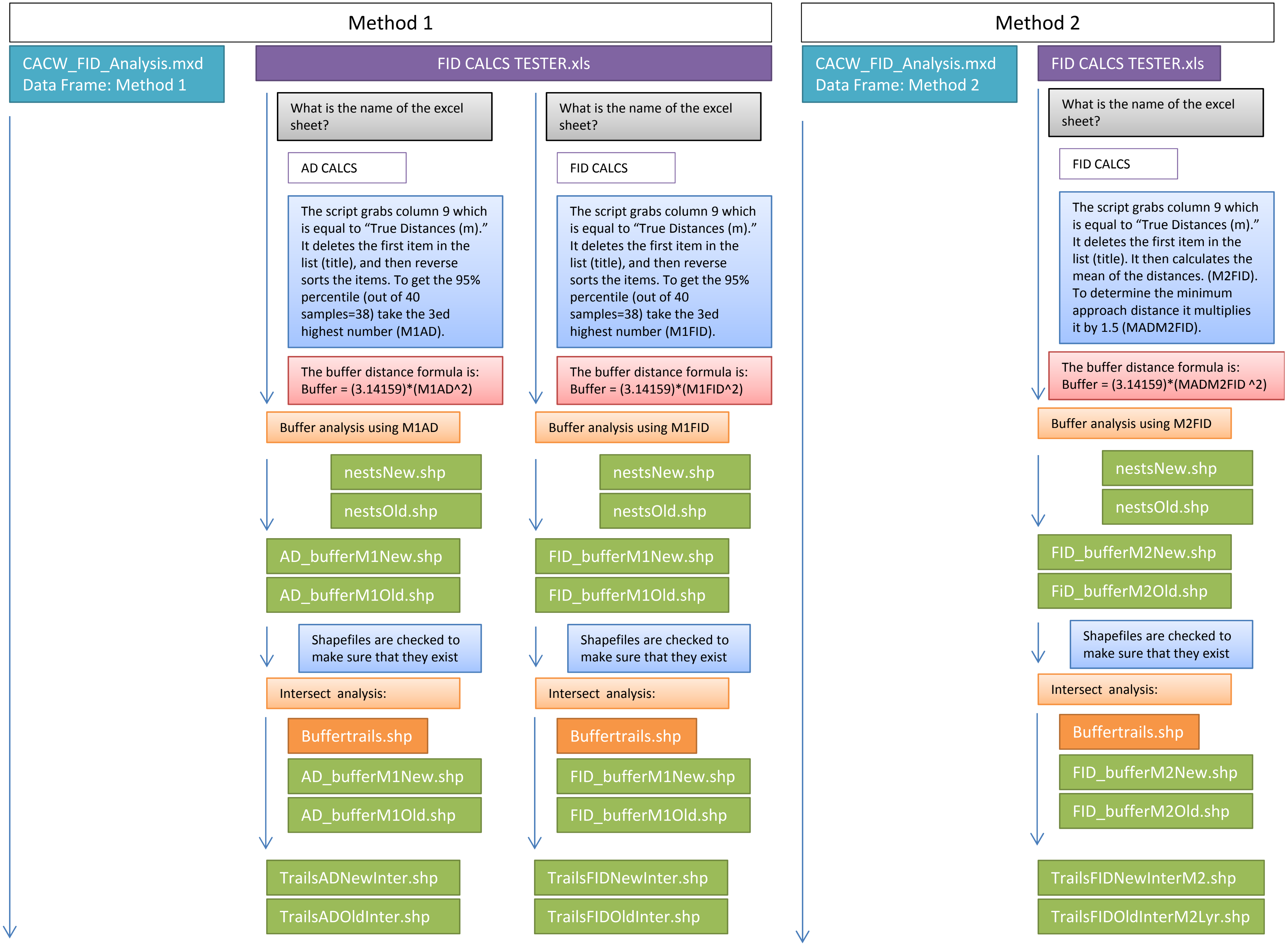
Bird Identification Number	**Number of Samples (n)**	**Site Territory**	**Sex**
1	2	3S01A	Unknown
2	2	3S01A	Female
3	6	3S01A	Male
4	1	3S01B	Female
5	1	3S01B	Male
6	11	AV01B	Male
7	9	AV01D	Unknown
8	2	AV01D	Female
9	6	AV01D	Male

Appendix F. Average width of the trails at Alta Vicente Reserve.

Trail Name	**Average Width (m)**
Prickly Pear Trail	2.199
North Spur Trail	6.683
Alta Vicente Trail	8.922
South Spur Trail	7.672
Nike Trail	3.338
Upper Trail (unnamed)	2.199

Appendix G. Flow Chart depicting how the Critical Trail Locations are calculated.


CACW_FID_Analysis.mxd
Does it have designated data frames?
Yes
What is the pathname to the map document?
CACW_FID_Analysis.mxd Data Frame: Method 1
Following layer files added:
nestsNewLyr.lyr
nestsOldLyr.lyr
trailsLyr.lyr
CACW_FID_Analysis.mxd Data Frame: Method 2
Following layer files added:
nestsNewLyr.lyr
nestsOldLyr.lyr
trailsLyr.lyr
FID CALCS TESTER.xls
Does the workbook contain the organized AD and FID data?
Yes
What is the name of the excel workbook?
FID CALCS TESTER.xls
Nests2014.shp
Is the new nests in a point shapefile?
Yes
The geometry of the shapefile is checked to ensure it is correct?
nestsNew.shp
The shapefile is saved as a layer file
nestsNewLyr.lyr
NestsOld.shp
Is the old nests in a point shapefile?
Yes
The geometry of the shapefile is checked to ensure it is correct?
nestsOld.shp
The shapefile is saved as a layer file
nestsOldLyr.lyr
AltaVicenteTrails.shp
Is the trails in a polyline shape file?
Yes
The geometry of the shapefile is checked to ensure it is correct?
trails.shp
The shapefile is saved as a layer file
trailsLyr.lyr
Are the trails already buffered?
No
Yes
What is the average width of the trails in meters?
The user input is checked to ensure that it is a correct number
Buffertrails.shp
Buffertrails.shp



Method 1

CACW_FID_Analysis.mxd
Data Frame: Method 1

FID CALCS TESTER.xls

What is the name of the excel sheet?

AD CALCS

The script grabs column 9 which is equal to “True Distances (m).” It deletes the first item in the list (title), and then reverse sorts the items. To get the 95% percentile (out of 40 samples=38) take the 3ed highest number (M1AD).

The buffer distance formula is:
Buffer = (3.14159)*(M1AD^2)

Buffer analysis using M1AD

nestsNew.shp
nestsOld.shp

AD_bufferM1New.shp
AD_bufferM1Old.shp

Shapefiles are checked to make sure that they exist

Intersect analysis:

Buffertrails.shp
AD_bufferM1New.shp
AD_bufferM1Old.shp

TrailsADNewInter.shp
TrailsADOldInter.shp

What is the name of the excel sheet?

FID CALCS

The script grabs column 9 which is equal to “True Distances (m).” It deletes the first item in the list (title), and then reverse sorts the items. To get the 95% percentile (out of 40 samples=38) take the 3ed highest number (M1FID).

The buffer distance formula is:
Buffer = (3.14159)*(M1FID^2)

Buffer analysis using M1FID

nestsNew.shp
nestsOld.shp

FID_bufferM1New.shp
FID_bufferM1Old.shp

Shapefiles are checked to make sure that they exist

Intersect analysis:

Buffertrails.shp
FID_bufferM1New.shp
FID_bufferM1Old.shp

TrailsFIDNewInter.shp
TrailsFIDOldInter.shp

Method 2

CACW_FID_Analysis.mxd
Data Frame: Method 2

FID CALCS TESTER.xls

What is the name of the excel sheet?

FID CALCS

The script grabs column 9 which is equal to “True Distances (m).” It deletes the first item in the list (title). It then calculates the mean of the distances. (M2FID). To determine the minimum approach distance it multiplies it by 1.5 (MADM2FID).

The buffer distance formula is:
Buffer = (3.14159)*(MADM2FID ^2)

Buffer analysis using M2FID

nestsNew.shp
nestsOld.shp

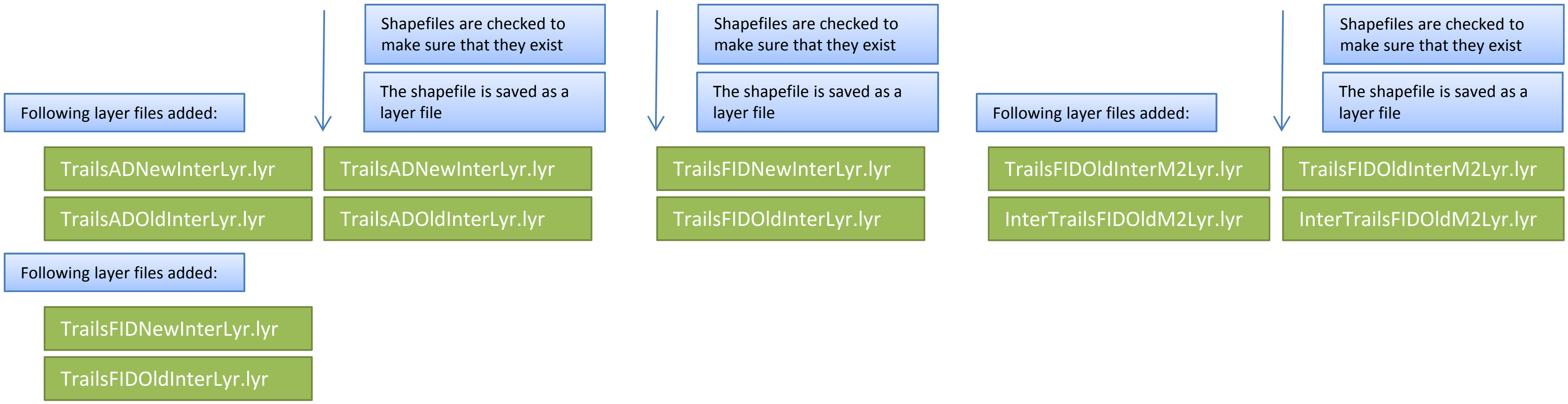
FID_bufferM2New.shp
FiD_bufferM2Old.shp

Shapefiles are checked to make sure that they exist

Intersect analysis:

Buffertrails.shp
FID_bufferM2New.shp
FID_bufferM2Old.shp

TrailsFIDNewInterM2.shp
TrailsFIDOldInterM2Lyr.shp


Following layer files added:
TrailsADNewInterLyr.lyr
TrailsADOldInterLyr.lyr
Following layer files added:
TrailsFIDNewInterLyr.lyr
TrailsFIDOldInterLyr.lyr
Shapefiles are checked to make sure that they exist
The shapefile is saved as a layer file
TrailsADNewInterLyr.lyr
TrailsADOldInterLyr.lyr
Shapefiles are checked to make sure that they exist
The shapefile is saved as a layer file
TrailsFIDNewInterLyr.lyr
TrailsFIDOldInterLyr.lyr
Following layer files added:
TrailsFIDOldInterM2Lyr.lyr
InterTrailsFIDOldM2Lyr.lyr
Shapefiles are checked to make sure that they exist
The shapefile is saved as a layer file
TrailsFIDOldInterM2Lyr.lyr
InterTrailsFIDOldM2Lyr.lyr

Appendix H. Python Script for Calculating Critical Trail Locations

```
#Julie McNamara, MSGISci Graduate
#California State University Long Beach
#04.25.14 Original
#06.14.14 Edited Version
#04.07.15 Updated for PVPLC report
#This code was created to create a map of critical trail locations for the California Cactus Wren
#on the Palos Verdes Peninsula using two different methods of Patch Buffer Area.
#The raw data used in this analysis was collected in 2013-2014 by Julie McNamara.
#Please see associated documentation for how to prepare the data for this script.(TrailCriticalLocationsSOP)
########################################################################################################################

#Set workspace
import arcpy
enviro = raw_input("Where is the data located?")
arcpy.env.workspace= r"enviro"

#allow for overwriting files
arcpy.env.overwriteOutput= True

#import Operating system to manipulate file names
import os
from os.path import basename
from os.path import splitext

#Setting up the location of the Map Document
f= raw_input("Have you created a map document with the designated data frames?")
if f=='y' or f=='ye' or f=='yes':
    mxd= raw_input("What is the pathname to the map document?")
    mapdoc= arcpy.mapping.MapDocument(mxd)

elif f=='n' or f=='no' or f=='nope' or f=='nop':
        print "Please see associated documentation on how to organize the data and associated files to run this script."
        raise SystemExit

else:
        print "Sorry, unable to recognize response. Please see associated documentation on how to organize the data and associated files to run
this script."
        raise SystemExit


#Open up modules that allow you to access the excel data sheet, set workbook name
from xlrd import open_workbook
g= raw_input("Have you created an excel 2007 workbook that contains the organized AD and FID data?")
if g=='y' or g=='ye' or g=='yes':
    wb= open_workbook(raw_input("What is the name of the excel file?"))

elif g=='n' or g=='no' or g=='nope' or g=='nop':
        print "Please see associated documentation on how to organize the data and associated files to run this script."
        raise SystemExit

else:
        print "Sorry, unable to recognize response. Please see associated documentation on how to organize the data and associated files to run
this script."
        raise SystemExit

#Ask questions to ensure that the data is ready to be processed
#get file names and check geometry

a= raw_input("Do you have the locations of New Cactus Wren Nests in a point shapefile?")
if a=='y' or a=='ye' or a=='yes':
    nestsNew = raw_input("What is the name of the point shapefile that contains New Nest Locations?")
    descNew = arcpy.Describe(nestsNew)
    if descNew.shapeType !="Point":
        print "Sorry, the data needs to be in a point shapefile. Please change geometry of file."
        raise SystemExit
```

```
elif a=='n' or a=='no' or a=='nope' or a=='nop':
        print "Please organize the New Nest data into a point shapefile, then rerun script."
        raise SystemExit
else:
        print "Sorry, unable to recognize response. Please respond with a 'Yes' or 'No'."
        raise SystemExit


b= raw_input("Do you have the locations of Old Cactus Wren Nests in a point shapefile?")
if b=='y' or b=='ye' or b=='yes':
    nestsOld = raw_input("What is the name of the point shapefile that contains Old Nest Locations?")
    descOld = arcpy.Describe(nestsOld)
    if descOld.shapeType !="Point":
        print "Sorry, the data needs to be in a point shapefile. Please change geometry."
        raise SystemExit
elif b=='n' or b=='no' or b=='nope' or b=='nop':
    print "Please organize the New Nest data into a point shapefile, then rerun script."
    raise SystemExit

else:
    print "Sorry, unable to recognize response. Please respond with a 'Yes' or 'No'."
    raise SystemExit

#Getting Files for trails that are pre-buffered or doing buffer analysis for trails that are not pre-buffered
m= raw_input("Is the trail data already buffered to the appropriate distances?")
if m=='y' or m=='ye' or m=='yes':
    BufferTrails= raw_input("What is the pathname to the buffer trails shapefile?")
    descNew = arcpy.Describe(BufferTrails)
    if descNew.shapeType !="Polygon":
        print "Sorry, the data needs to be in a polygon shapefile. Please change geometry of file."
        raise SystemExit
    else:
        #Save pre-buffered file as a layer file--> see below for more information on how to do that!
        BufferTrailsLyrName = basename(BufferTrails)
        BufferTrailsLyrBase= splitext(BufferTrailsLyrName)[0]
        BufferTrailsLyrIN= BufferTrailsLyrBase + "Lyr"
        BufferTrailsLyr= BufferTrailsLyrIN +".lyr"
        out_BufferTrails= BufferTrailsLyrIN
        arcpy.MakeFeatureLayer_management(BufferTrails,BufferTrailsLyrIN)
        arcpy.SaveToLayerFile_management(BufferTrailsLyrIN,BufferTrailsLyr,"RELATIVE")

elif m=='n' or m=='no' or m=='nope' or m=='nop':
        trails = raw_input("What is the name of the polyline shapefile that contains the non-buffered Trail Locations?")
        descTrails = arcpy.Describe(trails)
        if descTrails.shapeType !="Polyline":
            print "Sorry, the data needs to be in a polyline shapefile. Please change geometry."
            raise SystemExit

        else:
            BufferTrails = enviro + "\BufferTrails.shp"

            trailDis= int(raw_input("What is the average width of the trails in meters?"))
            if trailDis < 0.5:
                print "Sorry this is an invalid number."
                raise SystemExit

            #syntax= input, output name, distance
            BufferTrails= arcpy.Buffer_analysis(trails,BufferTrails,trailDis)

            #Save pre-buffered file as a layer file--> see below for more information on how to do that!
            trailsLyrName = basename(trails)
            trailsLyrBase= splitext(trailsLyrName)[0]
            trailsLyrIN= trailsLyrBase + "Lyr"
            trailsLyr= trailsLyrIN +".lyr"
            out_trails= trailsLyrIN
            arcpy.MakeFeatureLayer_management(trails,trailsLyrIN)
```

```
        arcpy.SaveToLayerFile_management(trailsLyrIN,trailsLyr,"RELATIVE")

else:
    print "Sorry, unable to recognize response. Please respond with a 'Yes' or 'No'."
    raise SystemExit

####################################################################################################

#Save files that will be used in all analyses as layer files
#Syntax for saving files as layerfiles:
#MakeFeatureLayer_management(in_features, out_layer0, where_clause, workspace)
#SaveToLayerFile_management(in_layer, out_layer, "ABSOLUTE")

#(in_features) are equal to above files: nestsNew, nestsOld, trails

#Set Local Variable to be able to save as layer files(in_layers):
#in order to use the users input for the path names there is ...Name (basename from user),
#...base(basename minus extension), and then ...IN (in_layer)

nestsNewLyrName = basename(nestsNew)
nestsNewLyrBase= splitext(nestsNewLyrName)[0]
nestsNewLyrIN= nestsNewLyrBase + "Lyr"

nestsOldLyrName = basename(nestsOld)
nestsOldLyrBase= splitext(nestsOldLyrName)[0]
nestsOldLyrIN= nestsOldLyrBase + "Lyr"


#Save as layer file to access later(Out_layers)

nestsNewLyr= nestsNewLyrIN +".lyr"
nestsOldLyr= nestsOldLyrIN +".lyr"

#Use intermedate Layer (out_layer0)

out_NestNew= nestsNewLyrIN
out_NestOld= nestsOldLyrIN

#Actually Save Layers

arcpy.MakeFeatureLayer_management(nestsNew,out_NestNew)
arcpy.SaveToLayerFile_management(nestsNewLyrIN,nestsNewLyr,"RELATIVE")

arcpy.MakeFeatureLayer_management(nestsOld,nestsOldLyrIN)
arcpy.SaveToLayerFile_management(nestsOldLyrIN,nestsOldLyr,"RELATIVE")


############################Method 1 files###########################################################
#Setting up the location of the Map Document

j= int(raw_input("What is the data frame number for Method 1 Analysis?"))

#set the data frame for mapping
df= arcpy.mapping.ListDataFrames(mapdoc)[j]

#Add layer files to map
#...Path = pathname to layerfile, ...Lyr = finding layer to add to map, then add layer to map.

Nests2014LyrPath= os.path.basename(nestsNewLyr)
Nests2014Lyr =arcpy.mapping.Layer(Nests2014LyrPath)
arcpy.mapping.AddLayer(df,Nests2014Lyr)

NestsOldLyrPath= os.path.basename(nestsOldLyr)
NestsOldLyr =arcpy.mapping.Layer(NestsOldLyrPath)
arcpy.mapping.AddLayer(df,NestsOldLyr)
```

```
if arcpy.Exists(BufferTrailsLyr):
    BufferTrailsAVPLyrPath= os.path.basename(BufferTrailsLyr)
    BufferTrailsAVPLyr =arcpy.mapping.Layer(BufferTrailsAVPLyrPath)
    arcpy.mapping.AddLayer(df,BufferTrailsAVPLyr)
else:
    arcpy.Exists(trailsLyr)
    TrailsAVPLyrPath= os.path.basename(trailsLyr)
    TrailsAVPLyr =arcpy.mapping.Layer(TrailsAVPLyrPath)
    arcpy.mapping.AddLayer(df,TrailsAVPLyr)


#Method 1 AD files###############################################################################################
#Buffer shapefiles- these have not been created yet but this will be their pathname

AD_bufferM1New = enviro +"\AD_bufferM1New.shp"
AD_bufferM1Old = enviro +"\AD_bufferM1Old.shp"

#Intersect shapefiles to allow for saving as layerfiles
#(in_features)-these have not been created yet but this will be their pathname

TrlADNewInter = enviro +"\TrlADNewInter.shp"
TrlADOldInter = enviro +"\TrlADOldInter.shp"

#Set Local Variable to be able to save as layer files(in_layers):
#in order to use the users input for the path names there is ...Name (basename from user),
#...base(basename minus extension), and then ...IN (in_layer)

TrailsADNewInterINName = basename(TrlADNewInter)
TrailsADNewInterINBase= splitext(TrailsADNewInterINName)[0]
TrailsADNewInterIN= TrailsADNewInterINBase + "Lyr"

TrailsADOldInterINName = basename(TrlADOldInter)
TrailsADOldInterINBase= splitext(TrailsADOldInterINName)[0]
TrailsADOldInterIN= TrailsADOldInterINBase + "Lyr"

#Save as layer file to access later(Out_layers)
TrailsADNewInterLyr= TrailsADNewInterIN+".lyr"
TrailsADOldInterLyr= TrailsADOldInterIN+".lyr"

#Use intermedate Layer (out_layer0)
out_TrailsADNewInter= TrailsADNewInterIN
out_TrailsADOldInter= TrailsADOldInterIN



#######Method 1 Analysis: Alert Distance##############################################################################
print "Method 1 Analysis: Alert Distance"

sheetAD= wb.sheet_by_name('AD CALCS')
AD= sheetAD.col_values(9)
#Column 9 is the True Distance calculated out in meters
del AD[0]
#you have to delete the first item in the list because it is the title of the column
AD.sort(reverse= True)
M1AD = AD[1]
print "The distance in which 95% of individuals are alert is equal to ", M1AD, " meters."
#to determine at which point 95% of individuals are alert/flee at you need to figure out what the 95% percentile is based on the
#number of samples you have. In my case I had 24 samples, 95% of that is 23, therefore I am able to reverse my list and
#determine that the 2nd item in my  list is the correct distance.
bufferM1AD= (3.14159)*(pow(M1AD,2))
#to create the buffer distance we use the radius of a circle formula.
print "The Buffer distance for Cactus Wrens being alert is equal to ", bufferM1AD, " meters squared."
#Buffer analysis for nests new:
#syntax= input, output name, distance
ADbuffNew= arcpy.Buffer_analysis(nestsNew,AD_bufferM1New,M1AD)
```

```
#Save pre-buffered file as a layer file
#This was added 4/5/15 by JM
ADbuffNew1 = enviro +"\AD_bufferM1New.shp"
ADbuffNew1LyrName = basename(ADbuffNew1)
ADbuffNew1LyrBase= splitext(ADbuffNew1LyrName)[0]
ADbuffNew1LyrIN= ADbuffNew1LyrBase + "Lyr"
ADbuffNew1Lyr= ADbuffNew1LyrIN +".lyr"
out_ADbuffNew1= ADbuffNew1LyrIN
arcpy.MakeFeatureLayer_management(ADbuffNew1,ADbuffNew1LyrIN)
arcpy.SaveToLayerFile_management(ADbuffNew1LyrIN,ADbuffNew1Lyr,"RELATIVE")

# The script below goes back to make sure that the analysis actually worked.
if arcpy.Exists(ADbuffNew):
   print "The AD Buffer analysis was complete for New Nests!"

else:
   print "The analysis was not completed, check input features."
   raise SystemExit


# Intersect analysis with the trails shapefile to determine overlap
#Syntax: Intersect_analysis (in_features, out_feature_class)
arcpy.Intersect_analysis([BufferTrails,ADbuffNew],TrlADNewInter)
if arcpy.Exists(TrlADNewInter):
   print "The Intersect analysis between Alert Distance (New Nests) and Trails was completed!"
else:
   print "The analysis was not completed, check input features."
   raise SystemExit

#save intersect as layer file
arcpy.MakeFeatureLayer_management(TrlADNewInter,out_TrailsADNewInter)
arcpy.SaveToLayerFile_management(TrailsADNewInterIN,TrailsADNewInterLyr,"RELATIVE")

#Buffer analysis for nests old:
ADbuffOld= arcpy.Buffer_analysis(nestsOld,AD_bufferM1Old,M1AD)

#Save pre-buffered file as a layer file
#This was added 4/5/15 by JM
ADbuffOld1 = enviro +"\AD_bufferM1Old.shp"
ADbuffOld1LyrName = basename(ADbuffOld1)
ADbuffOld1LyrBase= splitext(ADbuffOld1LyrName)[0]
ADbuffOld1LyrIN= ADbuffOld1LyrBase + "Lyr"
ADbuffOld1Lyr= ADbuffOld1LyrIN +".lyr"
out_ADbuffOld1= ADbuffOld1LyrIN
arcpy.MakeFeatureLayer_management(ADbuffOld1,ADbuffOld1LyrIN)
arcpy.SaveToLayerFile_management(ADbuffOld1LyrIN,ADbuffOld1Lyr,"RELATIVE")


if arcpy.Exists(ADbuffOld):
   print "The AD Buffer analysis was complete for Old Nests!"
else:
   print "The analysis was not completed, check input features."
   raise SystemExit


# Intersect analysis with the trails shapefile to determine overlap
#Syntax: Intersect_analysis (in_features, out_feature_class)
arcpy.Intersect_analysis([BufferTrails,ADbuffOld],TrlADOldInter)
if arcpy.Exists(TrlADOldInter):
   print "The Intersect analysis between Alert Distance (Old Nests) and Trails was completed!"
else:
   print "The analysis was not completed, check input features."
   raise SystemExit
arcpy.MakeFeatureLayer_management(TrlADOldInter,out_TrailsADOldInter)
arcpy.SaveToLayerFile_management(TrailsADOldInterIN,TrailsADOldInterLyr,"RELATIVE")
```

```
print "All files have been created for Method 1 Alert Distance of Estimating Patch Buffer Area for Cactus Wrens on the Palos Verdes Peninsula."

#Add the intersect analysis files to a map document
#...Path = pathname to layerfile, ...Lyr = finding layer to add to map, then add layer to map.
InterTrailsADNewLyrPath = os.path.basename(TrailsADNewInterLyr)
InterTrailsADNewLyr = arcpy.mapping.Layer(InterTrailsADNewLyrPath)
arcpy.mapping.AddLayer(df,InterTrailsADNewLyr)

InterTrailsADOldLyrPath = os.path.basename(TrailsADOldInterLyr)
InterTrailsADOldLyr = arcpy.mapping.Layer(InterTrailsADOldLyrPath)
arcpy.mapping.AddLayer(df,InterTrailsADOldLyr)

#This was added 4/5/15 by JM
ADbuffNew1LyrPath = os.path.basename(ADbuffNew1Lyr)
ADbuffNew1Lyr = arcpy.mapping.Layer(ADbuffNew1LyrPath)
arcpy.mapping.AddLayer(df,ADbuffNew1Lyr)

ADbuffOld1LyrPath = os.path.basename(ADbuffOld1Lyr)
ADbuffOld1Lyr = arcpy.mapping.Layer(ADbuffOld1LyrPath)
arcpy.mapping.AddLayer(df,ADbuffOld1Lyr)

mapdoc.save()

print "The layers for Method 1 Alert Distance were added to the Map document."
print "                                                                              "
#################################Method 1 FID files#########################################################################
#Buffer shapefiles- these have not been created yet but this will be their pathname
FID_bufferM1New =enviro + "\FID_bufferM1New.shp"
FID_bufferM1Old =enviro +"\FID_bufferM1Old.shp"

#Intersect shapefiles to allow for saving as layerfiles
#(in_features)-these have not been created yet but this will be their pathname
TrlFIDNewInter =enviro +"\TrlFIDNewInter.shp"
TrlFIDOldInter =enviro +"\TrlFIDOldInter.shp"

#Set Local Variable to be able to save as layer files(in_layers):
#in order to use the users input for the path names there is ...Name (basename from user),
#...base(basename minus extension), and then ...IN (in_layer)
TrailsFIDNewInterINName = basename(TrlFIDNewInter)
TrailsFIDNewInterINBase= splitext(TrailsFIDNewInterINName)[0]
TrailsFIDNewInterIN= TrailsFIDNewInterINBase + "Lyr"

TrailsFIDOldInterINName = basename(TrlFIDOldInter)
TrailsFIDOldInterINBase= splitext(TrailsFIDOldInterINName)[0]
TrailsFIDOldInterIN= TrailsFIDOldInterINBase + "Lyr"

#Save as layer file to access later(Out_layers)
TrailsFIDNewInterLyr = TrailsFIDNewInterIN +".lyr"
TrailsFIDOldInterLyr = TrailsFIDOldInterIN +".lyr"

#Use intermedate Layer (out_layer0)
out_TrailsFIDNewInter = TrailsFIDNewInterIN
out_TrailsFIDOldInter = TrailsFIDOldInterIN

###########################################Method 1: Flight Initiation Distance################################################
print "Method 1 Analysis: Flight Initiation Distance"

sheetFID= wb.sheet_by_name('FID CALCS')
FID= sheetFID.col_values(9)
del FID[0]
FID.sort(reverse= True)
M1FID = FID[2]
print "The distance in which 95% of individuals flee is equal to ", M1FID, " meters."
#to determine at which point 95% of individuals are alert/flee at you need to figure out what the 95% percentile is based on the
#number of samples you have. In my case I had 40 samples, 95% of that is 38, therefore I am able to reverse my list and
```

```
#determine that the 3rd item in my  list is the correct distance.

bufferM1FID= (3.14159)*(pow(M1FID,2))
print "The buffer distance for Cactus Wrens fleeing is equal to ", bufferM1FID, " meters squared."


#Buffer analysis for nests new:
#syntax= input, output name, distance
FIDbuffNew= arcpy.Buffer_analysis(nestsNew,FID_bufferM1New,M1FID)

#Save buffered nests file as a layer file
#This was added 4/5/15 by JM
FID_bufferM1New1 = enviro +"\FID_bufferM1New.shp"
FID_bufferM1New1LyrName = basename(FID_bufferM1New1)
FID_bufferM1New1LyrBase= splitext(FID_bufferM1New1LyrName)[0]
FID_bufferM1New1LyrIN= FID_bufferM1New1LyrBase + "Lyr"
FID_bufferM1New1Lyr= FID_bufferM1New1LyrIN +".lyr"
out_FID_bufferM1New1= FID_bufferM1New1LyrIN
arcpy.MakeFeatureLayer_management(FID_bufferM1New1,FID_bufferM1New1LyrIN)
arcpy.SaveToLayerFile_management(FID_bufferM1New1LyrIN,FID_bufferM1New1Lyr,"RELATIVE")


# The script below goes back to make sure that the analysis actually worked.
if arcpy.Exists(FIDbuffNew):
   print "The FID Buffer analysis was complete for New Nests!"
else:
   print "The analysis was not completed, check input features."
   raise SystemExit

# Intersect analysis with the trails shapefile to determine overlap
#Syntax: Intersect_analysis (in_features, out_feature_class)
arcpy.Intersect_analysis([BufferTrails,FIDbuffNew],TrlFIDNewInter)
if arcpy.Exists(TrlFIDNewInter):
   print "The Intersect analysis between Flight Initiation Distance (New Nests) and Trails was completed!"
else:
   print "The analysis was not completed, check input features."
   raise SystemExit

#save intersect as layer file
arcpy.MakeFeatureLayer_management(TrlFIDNewInter,out_TrailsFIDNewInter)
arcpy.SaveToLayerFile_management(TrailsFIDNewInterIN,TrailsFIDNewInterLyr,"RELATIVE")

#Buffer analysis for nests old:
FIDbuffOld= arcpy.Buffer_analysis(nestsOld,FID_bufferM1Old,M1FID)

#Save buffered nests file as a layer file
#This was added 4/5/15 by JM
FID_bufferM1Old1 = enviro +"\FID_bufferM1Old.shp"
FID_bufferM1Old1LyrName = basename(FID_bufferM1Old1)
FID_bufferM1Old1LyrBase= splitext(FID_bufferM1Old1LyrName)[0]
FID_bufferM1Old1LyrIN= FID_bufferM1Old1LyrBase + "Lyr"
FID_bufferM1Old1Lyr= FID_bufferM1Old1LyrIN +".lyr"
out_FID_bufferM1Old1= FID_bufferM1Old1LyrIN
arcpy.MakeFeatureLayer_management(FID_bufferM1Old1,FID_bufferM1Old1LyrIN)
arcpy.SaveToLayerFile_management(FID_bufferM1Old1LyrIN,FID_bufferM1Old1Lyr,"RELATIVE")

if arcpy.Exists(FIDbuffOld):
   print "The FID Buffer analysis was complete for Old Nests!"
else:
   print "The analysis was not completed, check input features."
   raise SystemExit

arcpy.Intersect_analysis([BufferTrails,FIDbuffOld],TrlFIDOldInter)
if arcpy.Exists(TrlFIDOldInter):
   print "The Intersect analysis between Flight Initiation Distance (Old Nests) and Trails was completed!"
else:
```

```
   print "The analysis was not completed, check input features."
   raise SystemExit

arcpy.MakeFeatureLayer_management(TrlFIDOldInter,out_TrailsFIDOldInter)
arcpy.SaveToLayerFile_management(TrailsFIDOldInterIN,TrailsFIDOldInterLyr,"RELATIVE")

print "All files have been created for Method 1 Flight Initiation Distance of Estimating Patch Buffer Area for Cactus Wrens on the Palos Verdes
Peninsula."


#Add the new intersect analysis files to a map document
#set the data frame for mapping
df = arcpy.mapping.ListDataFrames(mapdoc)[j]

#...Path = pathname to layerfile, ...Lyr = finding layer to add to map, then add layer to map.
InterTrailsFIDNewLyrPath = os.path.basename(TrailsFIDNewInterLyr)
InterTrailsFIDNewLyr = arcpy.mapping.Layer(InterTrailsFIDNewLyrPath)
arcpy.mapping.AddLayer(df,InterTrailsFIDNewLyr)

InterTrailsFIDOldLyrPath = os.path.basename(TrailsFIDOldInterLyr)
InterTrailsFIDOldLyr = arcpy.mapping.Layer(InterTrailsFIDOldLyrPath)
arcpy.mapping.AddLayer(df,InterTrailsFIDOldLyr)

#This was added 4/5/15 by JM
FID_bufferM1New1LyrPath = os.path.basename(FID_bufferM1New1Lyr)
FID_bufferM1New1Lyr = arcpy.mapping.Layer(FID_bufferM1New1LyrPath)
arcpy.mapping.AddLayer(df,FID_bufferM1New1Lyr)

FID_bufferM1Old1LyrPath = os.path.basename(FID_bufferM1Old1Lyr)
FID_bufferM1Old1Lyr = arcpy.mapping.Layer(FID_bufferM1Old1LyrPath)
arcpy.mapping.AddLayer(df,FID_bufferM1Old1Lyr)


mapdoc.save()
del mapdoc

print "The layers for Method 1 Flight Initiation Distance were added to the Map document."
print "                                                              "


##########################Method 2 files########################################################################################
#Setting up the location of the Map Document
f= raw_input("Have you created a map document with the designated data frames?")
if f=='y' or f=='ye' or f=='yes':
   mxd= raw_input("What is the pathname to the map document?")
   mapdoc= arcpy.mapping.MapDocument(mxd)

elif f=='n' or f=='no' or f=='nope' or f=='nop':
      print "Please see associated documentation on how to organize the data and associated files to run this script."
      raise SystemExit

else:
      print "Sorry, unable to recognize response. Please see associated documentation on how to organize the data and associated files to run
this script."
      raise SystemExit

#Setting up the data frame for Method 2 Analysis
m= int(raw_input("What is the data frame number for Method 2 Analysis?"))

#set the data frame for mapping
df= arcpy.mapping.ListDataFrames(mapdoc)[m]


#Add layer files to map
#...Path = pathname to layerfile, ...Lyr = finding layer to add to map, then add layer to map.
```

```
Nests2014LyrPath= os.path.basename(nestsNewLyr)
Nests2014Lyr =arcpy.mapping.Layer(Nests2014LyrPath)
arcpy.mapping.AddLayer(df,Nests2014Lyr)

NestsOldLyrPath= os.path.basename(nestsOldLyr)
NestsOldLyr =arcpy.mapping.Layer(NestsOldLyrPath)
arcpy.mapping.AddLayer(df,NestsOldLyr)

if arcpy.Exists(BufferTrailsLyr):
    BufferTrailsAVPLyrPath= os.path.basename(BufferTrailsLyr)
    BufferTrailsAVPLyr =arcpy.mapping.Layer(BufferTrailsAVPLyrPath)
    arcpy.mapping.AddLayer(df,BufferTrailsAVPLyr)
else:
    arcpy.Exists(trailsLyr)
    TrailsAVPLyrPath= os.path.basename(trailsLyr)
    TrailsAVPLyr =arcpy.mapping.Layer(TrailsAVPLyrPath)
    arcpy.mapping.AddLayer(df,TrailsAVPLyr)

#######################################################################################
#Buffer shapefiles- these have not been created yet
FID_bufferM2New = enviro +"\FID_bufferM2New.shp"
FID_bufferM2Old =enviro +"\FID_bufferM2Old.shp"

#Intersect shapefiles to allow for saving as layerfiles
#(in_features)-these have not been created yet but this will be their pathname
TrailsFIDNewInterM2 = enviro +"\TrailsFIDNewInterM2.shp"
TrailsFIDOldInterM2 = enviro +"\TrailsFIDOldInterM2.shp"

#Set Local Variable to be able to save as layer files(in_layers):
#in order to use the users input for the path names there is ...Name (basename from user),
#...base(basename minus extension), and then ...IN (in_layer)
TrailsFIDNewInterM2INName = basename(TrailsFIDNewInterM2)
TrailsFIDNewInterM2INBase= splitext(TrailsFIDNewInterM2INName)[0]
TrailsFIDNewInterM2IN= TrailsFIDNewInterM2INBase + "Lyr"

TrailsFIDOldInterM2INName = basename(TrailsFIDOldInterM2)
TrailsFIDOldInterM2INBase= splitext(TrailsFIDOldInterM2INName)[0]
TrailsFIDOldInterM2IN= TrailsFIDOldInterM2INBase + "Lyr"

#Save as layer file to access later(Out_layers)
TrailsFIDNewInterM2Lyr = TrailsFIDNewInterM2IN +".lyr"
TrailsFIDOldInterM2Lyr = TrailsFIDOldInterM2IN +".lyr"

#Use intermedate Layer (out_layer0)
out_TrailsFIDNewInterM2= TrailsFIDNewInterM2IN
out_TrailsFIDOldInterM2= TrailsFIDOldInterM2IN


########################Method 2: Flight Initiation Distance################################################################
print "Method 2 Analysis: Flight Initiation Distance"

sheetFID= wb.sheet_by_name('FID CALCS')
FID= sheetFID.col_values(9)
del FID[0]

#Determine the mean of the FID distances
def mean(FID):
    if len(FID) == 0:
        print float('nan')

floatNums = [float(x) for x in FID]
M2FID = sum(floatNums) / len(FID)
print "The mean distance at which Cactus Wrens Flee is", M2FID, "meters."

#Determine the minimum approach distance
#syntax: MAD= 1.5*(mean of FID)
```

```
MADM2FID= (1.5)*(M2FID)
print "The minimum approach distance is equal to", MADM2FID, "meters."

#Determine the buffer area
#syntax: buffer=(3.14159)*(MAD^2)
bufferM2FID= (3.14159)*(pow(MADM2FID,2))
print "The buffer distance for Cactus Wrens fleeing is equal to", bufferM2FID, "meters squared."

####################################################################################################
#Buffer analysis for nests new:
#syntax= input, output name, distance
FIDbuffNewM2= arcpy.Buffer_analysis(nestsNew,FID_bufferM2New,MADM2FID)

#Save buffered nests file as a layer file
#This was added 4/5/15 by JM
FID_bufferM2New1 = enviro +"\FID_bufferM2New.shp"
FID_bufferM2New1LyrName = basename(FID_bufferM2New1)
FID_bufferM2New1LyrBase= splitext(FID_bufferM2New1LyrName)[0]
FID_bufferM2New1LyrIN= FID_bufferM2New1LyrBase + "Lyr"
FID_bufferM2New1Lyr= FID_bufferM2New1LyrIN +".lyr"
out_FID_bufferM2New1= FID_bufferM2New1LyrIN
arcpy.MakeFeatureLayer_management(FID_bufferM2New1,FID_bufferM2New1LyrIN)
arcpy.SaveToLayerFile_management(FID_bufferM2New1LyrIN,FID_bufferM2New1Lyr,"RELATIVE")

# The script below goes back to make sure that the analysis actually worked.
if arcpy.Exists(FIDbuffNewM2):
    print "Method 2 FID Buffer analysis was complete for New Nests!"
else:
    print "The analysis was not completed, check input features."
    raise SystemExit


# Intersect analysis with the trails shapefile to determine overlap
#Syntax: Intersect_analysis (in_features, out_feature_class)
arcpy.Intersect_analysis([BufferTrails,FIDbuffNewM2],TrailsFIDNewInterM2)
if arcpy.Exists(TrailsFIDNewInterM2):
    print "The Intersect analysis between Flight Initiation Distance (New Nests) and Trails was completed!"
else:
    print "The analysis was not completed, check input features."
    raise SystemExit

#save intersect as layer file
arcpy.MakeFeatureLayer_management(TrailsFIDNewInterM2,out_TrailsFIDNewInterM2)
arcpy.SaveToLayerFile_management(TrailsFIDNewInterM2IN,TrailsFIDNewInterM2Lyr,"RELATIVE")

#Buffer analysis for nests old:
#syntax= input, output name, distance
FIDbuffOldM2= arcpy.Buffer_analysis(nestsOld,FID_bufferM2Old,MADM2FID)

#Save buffered nests file as a layer file
#This was added 4/5/15 by JM
FID_bufferM2Old1 = enviro +"\FID_bufferM2Old.shp"
FID_bufferM2Old1LyrName = basename(FID_bufferM2Old1)
FID_bufferM2Old1LyrBase= splitext(FID_bufferM2Old1LyrName)[0]
FID_bufferM2Old1LyrIN= FID_bufferM2Old1LyrBase + "Lyr"
FID_bufferM2Old1Lyr= FID_bufferM2Old1LyrIN +".lyr"
out_FID_bufferM2Old1= FID_bufferM2Old1LyrIN
arcpy.MakeFeatureLayer_management(FID_bufferM2Old1,FID_bufferM2Old1LyrIN)
arcpy.SaveToLayerFile_management(FID_bufferM2Old1LyrIN,FID_bufferM2Old1Lyr,"RELATIVE")

# The script below goes back to make sure that the analysis actually worked.
if arcpy.Exists(FIDbuffOldM2):
    print "Method 2 FID Buffer analysis was complete for Old Nests!"
else:
    print "The analysis was not completed, check input features."
    raise SystemExit
```

```
# Intersect analysis with the trails shapefile to determine overlap
#Syntax: Intersect_analysis (in_features, out_feature_class)
arcpy.Intersect_analysis([BufferTrails,FIDbuffOldM2],TrailsFIDOldInterM2)
if arcpy.Exists(TrailsFIDOldInterM2):
    print "The Intersect analysis between Flight Initiation Distance (Old Nests) and Trails was completed!"
else:
    print "The analysis was not completed, check input features."
    raise SystemExit

#save intersect as layer file
arcpy.MakeFeatureLayer_management(TrailsFIDOldInterM2,out_TrailsFIDOldInterM2)
arcpy.SaveToLayerFile_management(TrailsFIDOldInterM2IN,TrailsFIDOldInterM2Lyr,"RELATIVE")

#Add the intersect analysis files to a map document
InterTrailsFIDNewM2LyrPath = os.path.basename(TrailsFIDNewInterM2Lyr)
InterTrailsFIDNewM2Lyr = arcpy.mapping.Layer(InterTrailsFIDNewM2LyrPath)
arcpy.mapping.AddLayer(df,InterTrailsFIDNewM2Lyr)

InterTrailsFIDOldM2LyrPath = os.path.basename(TrailsFIDOldInterM2Lyr)
InterTrailsFIDOldM2Lyr = arcpy.mapping.Layer(InterTrailsFIDOldM2LyrPath)
arcpy.mapping.AddLayer(df,InterTrailsFIDOldM2Lyr)

#This was added 4/5/15 by JM
FID_bufferM2New1LyrPath = os.path.basename(FID_bufferM2New1Lyr)
FID_bufferM2New1Lyr = arcpy.mapping.Layer(FID_bufferM2New1LyrPath)
arcpy.mapping.AddLayer(df,FID_bufferM2New1Lyr)

FID_bufferM2Old1LyrPath = os.path.basename(FID_bufferM2Old1Lyr)
FID_bufferM2Old1Lyr = arcpy.mapping.Layer(FID_bufferM2Old1LyrPath)
arcpy.mapping.AddLayer(df,FID_bufferM2Old1Lyr)

mapdoc.save()
del mapdoc

print "The layers for Method 2 Flight Initiation Distances were added to the Map document."
print "                                                                    "
print "This analysis is complete. Please check you map document for the layer files."
```

Appendix I. Equations for calculating Method 1 and Method 2.

I1. Method 1

Minimum approaching distance (MAD) which is determined by a cumulative percentage plot of fleeing individuals against alert distance or flight initiation distance and determining when 95% of the individuals become alert and take flight.

Buffer area= π (MAD^2)

I2. Method 2

MAD= 1.5(FID*)

FID* = mean of FID

Buffer area = π $(MAD)^2$

Appendix J. Standard Operating Procedure for the Python Script to Calculate Critical Trail Locations.

Critical Trail Locations Python Script

Standard Operating Procedure

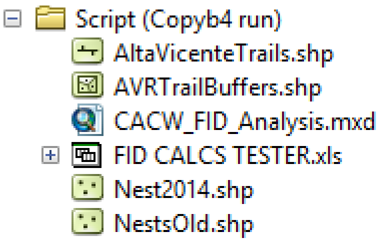
The python script “CriticalTrailLocationsPVPLC.py” was created to do a patch buffer analysis for California Cactus Wrens on the Palos Verdes Peninsula. With the necessary files, this script can be used to get the critical encroachment locations for any species. In order to use the script please organize your data as stated below.

1. If you do not have ArcMap and Python, then please download both of these. This script will not run without the software. The newest version of Python automatically downloads with ArcMap.

2. In order to use Python to access the excel file when the data is stored you have to download the following modules.
   Xlrd (excel read) and Xlwt (excel write): http://www.python-excel.org/

   A. Once you download the modules run this installer to make them accessible.
      (win32.exe): https://pypi.python.org/pypi/xlrd/0.7.1

3. Edit files or create the necessary files to run the script.
   A. Shapefiles (Figure 1):
      - The shapefiles need to be stored outside of a geodatabase.
      - The shapefiles are in NAD 1983 State Plane CA V FIPS_0405_FT
      - Nests2014.shp is the new nests that were built by Cactus Wrens this year (2014)
      - NestsOld.shp is old nests that have been built in the past
        - For Future analysis merge the new nest shapefile with the old nest shapefile to create the new old nests shapefile. The new nests GPS locations will need to be collected each breeding season.
      - AltaVicenteTrails.shp is the polylines of the trail locations at Alta Vicente Reserve
        - Using the geoprocessing tool, Select by Attribute, only the trails for Alta Vicente Reserve were selected from the shapefile containing all of the PVPLC reserve trails
        - AVRTrailBuffers.shp is a shapefile that already has the trails buffered at the average width per trail.
        - If the trails are not buffered then this scipt will buffer them all to one assigned size.



Script (Copyb4 run)
AltaVicenteTrails.shp
AVRTrailBuffers.shp
CACW_FID_Analysis.mxd
FID CALCS TESTER.xls
Nest2014.shp
NestsOld.shp

Figure 1. ArcCatalog list of files necessary to run Python script.

B. ArcMap Document (Figure 2):

- The map document that the script will populate needs to contain at least the two data frames for the 2 methods (ie. Method 1, Method 2).
  - I like to have three data frames to make the questions of what method on what data frame easy, because of the counting system which starts at zero it can become confusing.
- Add a base map to each data frame (Imagery)
- Save the map document in the same folder where all the data is stored.

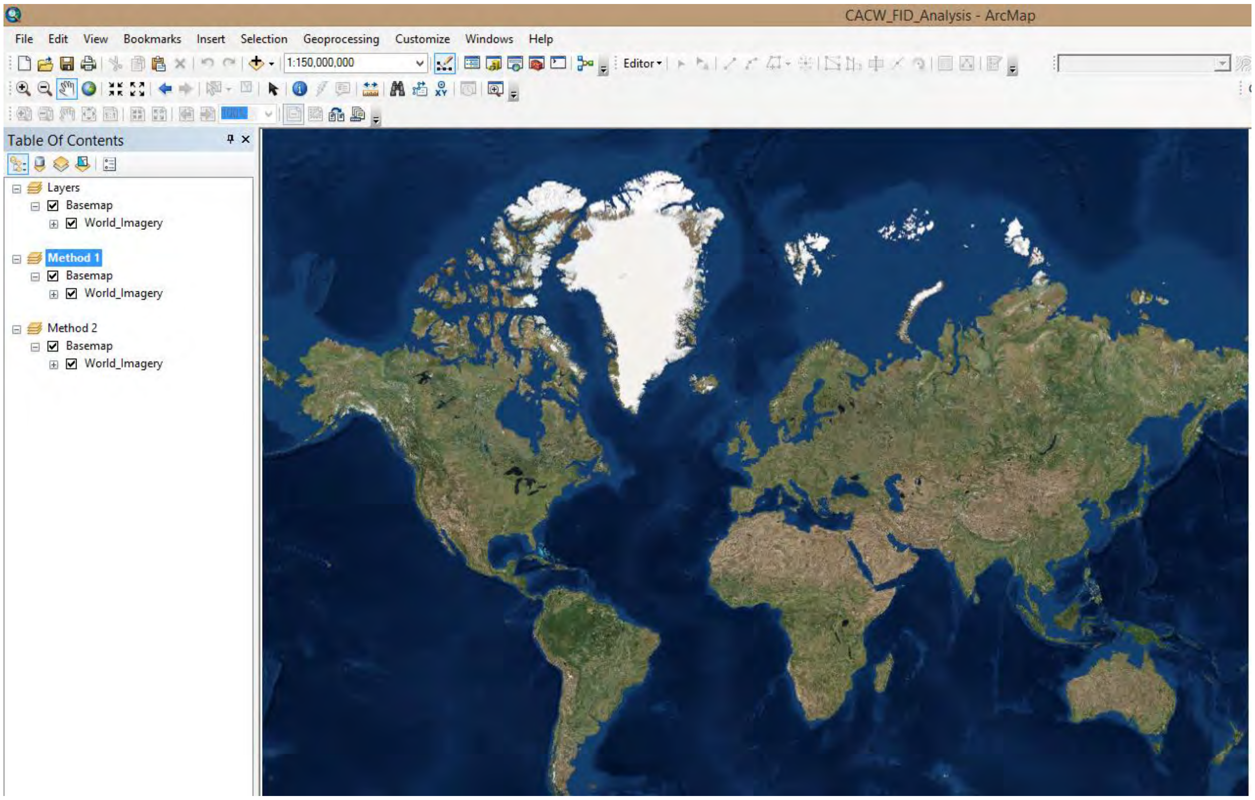
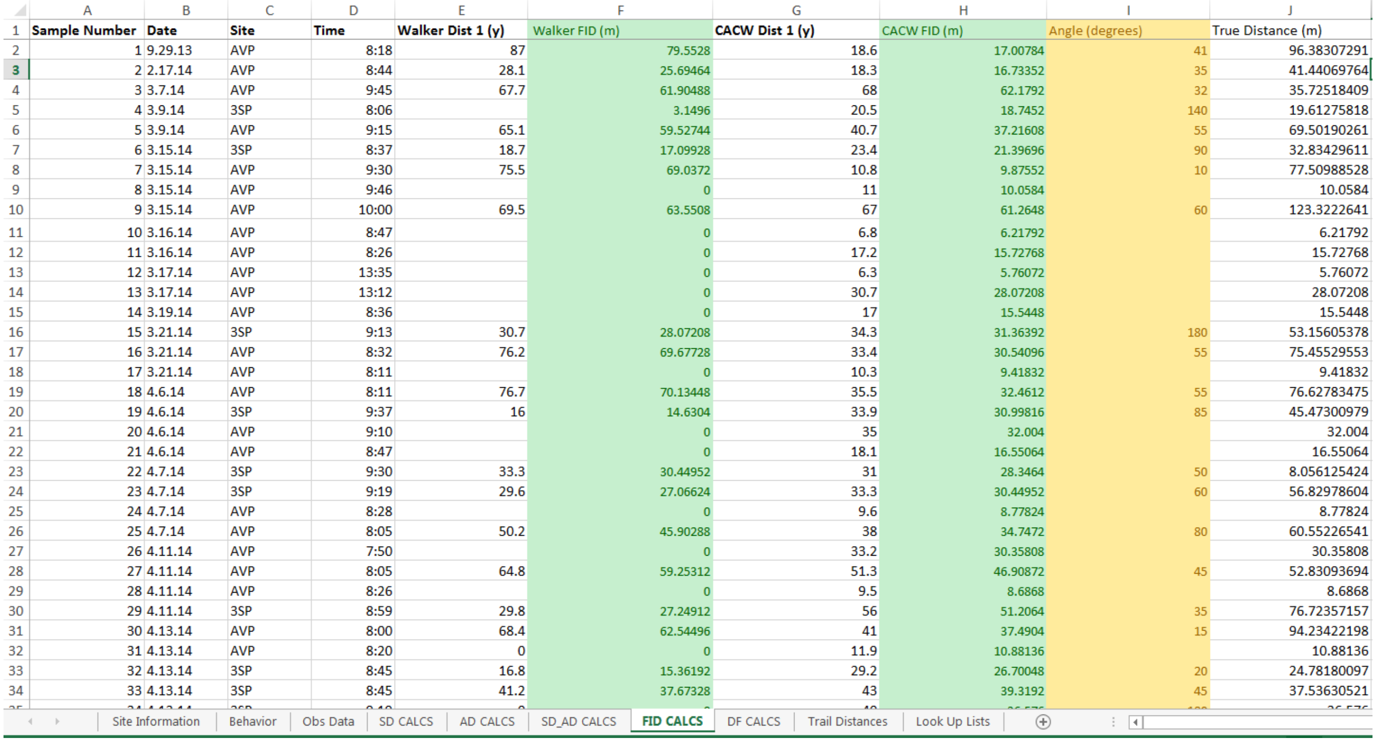


Figure 2. ArcMap document with the necessary data frame layers.

C. Excel Workbook where the data is stored (Figure 3):

- The excel work book has a very specific format that allows Python to access, read, and make calculations with the data.
- The script uses the "True Distance (m)" column on the "AD CALCS" and the "FID CALCS" tabs. This column is the Alert Distance and Flight Initiation Distance for each sample taken.



	A	B	C	D	E	F	G	H	I	J
1	**Sample Number**	**Date**	**Site**	**Time**	**Walker Dist 1 (y)**	Walker FID (m)	**CACW Dist 1 (y)**	CACW FID (m)	Angle (degrees)	True Distance (m)
2	1	9.29.13	AVP	8:18	87	79.5528	18.6	17.00784	41	96.38307291
3	2	2.17.14	AVP	8:44	28.1	25.69464	18.3	16.73352	35	41.44069764
4	3	3.7.14	AVP	9:45	67.7	61.90488	68	62.1792	32	35.72518409
5	4	3.9.14	3SP	8:06		3.1496	20.5	18.7452	140	19.61275818
6	5	3.9.14	AVP	9:15	65.1	59.52744	40.7	37.21608	55	69.50190261
7	6	3.15.14	3SP	8:37	18.7	17.09928	23.4	21.39696	90	32.83429611
8	7	3.15.14	AVP	9:30	75.5	69.0372	10.8	9.87552	10	77.50988528
9	8	3.15.14	AVP	9:46		0	11	10.0584		10.0584
10	9	3.15.14	AVP	10:00	69.5	63.5508	67	61.2648	60	123.3222641
11	10	3.16.14	AVP	8:47		0	6.8	6.21792		6.21792
12	11	3.16.14	AVP	8:26		0	17.2	15.72768		15.72768
13	12	3.17.14	AVP	13:35		0	6.3	5.76072		5.76072
14	13	3.17.14	AVP	13:12		0	30.7	28.07208		28.07208
15	14	3.19.14	AVP	8:36		0	17	15.5448		15.5448
16	15	3.21.14	3SP	9:13	30.7	28.07208	34.3	31.36392	180	53.15605378
17	16	3.21.14	AVP	8:32	76.2	69.67728	33.4	30.54096	55	75.45529553
18	17	3.21.14	AVP	8:11		0	10.3	9.41832		9.41832
19	18	4.6.14	AVP	8:11	76.7	70.13448	35.5	32.4612	55	76.62783475
20	19	4.6.14	3SP	9:37	16	14.6304	33.9	30.99816	85	45.47300979
21	20	4.6.14	AVP	9:10		0	35	32.004		32.004
22	21	4.6.14	AVP	8:47		0	18.1	16.55064		16.55064
23	22	4.7.14	3SP	9:30	33.3	30.44952	31	28.3464	50	8.056125424
24	23	4.7.14	3SP	9:19	29.6	27.06624	33.3	30.44952	60	56.82978604
25	24	4.7.14	AVP	8:28		0	9.6	8.77824		8.77824
26	25	4.7.14	AVP	8:05	50.2	45.90288	38	34.7472	80	60.55226541
27	26	4.11.14	AVP	7:50		0	33.2	30.35808		30.35808
28	27	4.11.14	AVP	8:05	64.8	59.25312	51.3	46.90872	45	52.83093694
29	28	4.11.14	AVP	8:26		0	9.5	8.6868		8.6868
30	29	4.11.14	3SP	8:59	29.8	27.24912	56	51.2064	35	76.72357157
31	30	4.13.14	AVP	8:00	68.4	62.54496	41	37.4904	15	94.23422198
32	31	4.13.14	AVP	8:20	0	0	11.9	10.88136		10.88136
33	32	4.13.14	3SP	8:45	16.8	15.36192	29.2	26.70048	20	24.78180097
34	33	4.13.14	3SP	8:45	41.2	37.67328	43	39.3192	45	37.53630521

Figure 3. Excel file with the necessary tabs and columns.

4. Running the Python Script
   a. Right click on the "CriticalTrailLocationsPVPLC.py" file
      i. Edit with Idle
         1. Script will open up
5. The following questions are asked by the script and will require the users input.
   - I suggest answering all the questions ahead of time and pasting the answer in this document. That way when you run the script all you have to do is copy and paste your answers instead of having to look each one up.
     - The blue is the question asked by the script
     - The orange is directions on what is an acceptable answer
     - The black is an example

Script-Questions and how to answer them:

1. Where is the data located?
   Provide the full pathname from ArcCatalog
   E:\Final Report PVPLC\Script

2. Have you created a map document with the designated data frames?
   Answer “yes” or “no”

3. What is the pathname to the map document?
   Provide full pathname from ArcCatalog
   E:\Final Report PVPLC\Script\CACW_FID_Analysis.mxd

4. Have you created an excel 2007 workbook that contains the organized AD and FID data?
   Answer “yes” or “no”

5. What is the name of the excel file?
   Enter in only the name of the excel file. File format in 2007 version.
   FID CALCS TESTER.xls

6. Do you have the locations of New Cactus Wren Nests in a point shapefile?
   Answer “yes” or “no”

7. What is the name of the point shapefile that contains New Nest Locations?
   Provide full pathname from ArcCatalog
   E:\Final Report PVPLC\Script\Nest2014.shp

8. Do you have the locations of Old Cactus Wren Nests in a point shapefile?
   Answer “yes” or “no”

9. What is the name of the point shapefile that contains Old Nest Locations?
   Provide full pathname from ArcCatalog
   E:\Final Report PVPLC\Script\NestsOld.shp

10. Is the trail data already buffered to the appropriate distances?
    Answer “yes” or “no”
    a. YES: What is the pathname to the buffer trails shapefile?
       Provide full pathname from ArcCatalog
       E:\Final Report PVPLC\Script\AVRTrailBuffers.shp

    b. NO: What is the name of the polyline shapefile that contains the Trail Locations?
       Provide full pathname from ArcCatalog
       E:\Final Report PVPLC\Script\AltaVicenteTrails.shp
       i. What is the average width of the trails in meters?
          Provide an integer distance that is greater than 0.5meters
          2

11. What is the data frame number for Method 1 Analysis?

    The data frame layer number can be found in the table of contents in ArcMap. Remember that the very first layer is equal to 0.

    1

12. Have you created a map document with the designated data frames?

    Answer “yes” or “no”

13. What is the pathname to the map document?

    Provide full pathname from ArcCatalog

    E:\Final Report PVPLC\Script\CACW_FID_Analysis.mxd

14. What is the data frame number for Method 2 Analysis?

    The data frame layer number can be found in the table of contents in ArcMap. Remember that the very first layer is equal to 0.

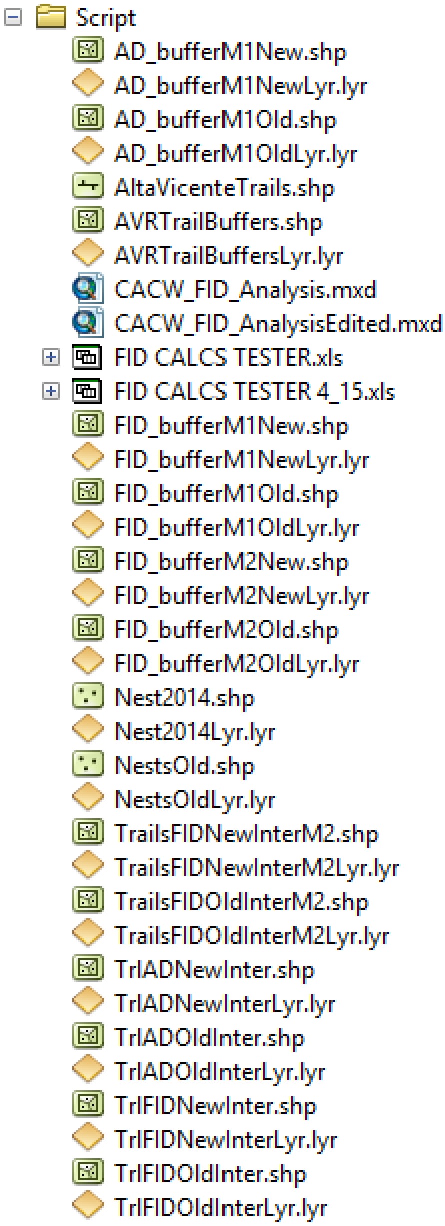
    2

6. When you are prepared to execute the script:
    a. Run
        i. Run Module
7. The successful completion of the script will look like:
    A. The Interactive window-Script text:

```
Method 1 Analysis: Alert Distance

The distance in which 95% of individuals are alert is equal to  97.3638146763  meters.

The Buffer distance for Cactus Wrens being alert is equal to  29781.3697049  meters squared.

The AD Buffer analysis was complete for New Nests!

The Intersect analysis between Alert Distance (New Nests) and Trails was completed!

The AD Buffer analysis was complete for Old Nests!

The Intersect analysis between Alert Distance (Old Nests) and Trails was completed!

All files have been created for Method 1 Alert Distance of Estimating Patch Buffer Area for Cactus Wrens on the Palos Verdes Peninsula.

The layers for Method 1 Alert Distance were added to the Map document.


Method 1 Analysis: Flight Initiation Distance

The distance in which 95% of individuals flee is equal to  96.383072907  meters.

The buffer distance for Cactus Wrens fleeing is equal to  29184.4183908  meters squared.

The FID Buffer analysis was complete for New Nests!

The Intersect analysis between Flight Initiation Distance (New Nests) and Trails was completed!

The FID Buffer analysis was complete for Old Nests!

The Intersect analysis between Flight Initiation Distance (Old Nests) and Trails was completed!

All files have been created for Method 1 Flight Initiation Distance of Estimating Patch Buffer Area for Cactus Wrens on the Palos Verdes Peninsula.

The layers for Method 1 Flight Initiation Distance were added to the Map document.


Method 2 Analysis: Flight Initiation Distance

The mean distance at which Cactus Wrens Flee is 41.758503051 meters.

The minimum approach distance is equal to 62.6377545765 meters.

The buffer distance for Cactus Wrens fleeing is equal to 12325.9916033 meters squared.
```

```
Method 2 FID Buffer analysis was complete for New Nests!

The Intersect analysis between Flight Initiation Distance (New Nests) and Trails was completed!

Method 2 FID Buffer analysis was complete for Old Nests!

The Intersect analysis between Flight Initiation Distance (Old Nests) and Trails was completed!

The layers for Method 2 Flight Initiation Distances were added to the Map document.

This analysis is complete. Please check you map document for the layer files.
```

B. ArcCatalog table of contents (Figure 4):



- ⊟ Script
  - AD_bufferM1New.shp
  - AD_bufferM1NewLyr.lyr
  - AD_bufferM1Old.shp
  - AD_bufferM1OldLyr.lyr
  - AltaVicenteTrails.shp
  - AVRTrailBuffers.shp
  - AVRTrailBuffersLyr.lyr
  - CACW_FID_Analysis.mxd
  - CACW_FID_AnalysisEdited.mxd
  - ⊞ FID CALCS TESTER.xls
  - ⊞ FID CALCS TESTER 4_15.xls
  - FID_bufferM1New.shp
  - FID_bufferM1NewLyr.lyr
  - FID_bufferM1Old.shp
  - FID_bufferM1OldLyr.lyr
  - FID_bufferM2New.shp
  - FID_bufferM2NewLyr.lyr
  - FID_bufferM2Old.shp
  - FID_bufferM2OldLyr.lyr
  - Nest2014.shp
  - Nest2014Lyr.lyr
  - NestsOld.shp
  - NestsOldLyr.lyr
  - TrailsFIDNewInterM2.shp
  - TrailsFIDNewInterM2Lyr.lyr
  - TrailsFIDOldInterM2.shp
  - TrailsFIDOldInterM2Lyr.lyr
  - TrlADNewInter.shp
  - TrlADNewInterLyr.lyr
  - TrlADOldInter.shp
  - TrlADOldInterLyr.lyr
  - TrlFIDNewInter.shp
  - TrlFIDNewInterLyr.lyr
  - TrlFIDOldInter.shp
  - TrlFIDOldInterLyr.lyr

Figure 4. ArcCatalog list of output files from the Python script.

C. Map document (Figure 5 &6):

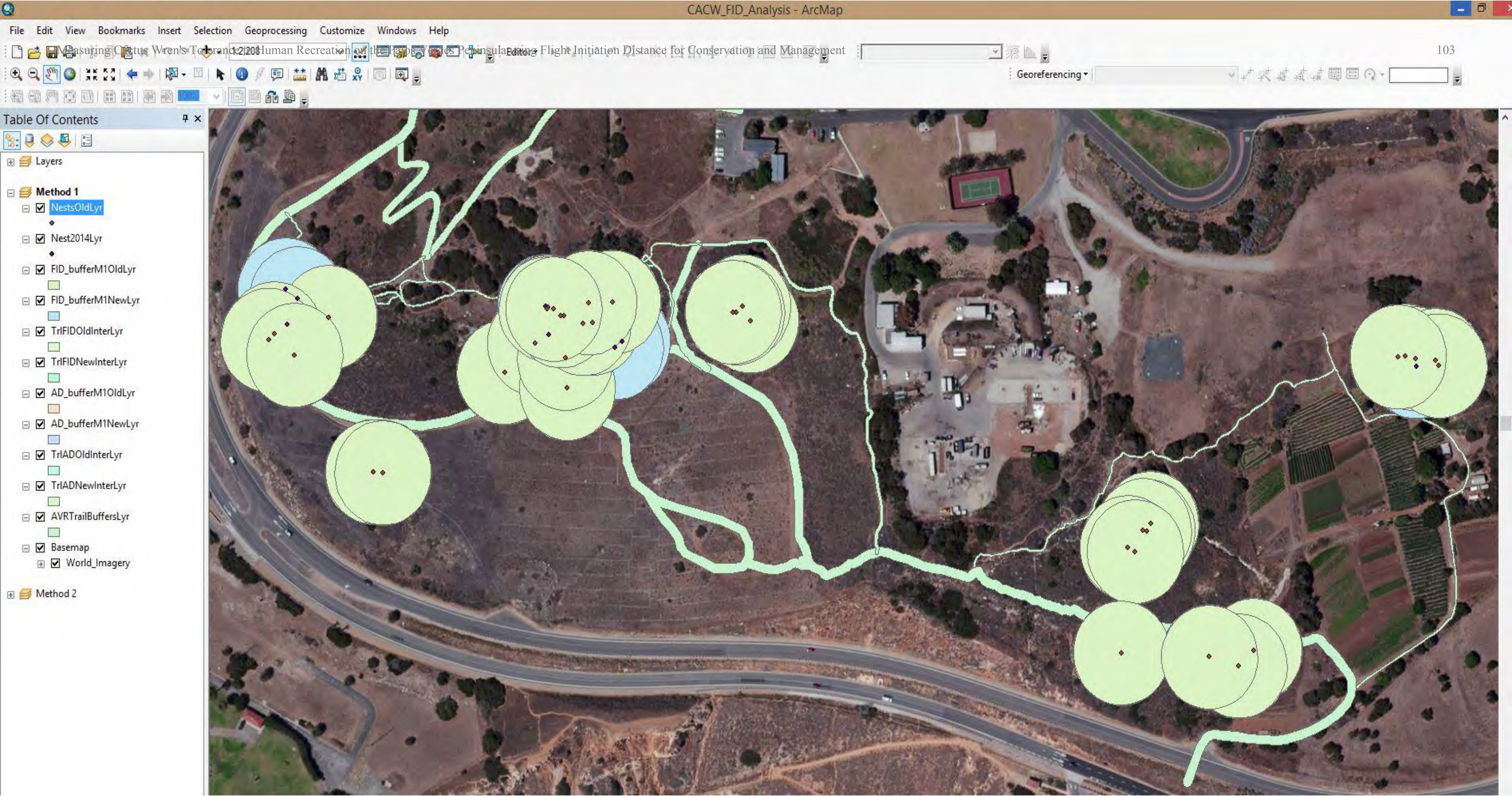


Figure 5. ArcMap data frame 1 showing the output files.

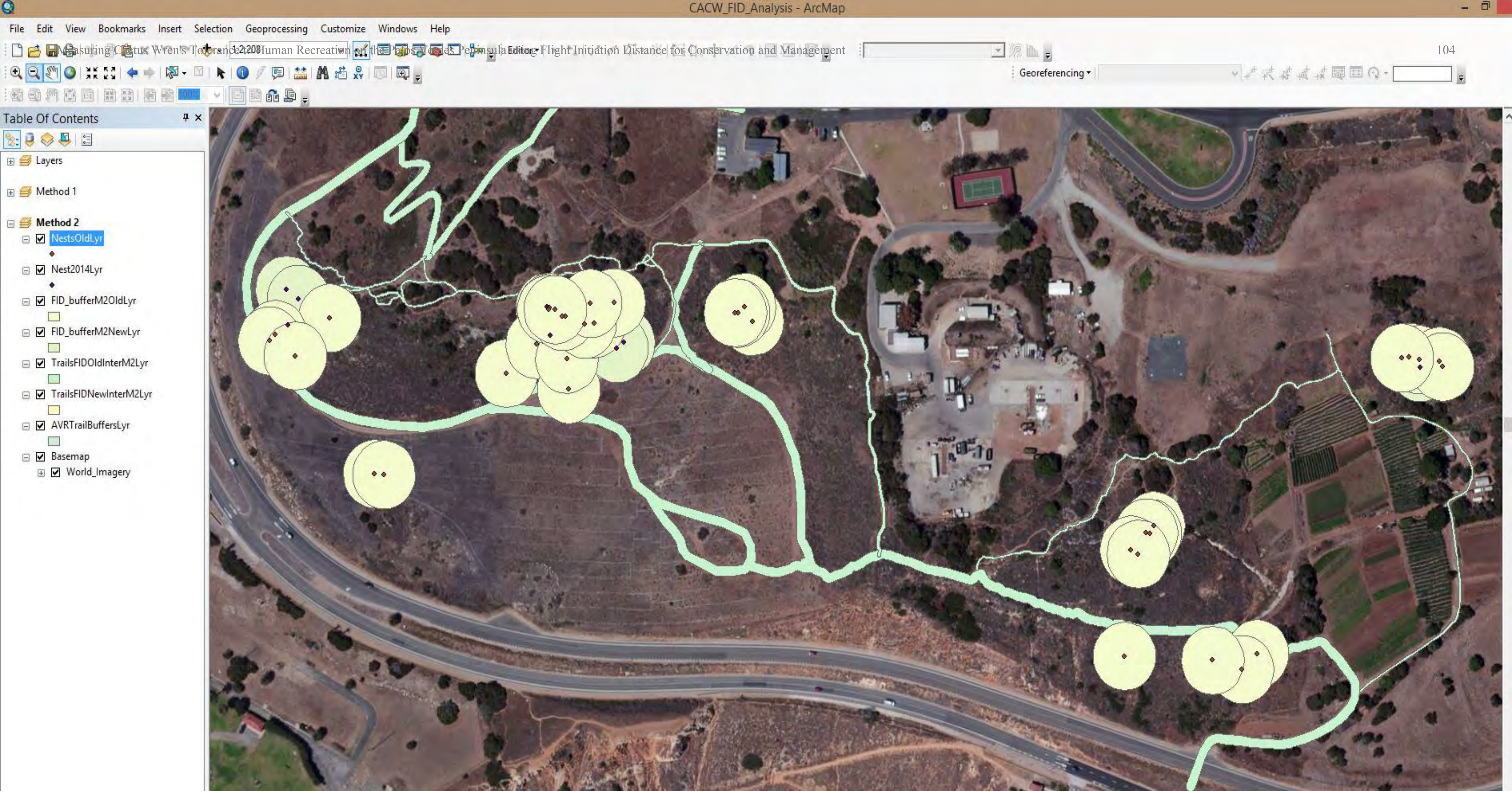


Figure 6. ArcMap data frame 2 showing the output files.

Appendix K. SPSS Statistical Outputs

K1. Parameter Estimates for Ln(Flight Initiation Distance) verses Bird Identification.

Parameter Estimates from SPSS Statistical Software

Dependent Variable: Ln(Flight Initiation Distance)

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
[BirdID=1]	.299	.806	.371	.713	-1.352	1.950
[BirdID=2]	.298	.811	.367	.716	-1.364	1.960
[BirdID=3]	-.239	.346	-.690	.496	-.949	.470
[BirdID=4]	.329	.912	.361	.721	-1.539	2.197
[BirdID=5]	-1.042	.658	-1.585	.124	-2.390	.305
[BirdID=6]	-1.273	.300	-4.242	.000	-1.888	-.659
[BirdID=7]	.450	.658	.684	.500	-.897	1.797
[BirdID=8]	.832	.865	.962	.345	-.940	2.603
[BirdID=9]	0[a]	.	.	.	.	.

K2. Parameter Estimates for Ln(Alert Distance) verses Initial Behavior.

Parameter Estimates from SPSS Statistical Software

Dependent Variable: Ln(Alert Distance)

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
[initialBehavCode=1.00]	-.621	.475	-1.308	.206	-1.614	.373
[initialBehavCode=2.00]	-.473	.520	-.910	.374	-1.561	.615
[initialBehavCode=3.00]	0^a	.	.	.	.	.
[initialBehavCode=4.00]	-3.520	.731	-4.812	.000	-5.050	-1.989
[initialBehavCode=5.00]	-.074	.731	-.101	.921	-1.604	1.457
[initialBehavCode=6.00]	0^a	.	.	.	.	.

[initialBehavCode=1.00] is equal to Observing
[initialBehavCode=2.00] is equal to Singing
[initialBehavCode=3.00] is equal to Foraging
[initialBehavCode=4.00] is equal to Hopping
[initialBehavCode=5.00] is equal to Preening
[initialBehavCode=6.00] is equal to Nest Building

K3. Parameter Estimates for Ln(Flight Initiation Distance) verses Initial Substrate.

Parameter Estimates from SPSS Statistical Software

Dependent Variable: Ln(Flight Initiation Distance)

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
[INITIALSUB1Code=1.00]	.297	.465	.638	.530	-.663	1.257
[INITIALSUB1Code=2.00]	-.304	.378	-.806	.428	-1.084	.475
[INITIALSUB1Code=3.00]	-1.877	.668	-2.809	.010	-3.257	-.498
[INITIALSUB1Code=4.00]	.172	.389	.442	.662	-.630	.974
[INITIALSUB1Code=5.00]	0[a]	.	.	.	.	.

[INITIALSUB1Code=1.00] is equal to Bare Ground or Dead Plants
[INITIALSUB1Code=2.00] is equal to Opuntia littorilis (Prickly Pear Cactus)
[INITIALSUB1Code=3.00] is equal to Man Made Material (Telephone Wire)
[INITIALSUB1Code=4.00] is equal to Nicotiana glauca (Tree Tobacco)
[INITIALSUB1Code=5.00] is equal to Rhus integrifolia (Lemonade Berry)

Appendix L. Field protocol for an one person approach

Flight Initiation Distance-Cactus Wrens on PVP- Field Protocol

Principle Investigator (PI): Julie McNamara, Master's Student at CSULB, 530.401.2669
Title: *Measuring Cactus Wren's Tolerance to Human Recreation on the Palos Verdes Peninsula using Flight Initiation Distance for Conservation and Management.*

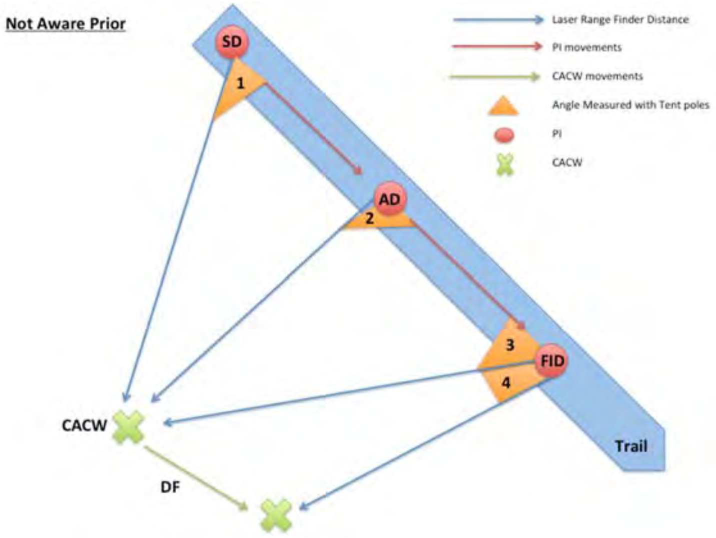
1. Fill out top portions of "Field Data Sheet."
   -Date
   -Time
   -Site = Reserve Name
   -Traffic = amount of human traffic in area (differentiate between runners, walkers, bikers…)

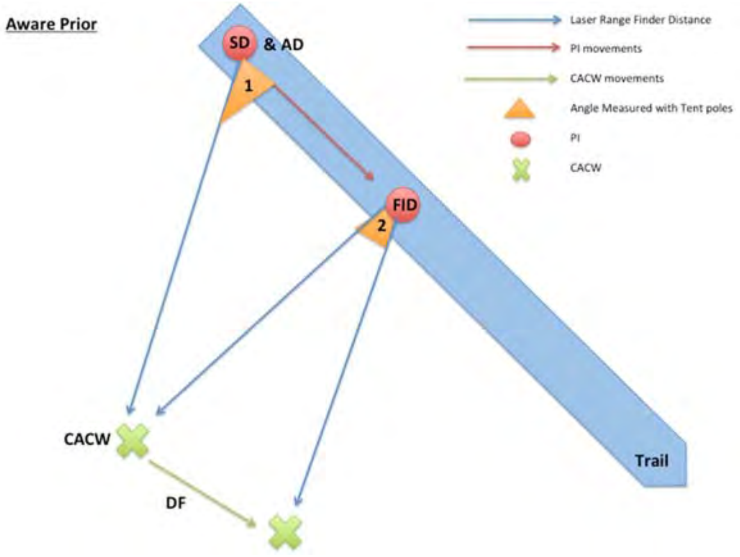
   Using the Fisher Scientific Traceable Enviro-Meter measure:
   -Temperature = degrees Celsius
   -Wind Speed = max, min (meters/second)
   -Humidity = out of 100, (RH)
   -Weather = general description (sunny, partially cloudy, over cast…)

2A. Walk on Reserve trails to locate a CACW. Once a CACW is located using binoculars, assess situation, is the CACW on the move or stationary. Write down, perching height, substrate, and behavior (charts 1-3).
B. If the CACW is stationary, drop flag (this is the starting distance (SD), notice if the CACW is aware of your presence (aware prior).
C. If CACW is aware of your presence the first flag dropped will be the alert distance (AD) and the SD. Continue with procedure (F-K).
D. If CACW is unaware of your presence, walk at a steady pace along the trail (0.45m/s), keeping eye contact on CACW to determine alert distance. Looking for head movements and listening for warning calls.
E. Once you notice a change in initial behavior, drop a flag. This is AD.
F. Continue along trail until CACW flees from perch, drop a flag. This is the flight initiation distance.
G. Measure the distance fled (DF) to new perch from FID, using Bushnell yardage pro laser range finder (meters) or a Stanley FatMax Blade Armor tape measure (feet).
H. Make note of perching height, substrate and behavior 30 seconds after flight.
I. Depending on distances between PI and CACW, SD, AD, FID, trail distance between SD & AD, and trail distance between AD & FID will be measured with a Bushnell yardage pro laser range finder (meters) or a Stanley FatMax Blade Armor tape measure (feet).
J. Using tent poles point one end to the direction in which the PI walked for approach (0 degrees), point the other end at the CACWs initial perch. Measure and record hypotenuse length using tape measure.
K. Repeat step J for angles of SD to perch and FID to flight perch.
L. Walk around area to determine the shortest distance between CACWs initial perch and trail location.

3. Fill out Cactus Wren Description Box.
   - Grid Coordinates = using maps made for each Reserve locate number and letter associated with where the CACW was approached
   - Aware Prior = if the CACW noticed the PI first (Y) or if PI noticed CACW first (N)
   - Sex = Male (M)- identified by singing, Female (F) – identified by no singing for a continuous period of time, Unknown (?) – identified by no singing and no pair identification
   - Flock size = is the number of CACW within a 10m circle of focal CACW
   - ID = this is only valid for when the PI has established home ranges for specific CACW and given them an identification number

4. Repeat steps 1-3 for new CACW. Do not repeat approach procedures on the same CACW in the same day or the day after.





Flight Initiation Distance-Cactus Wrens on PVP- Field Protocol

Charts:

(1) Height Estimations

Knee height	< 0.5m
Waist height	0.5-1m
Shoulder height	1-1.5m
Over head	>1.5m

(2) Substrates

Substrates	Definition
ac	**ac** Artemisia californica
bg	**bg** bare ground
cc	**cc** cholla cacti
ec	**ec** Encelia californica
gc	**gc** ground cover
mmm	**mmm** man made material
ol	**ol** Opuntia littorilis
pa	**pa** Peritoma aborea
rk	**rk** rock
ri	**ri** Rhus integrifolia
sa	**sa** Salvia apiana
tt	**tt** tobacco tree

(3) Behavioral Observations

Actions	Definition
DB	**DB** dustbathing
DFT	**DFT** defending territorial
F	**F** flight
FIN	**FIN** flight into nest
FON	**FON** flight out of nest
FD	**FD** feeding
FDS	**FDS** feeding self
FDY	**FDY** feeding young
FG	**FG** foraging
H	**H** hopping
M	**M** mating
NB	**NB** nest building
ND	**ND** nest destroying
OBS	**OBS** observing
OF	**OF** overflight
PR	**PR** preening
R	**R** resting
S	**S** singing
SW	**SW** singing warning
BKS	**BKS** beak scraping
TF	**TF** tail fanning

Foraging	Self-Hygiene	Pair Behavior	Flight
Climbing	Beak Scraping	Tail Fanning	Flight
Foraging	Dust Bathing	Wing lift	Flight into Nest
Feeding Self	Defending Territory	Mating	Flight out of Nest
Feeding young	Preening	Nest Building	Over Flight
Hopping	Resting	Nest Destroying	
	Observing		
	Singing or Warning Call		

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout:________________
Date:________________
Time:________________
Site:________________
Traffic:________________
____

Walker:________________
Temperature:________________
Wind Speed:________________
Humidity:________________
Weather:________________
____

Cactus Wren Description:
Grid coordinates:
____
____
Trail Name:__________
____

Aware Prior? Y/N
Sex: M/F/?
Flock Size:________________
ID:________________

Initial:
Perching Height:________________
Substrate:________________
Behavior:________________

After Flight:
Perching Height:________________
Substrate:________________
Behavior (30sec after):
____

Starting Distance (SD)
Walker:________________
CACW:________________
Angle:________________

Alert Distance (AD)
Walker:________________
CACW:________________
Angle:________________

Flight Initiation Distance (FID)
Walker:________________
CACW:________________
Angle:________________

Distance Fled (DF)
Starting Perch Dist:________
Ending Perch Dist:____________
Angle:____________________

Walker Trail Distances between:

SD to AD:________________

AD to FID:________________

SD/AD to FID: ________________

Notes:

FID:______________ AD:______________ Input:__________

Appendix M. Field protocol for a two person approach

Flight Initiation Distance-Cactus Wrens on PVP- Field Protocol

Principle Investigator (PI): Julie McNamara, Master's Student at CSULB, 530.401.2669
Title: *Determining the Set Back Zone for Cactus Wrens on the Palos Verdes Peninsula for Proper Conservation Management*

1. The Approach:

A. Have "Walker" wait at the start of the Reserve trail, while the "Scout" uses an upper trail to locate a CACW.

B. Once a CACW is located using binoculars, assess situation, is the CACW on the move or stationary? Based on the Scouts' assessment they will tell the walker to continue to wait at the trailhead or they will initiate the walk. The Scout and walker will communicate through the use of Motorola walky talkies with ear pieces.

B. Once the walk is initiated, the walker will drop a flag before starting. This is the starting distance (SD).The walker will walk at a steady pace along the trail (0.45m/s).

C. The Scout will determine if the CACW was aware of your presence prior to the walk. If CACW was aware of the walkers' presence, then first flag dropped will be the alert distance (AD) and the starting distance (SD). If CACW was unaware of the walkers presence, then the first flag is only the SD.

D. The Scout will keep eye contact on CACW to determine alert distance. This will be the bird reacting to the walkers' presence by more head movements, body movements and or warning calls.

E. Once the Scout notices a change in the initial behavior, they will relay a "drop" to the walker, who will drop a flag. This is the alert distance (AD).

F. The walker will continue along trail until the Scout relays a final "drop" that indicates that the CACW fled from its original perch. This is the flight initiation distance (FID).

G. The Scout will continue to watch the CACW to try to determine it's behavior, perch height, and substrate 30seconds after it fled.

2. Measurements:

a. The walker will measure the distances between the first (SD) and second flag (AD) and the second flag (AD) and the third flag (FID) OR had the CACW been aware prior to approach the walker will measure the distance between the first flag (SD&AD) and the second (FID) using a Stanley FatMax Blade Armor tape measure (feet).

b. The Scout will fill out top portions of "Field Data Sheet."
-Scout Name
-Walker Name
-Date
-Time
-Site = Reserve Name
-Traffic = amount of human traffic in area (differentiate between runners, walkers, bikers…)

c. Using the Fisher Scientific Traceable Enviro-Meter measure:
-Temperature = degrees Celsius
-Wind Speed = max, min (meters/second)

-Humidity = out of 100, (RH)
-Weather = general description (sunny, partially cloudy, over cast…)

d. Then the Scout will fill out the initial description and after flight description using charts 1-3:
-Perching Height
-Substrate
-Behavior

e. Fill out Cactus Wren Description Box:
- Grid Coordinates = using maps made for each Reserve locate number and letter associated with where the CACW was approached
-Aware Prior = if the CACW noticed the Walker first (Y) or if PI noticed CACW first (N)
-Sex = Male (M)- identified by singing, Female (F) – identified by no singing for a continuous period of time, Unknown (?) – identified by no singing and no pair identification (Juv)- identified by the lack of black patch on chest
-Flock size = is the number of CACW within a 10m circle of focal CACW
-ID = this is only valid for when the PI has established home ranges for specific CACW and given them an identification number

f. The Scout will measure the distance from them to the Walker and the CACW for the SD, AD, and FID using the Bushnell Laser range finder.

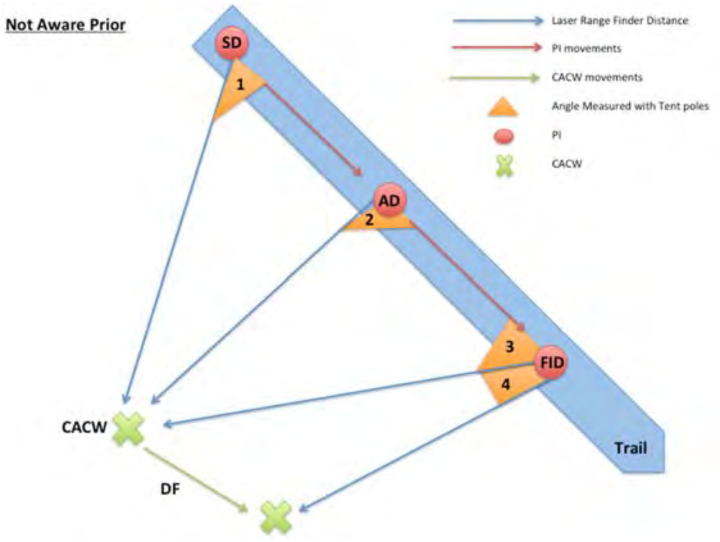
g. The Scout will also measure the angle between the Walker and CACW using a protractor for SD, AD, and FID.

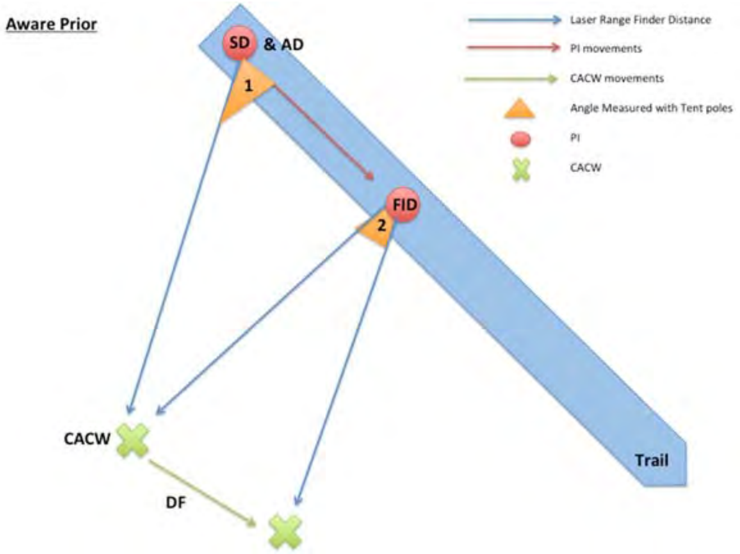
h. The Scout will measure the distance and angle between the CACW's initial perch and location of where the CACW fled this will be recorded under the Distance Fled (DF) section.

i. The Scout will make any other relevant notes in the Notes location or on the back of the paper.

4. Repeat steps 1-2 for new CACW. Do not repeat approach procedures on the same CACW in the same day. If the CACW doesn't respond to the walker or the Scout then the approach may be preformed again on the same CACW.

Flight Initiation Distance-Cactus Wrens on PVP- Field Protocol





Charts:

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mmm	**mmm** man made material
ol	**ol** Opuntia littorilis
pa	**pa** Peritoma aborea
rk	**rk** rock
ri	**ri** Rhus integrifolia
sa	**sa** Salvia apiana
tt	**tt** tobacco tree

(3) Behavioral Observations

Actions	Definition
DB	**DB** dustbathing
DFT	**DFT** defending territorial
F	**F** flight
FIN	**FIN** flight into nest
FON	**FON** flight out of nest
FD	**FD** feeding
FDS	**FDS** feeding self
FDY	**FDY** feeding young
FG	**FG** foraging
H	**H** hopping
M	**M** mating
NB	**NB** nest building
ND	**ND** nest destroying
OBS	**OBS** observing
OF	**OF** overflight
PR	**PR** preening
R	**R** resting
S	**S** singing
SW	**SW** singing warning
BKS	**BKS** beak scraping
TF	**TF** tail fanning

Foraging	Self-Hygiene	Pair Behavior	Flight
Climbing	Beak Scraping	Tail Fanning	Flight
Foraging	Dust Bathing	Wing lift	Flight into Nest
Feeding Self	Defending Territory	Mating	Flight out of Nest
Feeding young	Preening	Nest Building	Over Flight
Hopping	Resting	Nest Destroying	
	Observing		
	Singing or Warning Call		

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout:__________________
Date:__________________
Time:__________________
Site:__________________
Traffic:__________________
____

Walker:__________________
Temperature:__________________
Wind Speed:__________________
Humidity:__________________
Weather:__________________
____

<u>Cactus Wren Description:</u>
Grid coordinates:
____
____
Trail Name:____________
____

Aware Prior? Y/N
Sex: M/F/?
Flock Size:__________________
ID:__________________

<u>Initial:</u>
Perching Height:__________________
Substrate:__________________
Behavior:__________________

<u>After Flight:</u>
Perching Height:__________________
Substrate:__________________
Behavior (30sec after):
____

Starting Distance (SD)
  Walker:__________________
  CACW:__________________
  Angle:__________________

Alert Distance (AD)
  Walker:__________________
  CACW:__________________
  Angle:__________________

Flight Initiation Distance (FID)
  Walker:__________________
  CACW:__________________
  Angle:__________________

Distance Fled (DF)
  Starting Perch Dist:_________
  Ending Perch Dist:______________
  Angle:________________________

<u>Walker Trail Distances between:</u>

SD to AD:__________________

AD to FID:__________________

SD/AD to FID: __________________

Notes:

FID:________________ AD:_______________ Input:___________

Appendix N. Raw data collection sheets

Flight Initiation Distance of Cactus Wrens in PVP Data Sheet

Date: 9!7!13
Time: 9:26am
Site: AVP
Traffic: none

Temperature: 18.7° C
Wind speed: max 1.0 m/s/min 0.7
Humidity: 75.8 % RH
Weather:
over cast

Cactus Wren Information
Grid coordinates:
F7

Trail Name: S. Spur trail

Mated Pair? [✓ Y]/N
Sex: M / [✓ F]
Flock Size: 2
~~AFFT~~ AVOID

Initial:
Perching Height: waist high bush @ top
Substrate: Dead Brush
Behavior: OBS

After Flight:
Perching Height: Low
Substrate: op. lit
Behavior (30sec after):
w/in opuntia

Starting Distance (SD): 13.74, -17, 13
↕ same
Alert Distance (AD):

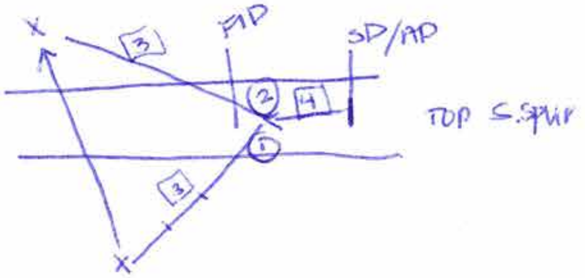
Flight Initiation Distance (FID): 13.74, -17, 13

Distance from Trail: 27.2, 19.6, 26

Landing changes between:
SD & AD: Ø
AD & FID: 7 ft.

Triangle Reference Distance from trail (sharpie): ① 152 inches ② 154 inches

Notes:
one flew first (my obs) then second flew @ 30sec after.



① protractor 160
② 180

clean

sample #
FID: excluded

Input:

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 9.29.13
Time: 8:18 am
Site: AVP
Traffic: 1 walker (P)
Dog (O)

Walker: Doreen
Temperature: 21.9°C
Wind Speed: 2.6 m/s - 0.5 m/s
Humidity: 62.2 % RH
Weather: sunny, no clouds

Cactus Wren Description:

- Grid coordinates: F7

- Trail Name: B Spur

Aware Prior? Y/ [✓ N]
Sex: M/F/ [✓ ?]
Flock Size: 1

ID: AV01D

Initial:
Perching Height: med 1M
Substrate: Dead Branch DD
Behavior: 0:36

After Flight:
Perching Height: OFS
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance (SD)
Walker: 90, -20, 85 yards
CACW: 18.6, -27, 16 yards
Angle: 45°

Alert Distance (AD)
Walker: 92, -18, 804
CACW: " "
Angle: 44°

Flight Initiation Distance (FID)
Walker: 87, 18, 82
CACW: " "
Angle: 41°

Distance Fled (DF)
Starting Perch: OFS
Ending Perch: OFS
Angle: OFS

Walker Trail Distances between:

SD & AD: 13' 7" 156" + 7" = 163"

AD & FID: 20' 3" 240" + 3" = 243"

Notes:

- Bird saw walker & went through FID process
- CACW fled around ridge so i couldnt record After Flight info & DF info.

sample # ~~FID~~: 1

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 2/17/ 14
Time: 8:44am
Site: AVP
Traffic: 3 humans

Walker: Arne
Temperature: 14.2°C
Wind Speed: 0 m/s
Humidity: 76.5 %RH
Weather: overcast

Cactus Wren Description:
Grid coordinates: F7
Trail Name: South spur trail

Aware Prior? [✓ Y]/N
Sex: M/F/[✓ ?]
Flock Size: 1
ID: AVOID

Juv - fresh feather or just molted* (PACK)
not calling.

Initial:
Perching Height: shoulder height 1.5m
Substrate: PP 01
Behavior: OBG - quite no calls

After Flight:
Perching Height: ground (0) ≤ 0.5
Substrate: [illegible] Bg
Behavior (30sec after): OFS

Starting Distance (SD)
Walker:
CACW:
Angle:

Walker Trail Distances between:

~~SD & AD: N/A~~

SD/AD & FID: 36' 8" 432+8=440"

Alert Distance (AD)/SD
Walker: 49y, -18°, 39y
CACW: [illegible] 18.3, 19°, 18y
Angle: 8°

Flight Initiation Distance (FID)
Walker: 2° 14, 79, 27y
CACW: [illegible] same
Angle: 35°

Distance Fled (DF)
Starting Perch: PP
Ending Perch: ground OFS Bg
Angle: 25°

Notes:
CACW noticed walker prior, SD ⊕ AD = same
it did Δ behavior prior to flight (actively moving head & moved body position.)

sample # ~~FID~~: 2
AD:
Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.2.14
Time: 8:26 am
Site: AVP
Traffic: None

Walker: Raban
Temperature: 16.8 C°
Wind Speed: 0.0
Humidity: 88.5
Weather: overcast → slight rain.

Cactus Wren Description:
Grid coordinates:
B6, B7
C6, C7
Trail Name: Alta Vicente trail

Aware Prior? Y/[✓ N]
Sex: M/F/[✓ ?]
Flock Size: 1

ID: AV018

Initial:
Perching Height: 1.5 m
Substrate: PP 01
Behavior: Nest building NB

After Flight:
Perching Height: OFS
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance (SD)
0° on CACW
Walker: 744, -24, 654
CACW: 20.8, -24, 194
Angle: 75°

Alert Distance (AD)
Walker: 454, -24, 41
CACW: 20.9, -25 19,
Angle: 25°

Flight Initiation Distance (FID)
Walker: 71 4, -24, 654
CACW: 404-25, 424
Angle: 35°

Distance Fled (DF)
Starting Perch: OFS
Ending Perch: OFS
Angle: OFS

Walker Trail Distances between:

SD & AD: 142' 1704"

AD & FID: 44' 528"

Notes:

sample #
FID: Excluded

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.7.14
Time: 9.45am
Site: AVP
Traffic: None

Walker: Doreen
Temperature: 19.5 °C
Wind Speed: 1.2 M/s
Humidity: 59% RH
Weather: sunny partly cloudy

Cactus Wren Description:
Grid coordinates:
F7

Trail Name: Mta Viente trail

Aware Prior? Y/[✓ N]
Sex: [✓ M]/F/?
Flock Size: 1

ID: AV01DM

Initial:
Perching Height: 1.5(F)
Substrate: OV
Behavior: calling S

After Flight:
Perching Height: ground <0.5
Substrate: OFS BG
Behavior (30sec after):
OFS

Starting Distance (SD)
Walker: 82.2, -19, 78y
0° CACW: 68, -12, 67
Angle: 70°

Alert Distance (AD)
Walker: 71.9, -21, 61y
CACW: 71, 72, 70y
Angle: 80°

Flight Initiation Distance (FID)
Walker: 67.7, -19, 104y
0° CACW: 68, -12, 674
Angle: 32°

Distance Fled (DF)
Starting Perch: 68, -12, 674
0° Ending Perch: 48, -13, 47y
Angle: 30°

Walker Trail Distances between:

SD & AD: 39'3" 468+3 = 471"

AD & FID: 158',4" 1896+4= 1900"

Notes:

sample # 3
~~FID:~~

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.9 14
Time: 8.06 am
Site: 3 sisters
Traffic: Biker prior

Walker: Elan
Temperature: 19.8°C
Wind Speed: 1.3 m/s
Humidity: 25.2% RH
Weather: partly cloudy w/ breeze.

Cactus Wren Description:

Grid coordinates: K5

Trail Name: barkentine trail by houses.

Aware Prior? [✓ Y]/N
Sex: M/F/[✓ ?]
Flock Size: 1

ID: 3501A

Initial:

Perching Height: 1.5 m
Substrate: opuntia 01
Behavior: obs

After Flight:

Perching Height: 1m
Substrate: opuntia 01
Behavior (30sec after): Hopping w/in H

Starting Distance (SD)
Walker: 63"
CACW: 23.9, -29, 20
Angle: 160°

same

Alert Distance (AD)
Walker: 102"
CACW:
Angle: 150°

Flight Initiation Distance (FID)
Walker: 124"
CACW: 20.5, -29, 18
Angle: 140°

Distance Fled (DF) 239, -29, 20
Starting Perch: opuntia ●
Ending Perch: opuntia X
Angle: 30°

Walker Trail Distances between:

SD & AD: 78"

AD & FID: 33"

Notes:

sample # 4

~~FID~~: AD: Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.9.14
Time: 9 15am
Site: AVP
Traffic: no

Walker: Elan
Temperature: 23.3°C
Wind Speed: 1.0 m/s
Humidity: 29.5 % RH
Weather: partly cloudy, Breeze

Cactus Wren Description:

Grid coordinates: C7, D7

Trail Name: Alta Vicente Trail

Aware Prior? Y [✓ N]
Sex: [✓ M]/F/?
Flock Size: 2

ID: AJ01 B

Initial:

Perching Height: 1.5 m
Substrate: opuntia 01
Behavior: calling S

After Flight:

Perching Height: 0.5 m
Substrate: dead tobacco tree #
Behavior (30sec after): calling S

Starting Distance (SD)/AD
0° Walker: 69.9, -19 ,66
CACW: 40.7, -19 , 37
Angle: 80°

Alert Distance ~~(AD)~~
~~Walker:~~
~~CACW:~~
Angle:

Flight Initiation Distance (FID)
0° Walker: 65.1 -21 64
CACW: 40.7, -19, 37
Angle: 55°

Distance Fled (DF)
0° Starting Perch: opuntia 40.7, -19, 37
Ending Perch: dead tobacco 31.6, -27, 29
Angle: 50°

Walker Trail Distances between:

SD & AD:
AD & FID: 67' 804"

Notes:

sample #
~~FID~~: 5
AD:
Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3 15.14
Time: 837am
Site: 3SP
Traffic: none

Walker: Doreen
Temperature: 20°C
Wind Speed: 0.5m/s
Humidity: 67.6 %RH
Weather: sunny w/ Haze

Cactus Wren Description:
Grid coordinates: J6, J7
Trail Name: Barkentine

Aware Prior? Y/[✓ N]
Sex: [✓ M]/F/?
Flock Size: 1
ID: 3501AM

Initial:
Perching Height: 1.5m
Substrate: PP OL
Behavior: OBS

After Flight:
Perching Height: 0.5 m
Substrate: PD OL
Behavior (30sec after): OBS → calling 1 min after

Starting Distance (SD)
Walker: 6' 6" 72+6=78"
CACW: 23.4y, -30, 29y
Angle: 180°

Alert Distance (AD)
Walker: 15' 8" 180+8=188"
CACW: 23.4y, -30, 29y
Angle: 165°

Flight Initiation Distance (FID)
Walker: 18.7, -6, 19y
CACW: 23.4y, -30, 29y
Angle: 90°

Distance Fled (DF)
Starting Perch Dist: 23.4y, -30, 29y
Ending Perch Dist: 35.7y, -26, 32y
Angle: 60°

Walker Trail Distances between:
SD to AD: 14' 9" 168+9=177"
AD to FID: 40' 2" 480+2=482"
SD/AD to FID: n/a

Notes:

sample #
FID: 6
AD:
Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.15.14
Time: 930 am
Site: AVP
Traffic: none

Walker: Doreen
Temperature: 25.7 °C
Wind Speed: 0.3m/s
Humidity: 58.4 %RH
Weather: sunny w/ haze

Cactus Wren Description:
Grid coordinates:
D7, E7

Trail Name: Alta Vicente trail

Aware Prior? [✓ Y]/N
Sex: M/F/[✓ ?] possibly ♂
Flock Size: 2

ID: AV010

Initial:
Perching Height: ground <0.5
Substrate: BG
Behavior: FG

After Flight:
Perching Height: OFS
Substrate: OFS
Behavior (30sec after):
S

Starting Distance (SD)/AD
Walker: 72.9, -19, 70
CACW: 10.9, -39, 94
Angle: 30°

Alert Distance (AD)
Walker:
CACW:
Angle:

Walker Trail Distances between:

SD to AD: n/A

AD to FID: n/A

SD/AD to FID: 24"

Flight Initiation Distance (FID)
Walker: 75.5, -18, 72
CACW: 10.8, 8-38, 8
Angle: 10°

Distance Fled (DF)
Starting Perch Dist: 10.8, -38, 8
Ending Perch Dist: OFS
Angle: 50°

Notes:

sample #
~~FID~~: 7

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Date: 3.15.14
Time: 9:46am
Site: AVP
Traffic: yes 1 walker (+) Dog, Biker

Temperature: 23°C
Wind Speed: 2.4 m/s
Humidity: @ 56.2 % RH
Weather: sunny w/ Haze

Cactus Wren Description:
Grid coordinates:
C7, D7
upper trail
Aware Prior? [✓ Y]/N

Sex: [✓ M]/F/?
Flock Size: 1
ID: AV01B

Initial:
Perching Height: >1.5m
Substrate: mmm - wire TP
Behavior: S

After Flight:
Perching Height: OFS
Substrate: OFS
Behavior (30sec after):
calling s

Starting Distance (SD): 31 +, 15, 30y

Alert Distance (AD): 14, +28, 13y

Flight Initiation Distance (FID): 11, +39, 9y

Distance Fled (DF): OFS

Trail Distances between:

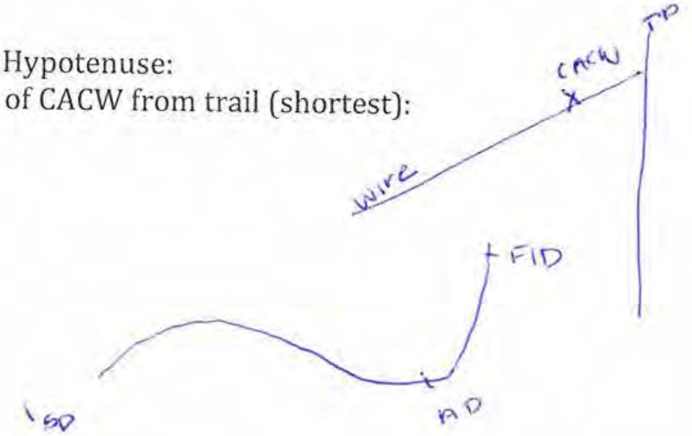
SD & AD: 53 my feet 153"

AD & FID: 13.5 my feet 135"

10" = 1 feet

Triangle Hypotenuse:
Distance of CACW from trail (shortest):

Notes:



CACW calling a lot prior & After approach.

sample # FID: 8

AD:

Input:

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.15.14
Time: 10:00 am
Site: AVP
Traffic: none

Walker: Doreen
Temperature: 26.8°c
Wind Speed: 2.5 mph
Humidity: 52% RH
Weather: sunny w/ Hazy

Cactus Wren Description:

Grid coordinates:
E7
F7
Trail Name: Alta Vicente trail

Aware Prior? Y/ [✓ N]
Sex: [✓ M] /F/?
Flock Size: 1
ID: AV01DM

Initial:

Perching Height: >1.5M
Substrate: tt
Behavior: S

After Flight:

Perching Height: OFS
Substrate: OFS
Behavior (30sec after): S

~ 2min after went back to same perch & S

Walker Trail Distances between:

SD to AD: 43' 10" 516+10=526"

AD to FID: 8' 2" 96+2=98"

SD/AD to FID: n/a

Starting Distance (SD)
Walker: 66, -19, 62
CACW: 67, -10, 66
Angle: 80°

Alert Distance (AD)
Walker: 68, -16, 65
0 CACW: same
Angle: 65°

Flight Initiation Distance (FID)
Walker: 69.5, -16, 67
0 CACW: same
Angle: 60°

Distance Fled (DF)
Starting Perch Dist: same
Ending Perch Dist: OFS
Angle: 160°

Notes:

sample # 9

FID:

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Date: 3.16.14
Time: 847am
Site: AVP
Traffic: Dogwalker

Temperature: 22.8°C
Wind Speed: 0 m/s
Humidity: 52.2 % Rt
Weather: sunny

Cactus Wren Description:
Grid coordinates:
F6, F7
upper trail
Aware Prior? [✓ Y]/N

Sex: M/F/[✓ ?]
Flock Size: 1
ID: AVOID

Initial:
Perching Height: >0.5
Substrate: PP OL
Behavior: H

After Flight:
Perching Height: >0.5
Substrate: PP OL
Behavior (30sec after):
H

Starting Distance (SD) AD: 74, -7, 74

~~Alert Distance (A~~D):

Flight Initiation Distance
(FID): 6.8, -12, 74

Distance Fled (DF): 7.8, -8, 74

Trail Distances between:

(~~SD & AD~~:

SD/AD & FID: 72U" 6 my feet

11" = 1 feet

Triangle Hypotenuse:
Distance of CACW from trail (shortest):

Notes:
was in PP low & as I approached it
Δ behave. possibly ♀ or juv - not clear ID

sample #
~~FID~~: 10

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Date: 3.16.14
Time: 826 am
Site: AVP
Traffic: none

Temperature: 21°C
Wind Speed: 0.3m/s
Humidity: 51.2 % RH
Weather: sunny

Cactus Wren Description:

Grid coordinates:
C6, C7
Vyper trail
Aware Prior? Y/ [✓ N]

Sex: [✓ M]/F/?
Flock Size: 1
ID: AV 01B

Initial:

Perching Height: 71.5m
Substrate: mmm- TP wire
Behavior: S

After Flight:

Perching Height: 1m
Substrate: PP
OL
SO
Behavior (30sec after):
OBS

Starting Distance (SD): 48, t5, 48 Y

Alert Distance (AD): 18.2, 12, 18 Y

Flight Initiation Distance (FID): 17.2, t13, 17 Y

Distance Fled (DF): 18.4, -4, 18 Y

1 min after went back to same perch (lower) calling

Trail Distances between:

SD & AD: 1353" , 123 my feet

AD & FID: 77" 7 my feet

11" = 1 my feet

Triangle Hypotenuse:
Distance of CACW from trail (shortest):

Notes:

Trail winded around so Distances are not direct.
CACW was calling prior & after.
He did the SW when Dog walker approached
after → may see dogs ~~[illegible]~~ as more of threat?

sample # ~~FID~~: 11

AD:

Input: ✓

Date 3.17.14
Time 135 pm
Site AVP
Tra none on
upper traile

35°C
0 6 m/s
36% RH
sunny

Cac
Grid
C6, C7

Tra
upper trail

A /Ⓝ
S Ⓐ
1
AV01B

In
Pe >1.5
Subs mmm- TP wire
Be S

< 0.5
PP OL
after):
S

Sta 47, +2, 46y

Ale 20.4, +11, 20y

between:

Fli
(FI 6.3, +42, 5y

1089" 99 my feet

649" 59 my feet

Dis 12.9, -6, 13y

11" = 1 my feet

large Bush in field of view B/W AD & SD
⇒ might have allowed me to get closer b/4 FID

sample # 12

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Date: 3.17.14
Time: 1:12pm
Site: AVP
Traffic: none

Temperature: 33°C
Wind Speed: [illegible] 1.0 m/s
Humidity: 34.5 % RH
Weather: sunny, no clouds

Cactus Wren Description:
Grid coordinates: F7, G7
Aware Prior? Y/ [✓ N]
S. Spur trail

Sex: M/F/ [✓ ?]
Flock Size: 1
ID: AV01D

Initial:
Perching Height: 71.5 m
Substrate: TT
Behavior: Pr

After Flight:
Perching Height: OFS
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance (SD): 57.3, -13, 67y

Alert Distance (AD): 38.2, -14, 37y

Flight Initiation Distance (FID): 30.7, -13, 30y

Distance Fled (DF): [illegible]
NO DF - OFS

Trail Distances between:

SD & AD: 786.5" 71.5 my feet

AD & FID: 280.5" 25.5 my feet

11" = 1 my feet

Triangle Hypotenuse:
Distance of CACW from trail (shortest):

Notes:

sample # ~~FID~~: 13

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.19.14
Time: 9 08am
Site: AVP
Traffic: prior two walkers w/ 1 Dog

Walker: Anne
Temperature: 19.1°C
Wind Speed: 1.9 m/s
Humidity: 67.7%RH
Weather: sunny

Cactus Wren Description:

Grid coordinates:
F6
F7
Trail Name: Alta Vicente trail - walker
S.Spur - crew

Aware Prior? Y/[✓ N]
Sex: [✓ M]/F/?
Flock Size: 1
ID: AVOID

Initial:
Perching Height: 1 5m
Substrate: PP 01
Behavior: S

After Flight:
Perching Height: 1 5m
Substrate: PP 0L
Behavior (30sec after):
OBS

Starting Distance (SD)/AD
Walker: ~~[illegible]~~ 112. ,-16, 113
0 CACW: 46.3, -9, 464
Angle: 145°

~~Alert Distance (AD)~~
~~Walker:~~
~~CACW: same~~
~~Angle:~~

Flight Initiation Distance (FID)
Walker: 99, -17, 954
0 CACW: same
Angle: 140°

Distance Fled (DF)
Starting Perch Dist: 46.6, -9, 464
Ending Perch Dist: 59.9, -8, 594
Angle: 140°

Walker Trail Distances between:

SD to AD: n/a

AD to FID: n/a

SD/AD to FID: 85' 2" 1020+2= 1022"

Notes:
- walker was pretty far away.
- could have possibly responded to something else that Im not aware of.

sample # ~~FID:~~ Excluded

AD:

Input: ✓

Flight Initiation Distance of Cactus Wrens on PVP Field Data Sheet

Date: 3.19.14
Time: 836 am
Site: AVP
Traffic: none

Temperature: 19.1°C
Wind Speed: 0.3m/s
Humidity: 69.7% RH
Weather: sunny, slight marine layer

Cactus Wren description
Grid coordinates:
C6
C7
Trail Name:
upper trail

Aware of Observer Y/[✓ N]
Sex [✓ M]/F
Number: 1
ID: AV01B no band

Initial
Perching Height (m): >1.5
Substrate: mmm - TP wire
Behavior: S

AFTER FID
Perching Height: < 1m
Substrate: PF 01
Behavior (30sec after):
S

Starting Distance (SD): 69, 0, 69y

Alert Distance (AD): 54, 0, 54y

Flight Initiation Distance
(FID): 17, +8, 17y

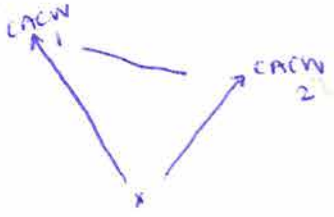
Distance Fled (m):
↓ TO be calc

Calculate distances between:

SD & AD 781" 71 my felt.

AD & FID 1364" 124 my felt

11" = 1 my feet



① = 9.9, +5, 10y

② = 15.7, +5, 15y

Triangle Hypotenuse
Distance of CACW from trail (shortest)

Notes: we tried to approach him from bottom trail but there was no response.

so I approached from upper trail

sample # ~~FID~~ 14

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.21.14
Time: 9:13
Site: 3SP
Traffic: None

Walker: Jacky
Temperature: 17.7°C
Wind Speed: 2.3 m/s
Humidity: 63% RH
Weather: overcast

Cactus Wren Description:
Grid coordinates:
J6

Trail Name:
Barkentine trail

Aware Prior? [✓ Y]/N
Sex: [✓ M]/F/?
Flock Size: 1

ID: ~~35~~ 3501A

Initial:
Perching Height: 1.0 m
Substrate: tt
Behavior: obs

After Flight:
Perching Height: < 0.5
Substrate: ground B9
Behavior (30sec after): OFS

Starting Distance (SD)/AD
Walker: 36, -2, 36 y
CACW: 34.3, -5, 34 y
Angle: 160

Alert Distance (AD)
Walker:
CACW:
Angle:

Flight Initiation Distance (FID)
Walker: 30.7, -2, 31 y
CACW: same
Angle: 140

Distance Fled (DF)
Starting Perch Dist: same
Ending Perch Dist: OFS
Angle: 40°

Walker Trail Distances between:

SD to AD: n/a

AD to FID: n/a

SD/AD to FID:

226''

Notes:
CACW saw scout first

sample # ~~FID~~: 15 AD: Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 3.21.14
Time: 8:32
Site: AVD
Traffic: none

Walker: Jacky
Temperature: 16.4°C
Wind Speed: 0.7 m/s
Humidity: 66.1 %RH
Weather: overcast

Cactus Wren Description:

Grid coordinates: E7, F7

Trail Name: Alta Vicente trail

Aware Prior? [✓ Y]/N
Sex: M/[✓ F]/?
Flock Size: 1
* ID: AV010F saw pair 1mn later

Initial:
Perching Height: >1.5
Substrate: PP 0L
Behavior: NB

After Flight:
Perching Height: <0.5
Substrate: ground Bq
Behavior (30sec after): OFS

Starting Distance (SD)/AD
0 Walker: 85.5, 11, 84
CACW: 33.4, -23, 31
Angle: 50°

~~Alert Distance (AD)~~
~~Walker:~~
~~CACW: same~~
~~Angle:~~

Flight Initiation Distance (FID)
Walker: 76.2, -12, 75
CACW: same
Angle: 55°

Distance Fled (DF)
0 Starting Perch Dist: 33.1, -23, 30
Ending Perch Dist: OFS
Angle: 70°

Walker Trail Distances between:

SD to AD: n/a

/AD to FID: n/a

SD/AD to FID: 507"

194" + 313" → ✓ on this pics

Notes:

sample # ~~FID:~~ 16

AD:

Input: ✓

Date: 3.21.14
Time: 8:11
Site: AVP
Traffic: bikers

Temperature: 16.9°C
Wind Speed: 0.6 m/s
Humidity: 64.420 RH
Weather: overcast

Cactus Wren Location
Grid coordinates:
C6, C7

Trail Name:
upper trail

Aware Prior? Y/ [✓ N]
Sex: [✓ M]/F
Markers: 1
ID: AV01B

Initial:
Perching Height: 7.5m
Substrate: mmm - TP wire
Behavior: S

Perched After:
Perching Height: 1.5m
Substrate: rp ol
Behavior (30 sec after):
S - new scold w/ tail pump

Starting Distance (SD): 47, +3, 47y

Alert Distance (AD): 13.7, 7, 14y

Flight Initiation Distance (FID): 10.3, +21, 10

Distance Flown (DF):
from 10.1 +23, 10y
to 8.5, -9, 8y

Distances between:
SD & AD: 726" 66 my feet
AD & FID: 990" 90 my feet
11" = 1 my feet

Triangle Hypotenuse
Distance of CACW from trail (shortest)

Notes:

sample # ~~FID:~~ 17

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4 6. 14
Time: 8 11 am
Site: AVP
Traffic: jogger (P) walker post FID

Walker: Alicia
Temperature: 19.0 °C
Wind Speed: 0.7 m/s
Humidity: 61.7 %RH
Weather: sunny, no clouds

Cactus Wren Description:

Grid coordinates:
D7
E7
Trail Name: Alta Vicente trail

Aware Prior? Y [✓ N]
Sex: [✓ M]/F/?
Flock Size: 2
ID: AVO1DM same pair that lives @ F7

Initial:

Perching Height: 1.5 m
Substrate: PP OL
Behavior: OBS

other cacw < 0.5m ground GF

Starting Distance (SD)
~~Walker~~: 39.1, -27, 31y
CACW: ~~35.5, -29, 31y~~
Angle: 60°

0 walker: 85.9, -14, 83y

Alert Distance (AD)
0 Walker: 67, -22, 62y
CACW: ~~35~~ 35.5, -29, 31y
Angle: 40

Flight Initiation Distance (FID)
Walker: 70.7, -22, 71
0 CACW: 35.5, -29, 31y
Angle: 55

Distance Fled (DF)
Starting Perch Dist: 35.7, -29, 31y
0 Ending Perch Dist: ~~50~~ 40, -7, 40y
Angle: 100°

After Flight:

Perching Height: 71.5m * By nest
Substrate: PP OL
Behavior (30sec after): SW to Dog walker

other cacw grabbed nesting material & flew off to new nest

Walker Trail Distances between:

SD to AD: ~~46' 11"~~ 97' 7" + 46' 11"
1164+7 + 552 + 11 = 1734

AD to FID: 169' 6" 2028 + 6 = 2034

SD/AD to FID: n/a

Notes: see Alicia's text for ✓ Distances.

sample # ~~FID~~: 18

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.6.14
Time: 9:37
Site: 356
Traffic: none

Walker: Alicia
Temperature: 29.5°C
Wind Speed: 0.1 m/s
Humidity: 41.9% RH
Weather: sunny, no clouds

Cactus Wren Description:

Grid coordinates:
J6
J7
Trail Name:
Barkentine trail

Aware Prior? Y/[✓ N]
Sex: M/F/[✓ ?]
Flock Size: 1

ID: 3561 A

Initial:

Perching Height: >1.5m
Substrate: RF
Behavior: OBS

After Flight:

Perching Height: 1 m
Substrate: unknown shrub on fence unkn
Behavior (30sec after):
OFS

Starting Distance (SD)
Walker: 0
CACW: 339, -17, 334
Angle: 180

Alert Distance (AD)
Walker: 12' 6" 144+6 = 150"
CACW: same
Angle: 100

Flight Initiation Distance (FID)
Walker: 16, -7, 16
CACW: same
Angle: 85°

Distance Fled (DF)
○ Starting Perch Dist: 339, 17, 334
Ending Perch Dist: 77, -2, 774
Angle: 80°

Walker Trail Distances between:

SD to AD: 12' 1" 144+1 = 145"

AD to FID: 33' 11" 396+11 = 407"

SD/AD to FID: N/A

Notes:

sample # ~~FID~~: 19

AD:

Input: ✓

4.6.14
9:10 am
AVP
yes - 1 walker
was stopped @
bottom of
south spur as
I approached

24.7°C
31.2% RH
0.7 m/s

sunny no
clouds

---

y - aware prior
south spur
upper trail F6, F7

sex ?
1

ID: AVOID

---

initial -
flight 1 m
PP o2
OBS carrying
nesting material

OFS
OFS
OFS

Trail
SD/AD → FID

SD/AD 38, -15, 37y

15 my feet 165"

11" = 1 my feet

FID 35, -15, 34y

DF - OFS

input ✓

sample # 20

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Date: 4.6.14
Time: 8:47am
Site: PVP
Traffic: none

Temperature: 19.7°C
Wind Speed: 0 m/s
Humidity: 51.8 % RH
Weather: sunny
no clouds

Cactus Wren Description:
Grid coordinates:
C6
C7
Aware Prior? Y/[✓ N]
Trail name: upper trail

Sex: [✓ M]/F/?
Flock Size: 1
ID: AV01B

Initial:
Perching Height: >1.5m
Substrate: mmm- TP wire
Behavior: S

After Flight:
Perching Height: 1.5m
Substrate: PP OL
Behavior (30sec after):
SW w/ Tail pump

Starting Distance (SD): 52, +1, 52

Alert Distance (AD): 36.2, +6, 36y

Flight Initiation Distance (FID): 18.1, +10, 18

Distance Fled (DF):

~~SD~~

DF 28.4, -4, 284

Trail Distances between:

SD & AD: 715" 65 my feet

AD & FID: ~~9~~ 704" 64 my feet

11" = 1 my feet

Triangle Hypotenuse:
Distance of CACW from trail (shortest):

Notes:

sample #
~~FID~~: 21
AD:
Input: ✓

8

Female to pair

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.7.14
Time: 930 am
Site: 3SP
Traffic: none

Walker: Alyssa
Temperature: 30.3°C
Wind Speed: 0.7 m/s
Humidity: 31.0 % RH
Weather: sunny, no clouds

Cactus Wren Description:

Grid coordinates:
J6
J7

Trail Name:
parkenme trail

Aware Prior? Y/[✓ N]
Sex: M/[✓ F]/?
Flock Size: 2

ID: ~~#~~W0501A

Initial:
Perching Height: 7 1.5
Substrate: tt
Behavior: OBS

After Flight:
Perching Height: 1.5
Substrate: PP OL
Behavior (30sec after):
NB

Starting Distance (SD)
Walker: 0
CACW: 26.9, -11, 264
Angle: 180

Alert Distance (AD)
Walker: 11.5, -4, 11y
CACW: 26.9, -11, 26y
Angle: 40

Flight Initiation Distance (FID)
Walker: 33.3, -1, 33y
CACW: 31, -9, 31y
Angle: 50

Distance Fled (DF)
Starting Perch: 30.8, -7, 31
Ending Perch: 33, -5, 63
Angle: 40

Walker Trail Distances between:

SD & AD: 1076 cm 423.62"

AD & FID: 1839 cm 724.015"

Notes:

sample # ~~FID:~~ 22

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

(x) male to pair

Scout: Julie
Date: 4.7.14
Time: 9:19am
Site: 350
Traffic: none

Walker: Alyssa
Temperature: 30.3°C
Wind Speed: 0.7 m/s
Humidity: 31.0% RH
Weather: sunny, no clouds

Cactus Wren Description:

Grid coordinates:
J6
J7
Trail Name:
Barkentine trail

Aware Prior? Y/[✓ N]
Sex: [✓ M]/F/?
Flock Size: 1
ID: 3501A

Initial:
Perching Height: 71.5 m
Substrate: RI
Behavior: OBS

After Flight:
Perching Height: 1.5
Substrate: PP DL
Behavior (30sec after):
OBS

Starting Distance (SD)
Walker: 0
CACW: 32.5, -18, 32Y
Angle: 180°

Alert Distance (AD)
Walker: 11.1, -5, 11Y
CACW: 33.3, -16, 32
Angle: 80°

Flight Initiation Distance (FID)
Walker: 29.6, -3, 30Y
0 CACW: 33.3, -16, 32Y
Angle: 60°

Distance Fled (DF)
0 Starting Perch Dist: 33.3, -16, 32Y
Ending Perch Dist: 54, -5, 54Y
Angle: 70°

Walker Trail Distances between:

SD to AD: 860# cm 338.58"
AD to FID: 16# 66# cm 655.9"
SD/AD to FID: N/A

Notes:

sample # ~~FID~~: 23
AD:
Input: ✓

Flight Initiation Distance Cactus Wrens in PVP: Field Data Sheet

Date: 4.7.14
Time: 8:28
Site: PVP
Traffic: 1 lady standing

Temperature: 25.0°C
Wind Speed: 0 m/s
Humidity: 42.9 %RH
Weather: sunny, no clouds

Cactus Wren Information
Grid coordinates: C6 C7
Trail Name: Upper trail

Aware of you? [✓ Y]/N
Sex: [✓ M]/F
Flock size: 1
ID: AVOIB

Initial
Perching Height: 71.5
Substrate: mmm - TP wire
Behavior: OBS

After Flight
Perching height: <0.5
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance: N/A

SD / Alert Distance (AD): 37, +2, 374

Flight Initiation Distance (FID): 9.6, +22, 94

Distance Walked:
St. 8.4, +22, 84
FID 18.5, -7, 184

GPS distances between:
SD & AD: N/A
SD / AD & FID: 1149.5" 104.5 my feet
11" > 1 my feet

Triangulation distances:
Distance ... (show all)

Notes:

Sample # ~~FID:~~ 24

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.7.14
Time: 8:05am
Site: PVP
Traffic: none

Walker: Alyssa
Temperature: 20.6 °C
Wind Speed: 0.4 m/s
Humidity: 53.2%RH
Weather: sunny, no clouds

Cactus Wren Description:
Grid coordinates: F7
Trail Name: South spur trail

Aware Prior? Y/ [✓ N]
Sex: M/F/ [✓ ?]
Flock Size: 1
ID: AVOID

Initial:
Perching Height: >1.5 m
Substrate: tt
Behavior: preening pr

After Flight:
Perching Height: <0.5
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance (SD)
Walker: 0
CACW: 39, -14, 384
Angle: 130°

Alert Distance (AD)
Walker: 47, -12, 464
CACW: ~~54, -20, 554~~ 38, -22, 354
Angle: 100

Flight Initiation Distance (FID)
Walker: 50.2, -16, 48
CACW: same AD
Angle: 80°

Distance Fled (DF)
Starting Perch Dist: same AD
Ending Perch Dist: OFS
Angle: 140°

Walker Trail Distances between:

SD to AD: 22' 60 cm 889.76"

AD to FID: 13' 63 cm 536.61"

SD/AD to FID: n/a

Notes:

sample # ~~FID:~~ 25
AD:
Input: ✓

Flight Initiation Distance on Cactus Wrens on PVP- Field Data Sheet

Date: 4.11. 14
Time: 7:50
Site: AVP
Traffic: upper trail

Temperature: 19.7
Wind Speed: 0 M/S
Humidity: 61.8% RH
Weather: sunny, no clouds

Cactus Wren Observation
Grid coordinates:
E7

Trail Name:
upper trail

Aware of Observer: O N
Sex: M O
Flock Size: 1
ID: ~~[illegible]~~ AVOIDF

Initial:
Perching Height: 1.5
Substrate: OL
Behavior: OBS

After Flush:
Perching Height: < 0.5
Substrate: Bg
Behavior (30sec after): OFS

~~Starting Distance:~~

SD/Alert Distance (AD): 36.5, -11, 36

Flight Initiation Distance
(FID): 33.2, -9, 334

Distance Fled (DF):
o ① 33.2, -9, 334
② 41.8, -9, 414 ∡ 40°

Calculations between:
SD & AD: N/A
SD/AD & FID: 154" 14 my feet pik crocs
crocks = 11"

Triangle Hypotenuse:
Distance of CACW from trail [shortest]

Notes:

sample# ~~FID:~~ 26 Alt: Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.11.14
Time: 8:05 am
Site: AVR
Traffic: ~~[illegible] alta~~
~~vicente trail~~
NONE

Walker: Elan
Temperature: 19.7 °C
Wind Speed: 0 m/s
Humidity: 61.8 % RH
Weather: sunny, no clouds

Cactus Wren Description:
Grid coordinates:
F7

Trail Name:
Alta Vicente Trail

Aware Prior? [✓ Y]/N
Sex: [✓ M]/F/?
Flock Size: 2

ID: AV01DM

Initial:
Perching Height: 71.5
Substrate: RI - clad
Behavior: S

After Flight:
Perching Height: OFS
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance (SD)/AD
Walker: 77.5, -20, 75 y
0 CACW: 51.3, -20, 48 y
Angle: 65°

Alert Distance (AD)
Walker:
CACW:
Angle:

Flight Initiation Distance (FID)
Walker: 64.6, -23, 60
0 CACW: same
Angle: 45°

Distance Fled (DF)
Starting Perch: same
Ending Perch: OFS
Angle: 100°

Walker Trail Distances between:

SD & AD:

AD & FID:
SD/AD & FID: 69' 10" 829 + 10 = 839"

Notes:
CACW was approached from S. Spur trail & did not respond to walker.
so we walked past & then on return the CACW responded.

sample # ~~FID:~~ 27
AD:
Input: ✓

Flight Initiation Distance of Cactus Wrens on PVP- Field Data Sheet

Date: 4.11.14
Time: 8:26
Site: AVP
Traffic: none

Temperature: 20.0°C
Wind Speed: 0.4 m/s
Humidity: 63.9 %RH
Weather: sunny, no clouds

Cactus Wren Detected at:
Grid coordinates:
C6
C7
Trail Name:
Upper trail

Aware of Observer? Y/[✓ N]
Sex: [✓ M] F U
Flock Size: 1
ID: AV01B

Initial:
Perching Height: 71.5
Substrate: mmm - TP wire
Behavior: S

After Flight:
Perching Height: 1.0
Substrate: unknown sp. see pics
Behavior (30sec after):
H

* Starting Distance (SD): 50.98 m

Alert Distance (AD): 27.2, +7, 27

Flight Initiation Distance (FID): 9.5, +21, 9 Y

Distance Fled (DF): 23.3, -3, 23 Y
∡50°

Total Distances between:
SD & FID: 1006.5" 91.5
AD & FID: 704" 64 my feet blk crocs

1 my feet = 11"

Triangle Heuristic (use):
Distance of CAWR from trail (shortest):

Notes:

From SD
pole * ① 40, +3, 40 ∡180°

②
pole 24.8, +8, 24 Y
∡30°
③ 32.1, +6, 32 Y
wire

~~FID:~~ 28
Sample #

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.11.14
Time: 8:59
Site: 3SP
Traffic: none

Walker: Elan
Temperature: 24.0 °C
Wind Speed: 1.2 m/s
Humidity: 44.2% RH
Weather: sunny, no clouds

Cactus Wren Description:
Grid coordinates:
J6

Trail Name:
Barkentine.

Aware Prior? Y/ [✓ N]
Sex: M/ [✓ F] /?
Flock Size: 1

ID: 3501A

Initial:
Perching Height: 7'.5
Substrate: OL
Behavior: NB

After Flight:
Perching Height: <0.5
Substrate: OL
Behavior (30sec after): OBS

Starting Distance (SD)
Walker: 0
CACW: 56, -6, 554
Angle: 180°

Alert Distance (AD)
Walker: 15.7, -1, 164
o CACW: same
Angle: 50°

Flight Initiation Distance (FID)
Walker: 29.8, -4, 304
o CACW: same
Angle: 350

Distance Fled (DF)
Starting Perch: 42, -8, 424
o Ending Perch: 56, -12, 554
Angle: 30°

Walker Trail Distances between:

SD & AD: 46' 2" 552+2=554"

AD & FID: 41' 5" 492+5=497"

Notes:

sample # ~~FID~~: 29

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.13.14
Time: 8am
Site: AVP
Traffic: none

Walker: Melissa
Temperature: 17.5°c
Wind Speed: 0 m/s
Humidity: 61.5% RH
Weather: overcast

Cactus Wren Description:

Grid coordinates: F7

Trail Name: Alta Vicente Trail

Aware Prior? [✓ Y]/N
Sex: [✓ M]/F/?
Flock Size: 1

ID: AV01DM

Initial:
Perching Height: 1 m
Substrate: OL
Behavior: OBS

After Flight:
Perching Height: <0.5
Substrate: OL
Behavior (30sec after): H

Starting Distance (SD)/AD
Walker: 54.5, -18, 554
CACW: 41, -21, 394
Angle: 70°

Alert Distance (AD)
Walker:
CACW:
Angle:

Walker Trail Distances between:

SD & AD: n/a

AD & FID: n/a

SD/AD & FID: 1552"

Notes:
was approached 2X prior, but didnt respond.

Flight Initiation Distance (FID)
Walker: 68.4, -21, 644
CACW: same
Angle: 15°

Distance Fled (DF)
Starting Perch: 41, -21, 384
Ending Perch: 42, -22, 394
Angle: 20°

sample #
~~FID:~~ 30

AD:

Input: ✓

Flight Initiation Distance of Cactus Wrens on PVP: Field Data Sheet

Date: 4.13.14
Time: 8:20 am
Site: AVP
Traffic:
none

Temperature: 18.1 °C
Wind Speed: 0.3 m/s
Humidity: 60.9 %RH
Weather: over cast

Cactus Wren Location:
Grid coordinates:
C6
C7
Trail Name:
upper trail

Aware Before? Y/ [✓ N]
Sex: [✓ M] F ?
Flock Size: 1
ID: AV01B

Initial:
Perching Height: >1.5m
Substrate: mmm- TP wire
Behavior: S

After Flight:
Perching Height: 1 m
Substrate: OL
Behavior (30sec after):
S

Starting Distance (SD): 43.9, +9, 43y

Alert Distance (AD): 24.7, +21, 24y

Flight Initiation Distance
(FID): 11.9, +41, 11y

Distance Fled (DF):
① 20.7, +26, 19y
② 11.1, -8, 11y
+ 120°
Triangle formula is:
Distance of AD from trail [show cut]

Notes:

Grid Distances between:

SD & FID: 946" 86

AD & FID: 764.5" 69.5 my feet

1 my feet = 11"

~~FID:~~ sample # 31

FID: ____

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.13.14
Time: 845am
Site: 35P
Traffic: none

Walker: melissa
Temperature: 18°C
Wind Speed: 1.2m/s
Humidity: 58% RH
Weather: overcast

Cactus Wren Description:
Grid coordinates:
K5

Trail Name: Barrenetree Trail

Aware Prior? [✓ Y]/N
Sex: [✓ M]/F/?
Flock Size: 2

ID: 3501BM

Initial:
Perching Height: 7 1.5m
Substrate: OL
Behavior: S

After Flight:
Perching Height: 1
Substrate: OL
Behavior (30sec after): S

Starting Distance (SD)
Walker: 0
CACW: 29.2, -9, 294
Angle: 180

~~Alert Distance (AD)~~
~~Walker:~~
~~CACW:~~
~~Angle:~~

Walker Trail Distances between:

SD to AD:

AD to FID:

SD/AD to FID: 82' 984"

Flight Initiation Distance (FID)
Walker: 16.8, -9, 164
CACW: same
Angle: 20°

Distance Fled (DF)
Starting Perch Dist: 31.5, -9, 314
Ending Perch Dist: 38.3, -10, 384
Angle: 10°

Notes:

sample #
~~FID:~~ 32

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.13.14
Time: 8:45am
Site: 35P
Traffic: none

Walker: melissa
Temperature: 18 °C
Wind Speed: 1.2 m/s
Humidity: 58 % RH
Weather: overcast

Cactus Wren Description:

Grid coordinates: K5

Trail Name: Barkentine trail

Aware Prior? Y/[✓ N]
Sex: M/[✓ F]/?
Flock Size: 2

ID: 3501BF

Initial:

Perching Height: 7' 0
Substrate: OL
Behavior: OBS

After Flight:

Perching Height: OFS
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance (SD)
Walker: 19.6, -10, 19y
CACW: 30.4, -10, 38
Angle: 20

Alert Distance (AD)
Walker: 30.7, -10 30y
CACW: 41.3 -9, 41y
Angle: 45°

Flight Initiation Distance (FID)
Walker: 41.2, -8, 41y
CACW: 43, -9, 42y
Angle: 45°

Distance Fled (DF)
Starting Perch Dist: same
Ending Perch Dist: OFS
Angle: 90°

Walker Trail Distances between:

SD to AD: 580"

AD to FID: 152"

SD/AD to FID: n/a

Notes:

sample # ~~FID~~: 33

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.13.14
Time: 9:19 am
Site: 53P
Traffic: none

Walker: Melissa
Temperature: 17.8°C
Wind Speed: 2.3 m/s
Humidity: 62.2% RH
Weather: overcast

Cactus Wren Description:
Grid coordinates: K5

Trail Name: parkentine trail

Aware Prior? [✓ Y]/N
Sex: [✓ M]/F/?
Flock Size: 1

ID: 3501 A

Initial:
Perching Height: >1.5m
Substrate: OL
Behavior: S

After Flight:
Perching Height: OFS
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance (SD)
Walker: 0
CACW: 54.4, -6, 544
Angle: 180

Alert Distance (AD)
Walker:
CACW:
Angle:

Flight Initiation Distance (FID)
Walker: 0
CACW: 40, -7, 394
Angle: 180

Distance Fled (DF)
Starting Perch Dist: 54.4, -6, 544
Ending Perch Dist: OFS
Angle: 40'

Walker Trail Distances between:

SD to AD: n/A

AD to FID: n/A

SD/AD to FID: 584"

Notes:

sample # ~~FID~~: 34

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.14.14
Time: 7:59 am
Site: AVP
Traffic: none

Walker: Alyssa
Temperature: 17.8 C
Wind Speed: 0.0 m/s
Humidity: 65.8 %RH
Weather: sunny, w/ haze

Cactus Wren Description:
Grid coordinates: F7
Trail Name: S. Spur & Alta Vicente

Aware Prior? Y/[✓ N]
Sex: M/F/[✓ ?]
Flock Size: 2
ID: AV010

Initial:
Perching Height: >1.5
Substrate: DD
Behavior: OBS

After Flight:
Perching Height: <0.5
Substrate: OFS
Behavior (30sec after): OFS

Starting Distance (SD)
Walker: 41, -6, 41y
CACW: 54.6, -20, 51y
Angle: 110

Alert Distance (AD)
Walker: 43.5, -15, 42y
CACW: same
Angle: 85°

Flight Initiation Distance (FID)
Walker: 39, -20, 36y
CACW: same
Angle: 40°

Distance Fled (DF)
Starting Perch Dist: same
Ending Perch Dist: OFS
Angle: 120°

Walker Trail Distances between:
SD to AD: 2089 cm 822.4"
AD to FID: 2811 cm 1106.69"
SD/AD to FID: n/A

Notes:

sample # ~~FID~~: 35
AD:
Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.18.14
Time: 8:12 am
Site: AVP
Traffic: none

Walker: Elan
Temperature: 18.8 C
Wind Speed: 0.8 m/s
Humidity: 68.3% RH
Weather: overcast w/ breeze & sprinkle

Cactus Wren Description:
Grid coordinates: P7
Trail Name: S. Spur Trail

Aware Prior? Y/ [✓ N]
Sex: [✓ M]/F/?
Flock Size: 1
ID: AV010M

Initial:
Perching Height: 71.5
Substrate: TT
Behavior: G

After Flight:
Perching Height: 1m
Substrate: OL
Behavior (30sec after): OBS

Starting Distance (SD)
Walker: 0
CACW: 32.2, -13, 31y
Angle: 180°

Alert Distance (AD)
Walker: 10.6, ~~24~~, 15y
CACW: same
Angle: 65°

Flight Initiation Distance (FID)
Walker: 44. , -19, 42y
CACW: ~~same~~ 450, -18, 47y
Angle: 50°

Distance Fled (DF)
Starting Perch Dist: same
Ending Perch Dist: 30.5, -17, 29y
Angle: 80

Walker Trail Distances between:

SD to AD: 65' 780"

AD to FID: 225' 4" 2700 + 4 = 2704"

SD/AD to FID: n/a

Notes: Red tailed Hawk perched on TP. - Kinda quite

~~FID:~~ sample# 37
AD:
Input: ✓

Flight Initiation Distance on Cactus Wrens on PVP Field Data Sheet

Date: 4.16.14
Time: 8:46am
Site: AVP
Traffic: none

Temperature: 19.6°C
Wind Speed: 1.1 m/s
Humidity: 67.6% RH
Weather: overcast w/ breeze

Cactus Wren Information
Grid coordinates: E7
Trail Name: Upper trail

Aware of Observer: [✓ Y]/N
Sex: [✓ M] F
Flock Size: 1
ID: AV01B

Initial:
Perching Height: >1.5
Substrate: mmm- TP MVC
Behavior: S

After Event:
Perching Height: 1-0
Substrate: OL
Behavior (30sec after): S

AD / Starting Distance: 138, +6, 144

Alert Distance: n/A

Flight Initiation Distance (FID): 6.6, +18, 64

Distance Fled: 16.2, -2, 164
<65

Distance between:
n/A

SD/ Alt & FID: 59 my feet 649"

11" = 1 my feet

post: Dog walker SW from CACW

Triangulation
Distance

Notes:

Sample # ~~FID~~: 38

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.18.14
Time: 9:01
Site: AVP
Traffic: more 2 walker
1 Dog

Walker: Elan
Temperature: 19.5° C
Wind Speed: 3.4 m/s
Humidity: 679% RH
Weather: overcast w/
breez

Cactus Wren Description:
Grid coordinates:
D7
E7
Trail Name:
Alta Vicente Trail

Aware Prior? [✓ Y]/N
Sex: M/F/[✓ ?]
Flock Size: 1

ID: AV01D

Initial:
Perching Height: 0.5
Substrate: TI
Behavior: OBS

After Flight:
Perching Height: <0.5
Substrate: OFS
Behavior (30sec after):
OFS

Starting Distance (SD)/AD
Walker: 65.3, -21, 61y
CACW: 75, -7, 74 y
Angle: 110°

Alert Distance (AD)
Walker:
CACW:
Angle:

Flight Initiation Distance (FID)
Walker: 66.4, -17, 64y
CACW: same
Angle: 80°

Distance Fled (DF)
Starting Perch Dist: same
Ending Perch Dist: OFS
Angle: 60°

Walker Trail Distances between:

SD to AD: n/a

AD to FID: n/a

SD/AD to FID: 60' 6" 720 + 6 = 726"

Notes:
not sure of ♂ or ♀

CACW. SW to Dog

sample # FID: 39

AD:

Input: ✓

Flight Initiation Distance-Cactus Wrens on PVP- Field Data Sheet

Scout: Julie
Date: 4.18.14
Time: 9:33
Site: 3SD
Traffic: none

Walker: Elan
Temperature: 21 C
Wind Speed: 2 9 m/s
Humidity: 62.8 % RH
Weather: overcast w/ breez

Cactus Wren Description:
Grid coordinates: J6
Trail Name: Barkentine trail

Aware Prior? [✓ Y]/N
Sex: [✓ M]/F/?
Flock Size: 1
ID: 3501A

Initial:
Perching Height: 1 m
Substrate: TT
Behavior: OBS

After Flight:
Perching Height: 71.C
Substrate: OL
Behavior (30sec after): S

SD/AD
walker 0
CACW 26.8, -10, 26y
angle 180.

SD/AD & FID: 13'2" 156+2= 158'

FID
walker 0
CACW 23.4, -12, 23y
∢ 180.

DF
starting 26.8, -10, 26y
ending 49.8, -6, 49y
∢ 35.

NOS GF prior to approach.

2x tried to get FID while GF didnt WRK

input ✓

sample # 40

Genetic Structure in the Cactus Wren in Coastal Southern California

By Kelly R. Barr, Amy G. Vandergast*, and Barbara E. Kus*

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Genetic Structure in the Cactus Wren in Coastal Southern California

By Kelly R. Barr, Amy G. Vandergast, and Barbara E. Kus

Introduction

The cactus wren (*Camphylorynchus brunneicapillus*) is a habitat-restricted species in southern California, nesting strictly in prickly pear (*Opuntia* sp.) and cholla (*Cylindropuntia* sp.) cacti that exist primarily in coastal sage scrub and chaparral habitats. Long-term survival of cactus wrens in southern California relies upon the persistence of such habitat; however, urbanization, agriculture, and fire have greatly reduced cactus habitat throughout the region (Shuford & Gardali 2008). Presently, large aggregations of cactus wrens exist only in areas where urbanization and agriculture have largely been excluded, such as habitat preserves and military installations. Smaller groups are found in urban canyons, parks, and on private lands. While the exact number of extant cactus wrens is unknown, several hundred territories are thought to remain in coastal southern California. This likely represents a major reduction from historical population sizes (Unitt 2004, Shufard & Gardali 2008).

In a previous study focused on southern Orange and San Diego Counties, we detected limitations on genetic connectivity in the cactus wren that were concordant with habitat fragmentation (Barr et al. 2012). While we detected a pattern of genetic isolation by distance over the study area, we also determined that many groups of cactus wrens were much more genetically differentiated than could be attributed to geographic distances alone. Genetic structure was also detected in areas only recently fragmented by urban development, suggesting a rapid reduction in genetic connectivity among coastal cactus wren aggregations in the face of land-use alterations by urban development, agriculture, and wildfire. Such limitations on connectivity can have severe consequences for small populations.

Connectivity, which describes the level of movement between habitat patches by an organism during migration, dispersal, or as part of regular behavioral activity, is essential for a species' long-term persistence (Lowe & Allendorf 2010). With high connectivity between populations, genetic diversity is better preserved (Reed & Frankham 2003). Though genetic drift, small and isolated populations can naturally lose genetic diversity, potentially causing a reduction in potential for adaptation to environmental change and novel disease (Quattro & Vrijenhoek 1989, Leberg & Vrijenhoek 1994). As populations become exceptionally small, a lack of connectivity with other groups may also lead to inbreeding depression, reducing the genetic health of individuals (Charlesworth & Charlesworth 1987, Hemmings et al 2012). Demographic recovery of local populations reduced by stochastic events, such as wildfires, may also be much slower if connectivity with source populations is low. In the case of cactus wrens, aggregations in Orange County were severely reduced by wildfires and have been slow to recover (Bontrager et al. 1995, Preston & Kamada 2012). Part of the slow recovery is attributable to the low growth rates of cacti, which need to achieve a height of one to two meters to be suitable for nesting cactus wrens. It is also likely that habitat fragmentation has disrupted connectivity, and with larger, nearby populations as well (Barr et al. 2012).

Genetic tools have long been employed for studying connectivity, and can be complementary to direct studies of movement (Bohonak 1999). Mark-recapture and re-sighting studies quantify dispersal movements, but field efforts are limited over space and time. Genetic estimates of connectivity quantify gene flow, which is the product of movement and successful breeding by individuals. These estimates typically integrate across generations, and can capture rarer long distance dispersal events that are very difficult to detect with field efforts. Patterns of gene flow and genetic drift over many generations are reflected in the genetic population structure over a species' range. By analyzing this genetic population structure, genetic connectivity patterns and the impacts of fragmentation can be inferred.

In this study, we analyze genetic population structure in the cactus wren throughout coastal southern California using microsatellite markers developed specifically for this species. Microsatellites, or short tandem repeats, are repeating regions of DNA with relatively high mutation rates. These mutation rates provide the variability to resolve the effects of recent landscape alterations on genetic population structure, such as those caused by urbanization, agriculture, and wildfire. We expand upon our previous study focused in Orange and San Diego Counties (Barr et al. 2012), adding cactus wren samples from Ventura, Los Angeles, San Bernardino, and Riverside Counties. With this full dataset, we characterize the current population genetic structure to provide information on levels of gene flow throughout the cactus wren's range in coastal southern California. We also analyze genetic diversity and recent demographic change over the study area. Understanding these patterns will aid in management of current cactus wren populations and future efforts in habitat restoration.

Methods

Samples

We visited known occupied and accessible (those on public lands or private lands that provided permission) cactus patches throughout the study area in 2011 and 2012. We identified potential sites using information from recent surveys by cooperators and a database of mapped cactus (data not shown; pers. comm. C. Winchell). In Orange and San Diego Counties, we monitored nests and sampled nestlings for growing feathers at 6 to 12 days of age, and captured adults where nests were inaccessible. Elsewhere in the study area, we sampled more opportunistically, either sampling nestlings of appropriate age when encountered or taking blood via toe-nail clips from adults captured using standard mist-netting techniques with song playback. We banded all individuals with a numbered metal federal band to prevent re-sampling individuals. Sample collection was authorized by a Memorandum of

Understanding between the California Department of Fish and Wildlife and B. Kus, and permit SC-001504 held by B. Kus. The Nature Reserve of Orange County (NROC) provided many of the samples from Orange County.

Samples were stored in Queen's Lysis Buffer at -20°C until extraction. We also collected a few deceased birds discovered in or near nests, providing muscle or toepads for DNA. We extracted DNA using standard protocols provided with the DNA Tissue Extraction Kit (Qiagen), modified by adding 20 µL of dithiothreitol to the extraction buffer and extending tissue digestion to 48 hours. We quantified all DNA extractions with a Nanodrop spectrophotometer and diluted them to ≤50 ng/µL to normalize PCR amplifications across samples.

Library Development and Genotyping

We discovered microsatellite loci in the cactus wren genome using a modification of the techniques in Hamilton et al. (1999). Libraries were constructed by excising genomic DNA using the restriction enzyme *Hinc*II, and ligating these fragments to SNX linkers. Biotinylated oligonucleotide probes that included both trinucleotide and tetranucleotide repeats were then used to isolate and separate microsatellite repeat regions. These fragments were amplified via polymerase chain reactions (PCR) and sequenced on a Roche 454 GL FLX DNA sequencer in the Evolutionary Genetics Core Facility (EGCF) at Cornell University. In 3,350 captured sequences, 414 contained microsatellite repeat regions. We mapped these sequences to the Zebra Finch (*Taeniopygia guttata)* genome to identify their physical locations and facilitate library development. After eliminating loci with complex repeats, on sex chromosomes, and lacking sufficient flanking sequence for primer design, we tested the remaining 52 loci for variation using a three-primer technique (Schuelke 2000). All genotyping runs occurred on an ABI 3730 DNA Analyzer in the CSUPERB Microchemical Core Facility at San Diego State University or at BATJ, Inc. in San Diego, CA.

We discovered 28 variable loci, and co-amplified these in three PCRs using a Qiagen multiplex kit following the manufacturer's protocol. Combinations of loci are indicated in Table 1. Approximately 10% of the samples were amplified and genotyped twice to obtain an error rate. We used MICRO-CHECKER (van Oosterhout et al. 2004) to check loci for stepwise mutational model consistency, and GENEPOP ON THE WEB (Raymond & Rousset 1995, Rousset 2008) to test loci for Hardy-Weinberg Equilibrium and linkage disequilibrium. These tests address assumptions made by many of the analyses used herein. Loci can exhibit departures from Hardy-Weinberg Equilibrium due to allelic dropout (i.e., missing alleles due to mutations in primer sites), selection, or sampling issues (i.e., Wahlund effect). Linkage disequilibrium occurs when loci are physically or statistically linked, and hence confound analyses due to a lack of independence.

Genetic Analyses

We used multiple analyses to explore genetic population structure and patterns of diversity across the study area. First, we employed Bayesian clustering analyses to determine if individuals were arranged in distinct gene pools or clusters. We also identified groups of individuals sharing recent gene flow using a modified exact test following Waples and Gaggiotti

(2006). This method is more powerful for detecting local population structure when gene flow is on-going, whereas Bayesian clustering analyses infer structure that is the product of major constraints on gene flow over many generations. Hence, the groupings of individuals suggested by the Waples and Gaggiotti (2006) method are likely in panmixia—that is, gene flow is evenly distributed among them—and we refer to them as "populations." We refer to groups detected by the Bayesian clustering analyses as "clusters," as these can be composed of numerous populations among which there may be some finer-scale restrictions on gene flow. We use analyses of spatial autocorrelation to examine local gene flow and connectivity patterns within clusters. Finally, we quantified patterns of genetic diversity and recent demographic change.

Cluster Inference

Bayesian clustering analyses are individual-based, searching for combinations of individuals that can best be grouped together while conforming to expectations of Hardy-Weinberg Equilibrium and linkage disequilibrium. These expectations are met when a group of individuals is essentially a common gene pool in population genetics terms, without major barriers to gene flow between them for numerous generations. Since the presence of closely-related individuals can confound analyses based upon Hardy-Weinberg Equilibrium and linkage disequilibrium (Anderson & Dunham 2008), we implemented the program COLONY (Wang 2009) to identify full sibships (i.e., parent-offspring or full siblings) in the dataset. We eliminated a member of each full sibship for all analyses, except where noted.

Initially, we used the Bayesian clustering program GENELAND (Guillot et al. 2008) to identify population structure over the full dataset. This analysis takes geographic relationships into consideration along with individual genotypic data, and can identify recently developed clusters (Guillot 2008). Analyses were conducted using the uncorrelated alleles model with admixture, testing for clusters (*K*) between 1 to 10 with 1 million Markov chain Monte Carlo repetitions and a 20% burn-in. Using these same parameters, we analyzed detected clusters individually in GENELAND to detect further substructure.

Defining Local Populations and Fine-scale Gene Flow Patterns

To define locally panmictic populations, we grouped geographically aggregated individuals with no obvious potential barrier to movement, and conducted an exact test for genetic differentiation among them as implemented in GENEPOP ON THE WEB. Aggregations with <4 samples were excluded from this analysis. The exact test for genetic differentiation tests a null hypothesis of genetic panmixia (no genetic structure). Exact tests were conducted for each microsatellite locus and resulting *p*-values were combined via Fisher's method. Automated programs like GENEPOP ON THE WEB may calculate extremely low *p*-values for individual loci, hence reducing the result of the overall test. Following Waples and Gaggiotti (2006), we made this test more conservative by setting *p*-values for individual loci to a minimum of 0.0001 prior to combining with Fisher's method. Aggregations were determined to be in the same population if the overall *p*-value for the pairwise exact test between them was >0.01. To determine whether geographic distance influenced genetic structure, we calculated pairwise F_{ST}, a measure of genetic differentiation, between these populations using GENEPOP ON THE WEB, and tested for isolation-by-distance using a Mantel test as implemented in IBDWS

(Jensen et al. 2005). Finally, we visualized relationships among populations based upon F_{ST} using a principal coordinates analysis as implemented in GENALEX, thereby allowing comparison of genetic differentiation patterns with those detected in Bayesian clustering analyses.

To estimate patterns of genetic similarity and gene flow within clusters, we calculated the spatial autocorrelation coefficient, *r*, in GENALEX (Peakall & Smouse 2012). For this, we used 999 permutations to test significance the significance of *r* and 999 bootstraps to obtain a confidence interval. Spatial autocorrelation quantifies the average genetic similarity between each individual and all others within binned geographic distances from that individual. These patterns can provide inferences of genetic structure within local groups, with positive spatial autocorrelation indicating distances within which gene flow occurs. Since broad-scale genetic structure can confound this analysis (Banks & Peakall 2012), analyses were conducted within three individual regions (central Orange County - northern San Diego County, southern San Diego County, and the eastern Los Angeles Basin) based upon detected patterns of population structure. We did not have enough samples with a suitable spatial arrangement to conduct this analysis in other regions. Initially, we used bins of 1000m up to the greatest distance between samples; however, to better display the results, a subset of bins is presented here.

Genetic Diversity

We quantified genetic diversity within populations in the form of allelic richness in HP-RARE (Kalinowski 2005) and heterozyosity, both observed and expected, in GENALEX. Tests for heterozygote excesses were conducted in BOTTLENECK (Piry et al. 1999). This test is based upon the expectation that allelic diversity is lost more rapidly than heterozygosity during a genetic bottleneck, and thus determines whether a significant population decline has recently occurred. Finally, we implemented LDNe (Waples & Do 2008) and COLONY to calculate current effective population sizes, N_e. The former calculates effective population size based upon linkage disequilibrium, and the latter uses a sibship approach. This analysis in COLONY is the only one in which we used all genotyped individuals, full sibships included. Effective population size is an important parameter in population genetics, as it determines inbreeding rates, the strength of genetic drift, the potential for selection, and the effect of migration. It is associated with the number of successful breeding individuals in a population (Frankham 1995).

Results

Data Quality

Although 620 coastal cactus wrens were sampled in the study area, multiple nestlings from the same nest do not represent independent genetic samples; furthermore, 20 captured adults were determined to be full sibs. After eliminating redundant nestling samples and one member of each full sibship, we analyzed a dataset of 349 cactus wrens. Since closely related individuals were not used in analyses, we can infer that detected signals of population structure are the product of gene flow and connectivity regimes rather than spurious results created by family structure (Anderson & Dunham 2008). Samples provided thorough coverage of the cactus wren range in coastal southern California (Figs. 1 - 5).

After eliminating loci that were in linkage disequilibrium, did not conform to Hardy-Weinberg Equilibrium, or inconsistently amplified, 19 loci were used for all analyses (Table 1). These loci are located across the genome, falling on nine different chromosomes. Total numbers of alleles ranged from three to 18, and overall heterozygosities were generally high (mean: 0.63), as would be expected with highly polymorphic microsatellites. After re-runs, the error rate was found to be negligible (<0.1%), and there were very few missing data from failed amplifications (<0.01%).

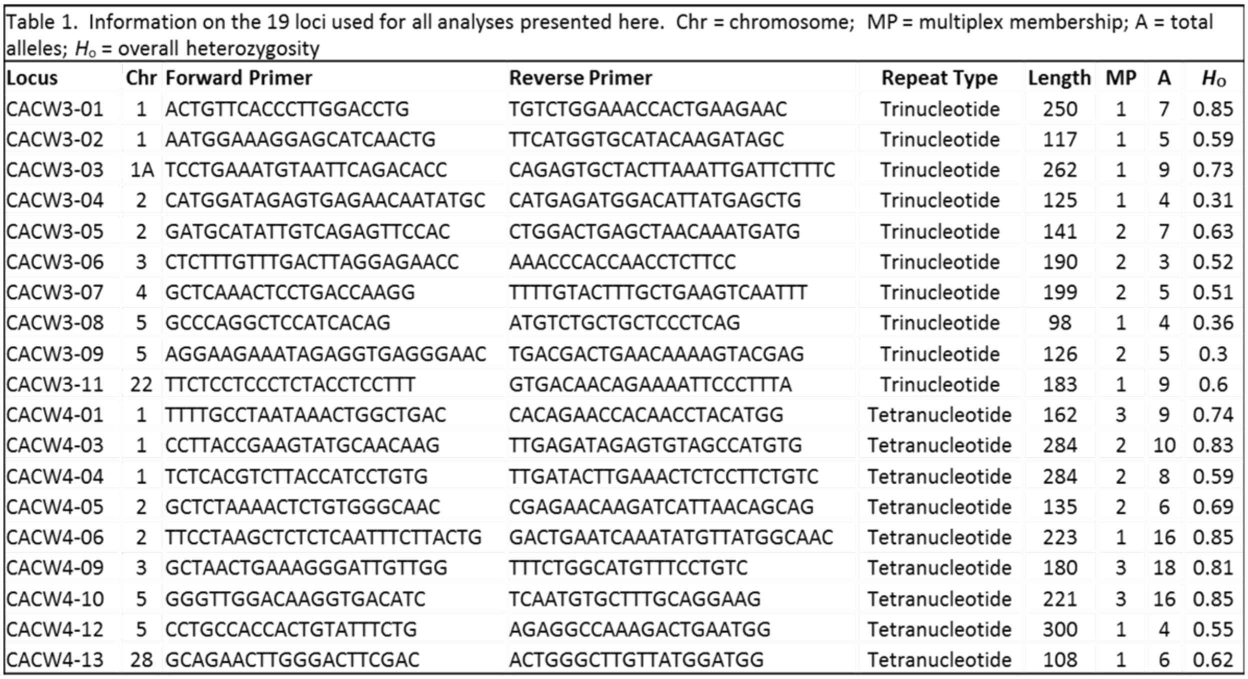


Table 1. Information on the 19 loci used for all analyses presented here. Chr = chromosome; MP = multiplex membership; A = total alleles; H_o = overall heterozygosity

Locus	Chr	Forward Primer	Reverse Primer	Repeat Type	Length	MP	A	H_O
CACW3-01	1	ACTGTTCACCCTTGGACCTG	TGTCTGGAAACCACTGAAGAAC	Trinucleotide	250	1	7	0.85
CACW3-02	1	AATGGAAAGGAGCATCAACTG	TTCATGGTGCATACAAGATAGC	Trinucleotide	117	1	5	0.59
CACW3-03	1A	TCCTGAAATGTAATTCAGACACC	CAGAGTGCTACTTAAATTGATTCTTTC	Trinucleotide	262	1	9	0.73
CACW3-04	2	CATGGATAGAGTGAGAACAATATGC	CATGAGATGGACATTATGAGCTG	Trinucleotide	125	1	4	0.31
CACW3-05	2	GATGCATATTGTCAGAGTTCCAC	CTGGACTGAGCTAACAAATGATG	Trinucleotide	141	2	7	0.63
CACW3-06	3	CTCTTTGTTTGACTTAGGAGAACC	AAACCCACCAACCTCTTCC	Trinucleotide	190	2	3	0.52
CACW3-07	4	GCTCAAACTCCTGACCAAGG	TTTTGTACTTTGCTGAAGTCAATTT	Trinucleotide	199	2	5	0.51
CACW3-08	5	GCCCAGGCTCCATCACAG	ATGTCTGCTGCTCCCTCAG	Trinucleotide	98	1	4	0.36
CACW3-09	5	AGGAAGAAATAGAGGTGAGGGAAC	TGACGACTGAACAAAAGTACGAG	Trinucleotide	126	2	5	0.3
CACW3-11	22	TTCTCCTCCCTCTACCTCCTTT	GTGACAACAGAAAATTCCCTTTA	Trinucleotide	183	1	9	0.6
CACW4-01	1	TTTTGCCTAATAAACTGGCTGAC	CACAGAACCACAACCTACATGG	Tetranucleotide	162	3	9	0.74
CACW4-03	1	CCTTACCGAAGTATGCAACAAG	TTGAGATAGAGTGTAGCCATGTG	Tetranucleotide	284	2	10	0.83
CACW4-04	1	TCTCACGTCTTACCATCCTGTG	TTGATACTTGAAACTCTCCTTCTGTC	Tetranucleotide	284	2	8	0.59
CACW4-05	2	GCTCTAAAACTCTGTGGGCAAC	CGAGAACAAGATCATTAACAGCAG	Tetranucleotide	135	2	6	0.69
CACW4-06	2	TTCCTAAGCTCTCTCAATTTCTTACTG	GACTGAATCAAATATGTTATGGCAAC	Tetranucleotide	223	1	16	0.85
CACW4-09	3	GCTAACTGAAAGGGATTGTTGG	TTTCTGGCATGTTTCCTGTC	Tetranucleotide	180	3	18	0.81
CACW4-10	5	GGGTTGGACAAGGTGACATC	TCAATGTGCTTTGCAGGAAG	Tetranucleotide	221	3	16	0.85
CACW4-12	5	CCTGCCACCACTGTATTTCTG	AGAGGCCAAAGACTGAATGG	Tetranucleotide	300	1	4	0.55
CACW4-13	28	GCAGAACTTGGGACTTCGAC	ACTGGGCTTGTTATGGATGG	Tetranucleotide	108	1	6	0.62

Inference of Clusters

GENELAND identified six geographically distinct clusters over the full dataset (Fig. 1): 1) individuals from Ventura, Los Angeles, and San Bernardino Counties (VENT, LASB, DBCH); 2) Riverside County (RIVR); 3) most of Orange County and Marine Corps Base Camp Pendleton and Fallbrook Naval Weapons Station in San Diego County (OCPN); 4) San Pasqual Valley (PASQ); 5) Lake Jennings, Sweetwater Reservoir, and several urban parks and canyons in San Diego (SD); and 6) Otay River (OTAY). Notably, an individual sampled at Lake Elsinore in Riverside County was clustered into OCPN.

Substructure GENELAND analyses focused within each of three of these clusters, RIVR, PASQ, and OTAY, did not reveal any further clusters. Analyses within the clusters of cactus wrens from Ventura, Los Angeles, and San Bernardino counties identified Ventura (VENT) as an independent cluster (Fig. 2). Removing VENT and focusing GENELAND analyses on the

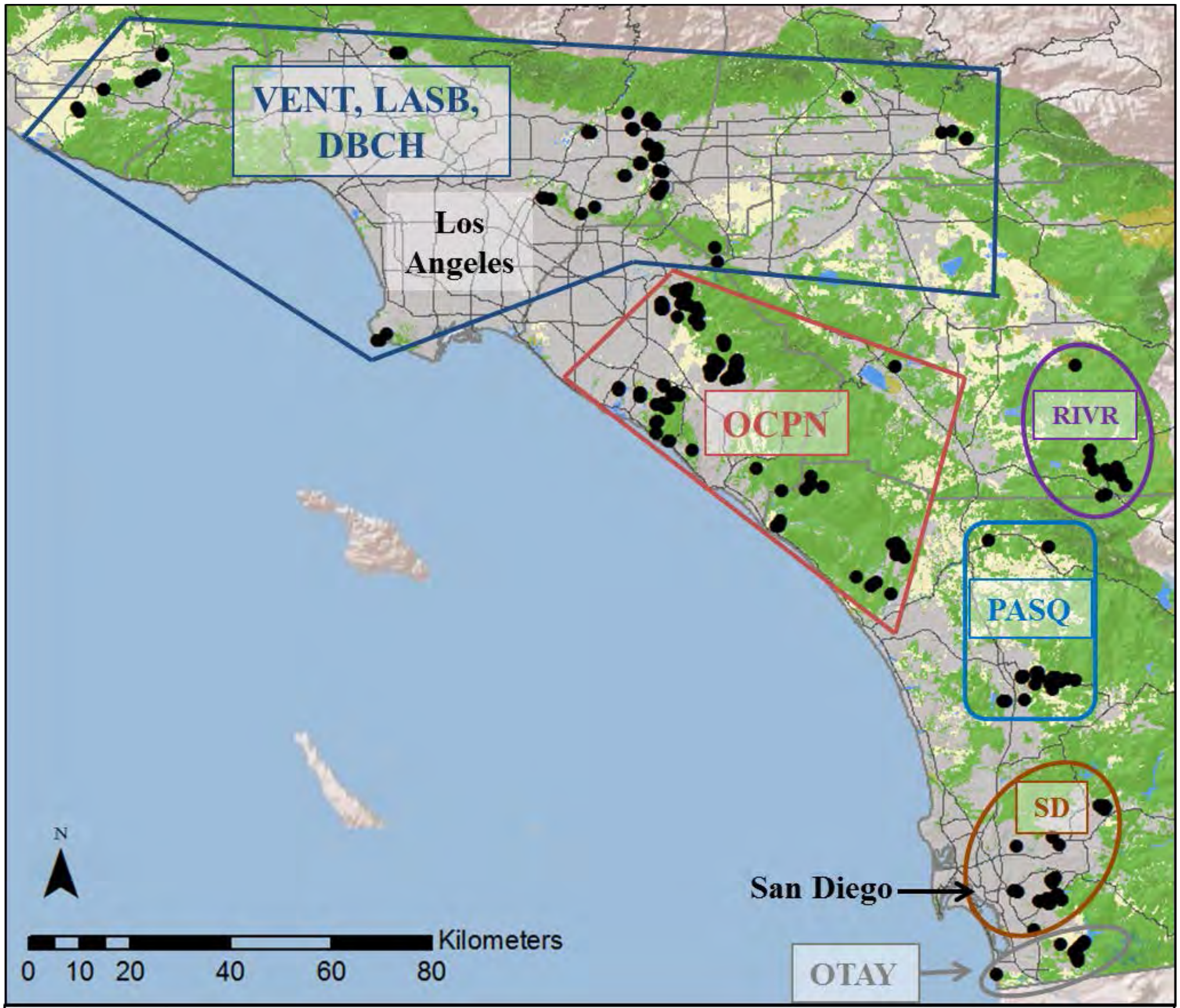


Figure 1. Map of sample locations (black dots) and clusters detected in GENELAND (colored polygons). Gray landscape indicates urban development, yellow agriculture, and green sage scrub, chaparral, and otherwise undeveloped open space.

remaining Los Angeles and San Bernardino County cactus wrens revealed additional clusters, including one larger cluster composed of cactus wrens widely distributed in Los Angeles and San Bernardino Counties (LASB) and a smaller cluster in the area of Diamond Bar and Chino Hills State Park (DBCH). Substructure analyses within VENT, LASB, and DBCH did not reveal any further clusters. Within OCPN, two additional clusters were apparent, one composed of wrens in the coastal reserve of NROC and another large central group occupying an extended area east of Interstate 5 through Marine Corps Base (MCB) Camp Pendleton and Fallbrook Naval Weapons Station (NWS; Fig. 3). No additional clusters were detected within the coastal OCPN cluster by GENELAND. Substructure analysis within both the central OCPN cluster (Fig. 3) and within SD (Fig. 4) suggests two additional clusters are present within each of these areas (Data Not Shown).

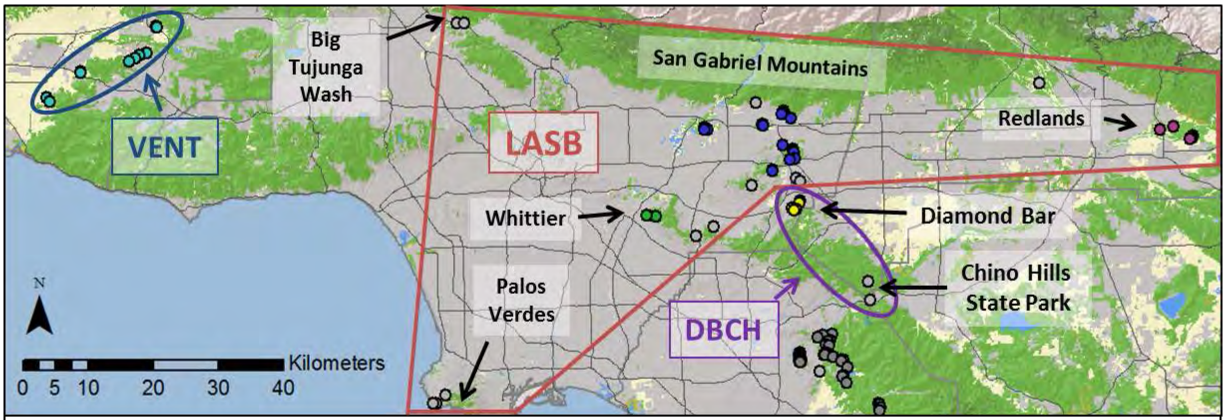


Figure 2. Map of sample locations (colored dots) and clusters detected in GENELAND (colored polygons). Gray indicates urban development, yellow agriculture, and green sage scrub, chaparral, and otherwise undeveloped open space.

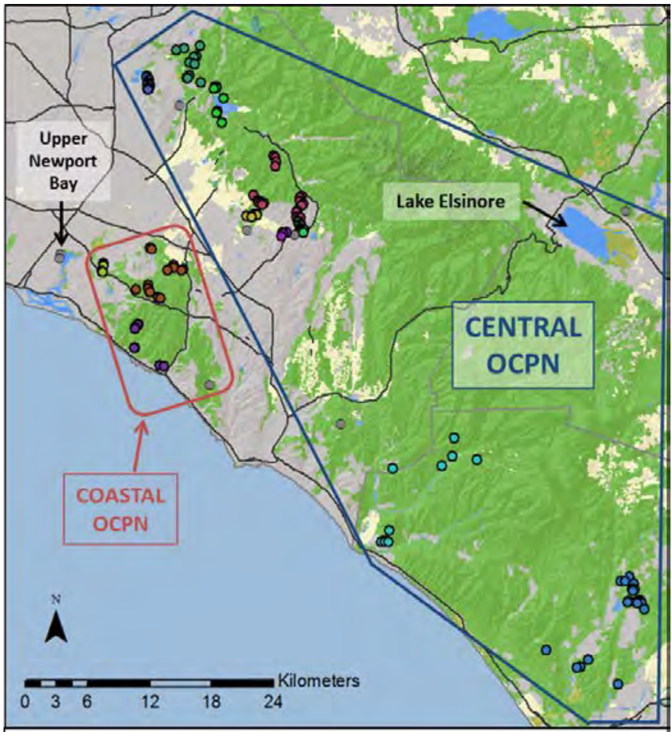


Figure 3. Map of sample locations (colored dots) and clusters detected in GENELAND (colored polygons). Gray indicates urban development, yellow agriculture, and green sage scrub, chaparral, and otherwise undeveloped open space.

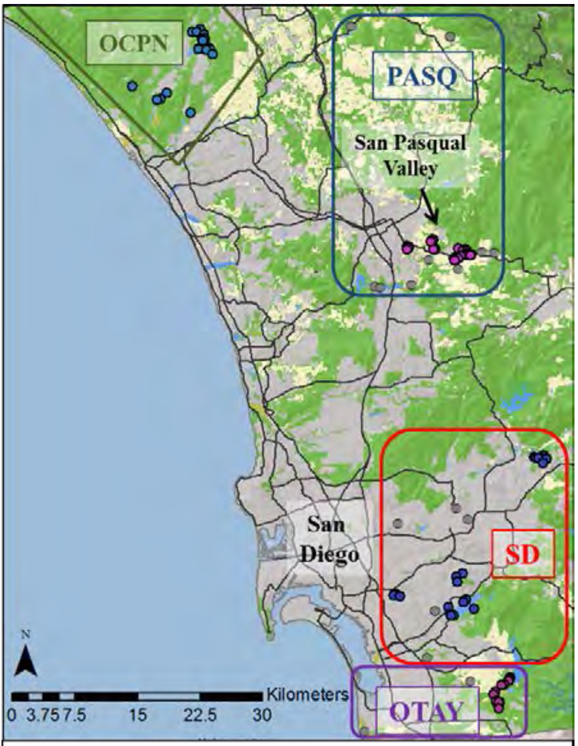


Figure 4. Map of sample locations (colored dots) and clusters detected in GENELAND (colored polygons). Gray indicates urban development, yellow agriculture, and green sage scrub, chaparral, and otherwise undeveloped open space.

Identification of Local Populations

Using the Waples and Gaggiotti (2006) method, 19 panmictic populations were detected (Fig. 5), and pairwise F_{ST} among these ranged 0.003 to 0.179 with a significant correlation with geographic distance (Fig. 6; r = 0.644, $p < 0.001$). Hence, there is an overall signal of isolation by distance in this dataset. These analyses exclude 41 individuals sampled in disparate locations and not part of aggregations of five or more. Principal coordinates analysis on these genetic distances reveals relationships between these populations that are similar to clustering results, with 51.05% of the variance explained by the two plotted coordinates (Fig. 7). For instance, most of the populations within OCPN were aggregated, as were those within LASB. Each of the other populations was dispersed throughout the coordinate space. One exception to this concordance is that cactus wrens sampled on a reserve at the University of California-Irvine were separated from the rest of OCPN despite being sorted into the coastal cluster by GENELAND.

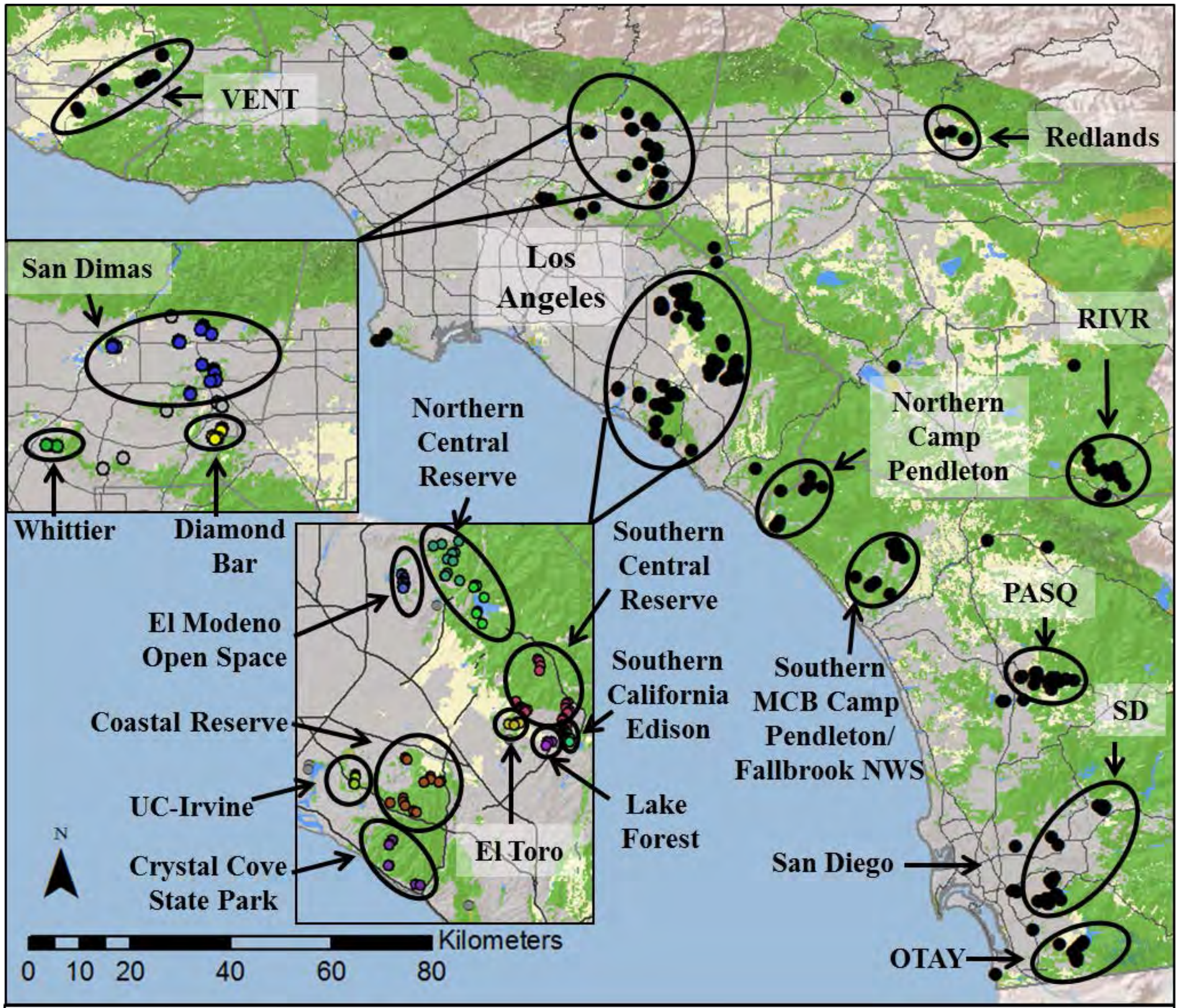


Figure 5. Map of the 349 sample locations (dots) and populations detected with the Waples and Gaggiotti (2006) method (black circles). Gray landscape indicates urban development, yellow agriculture, and green sage scrub, chaparral, and otherwise undeveloped open space.

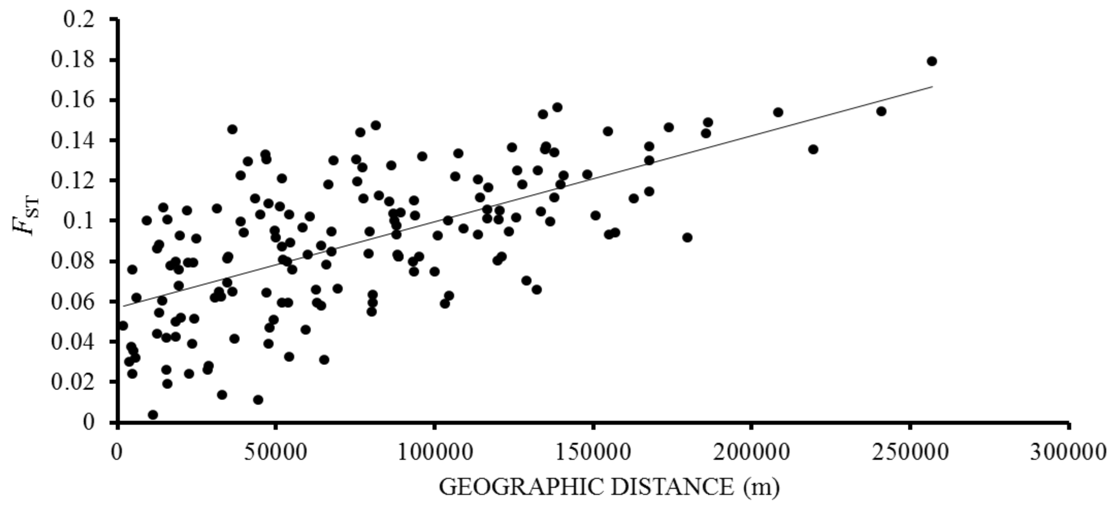


Figure 6. Pairwise genetic distances versus pairwise geographic distances between populations designated by the Waples and Gaggiotti (2006) method. The Mantel test on this relationship was significant (r = 0.644, $p < 0.001$).

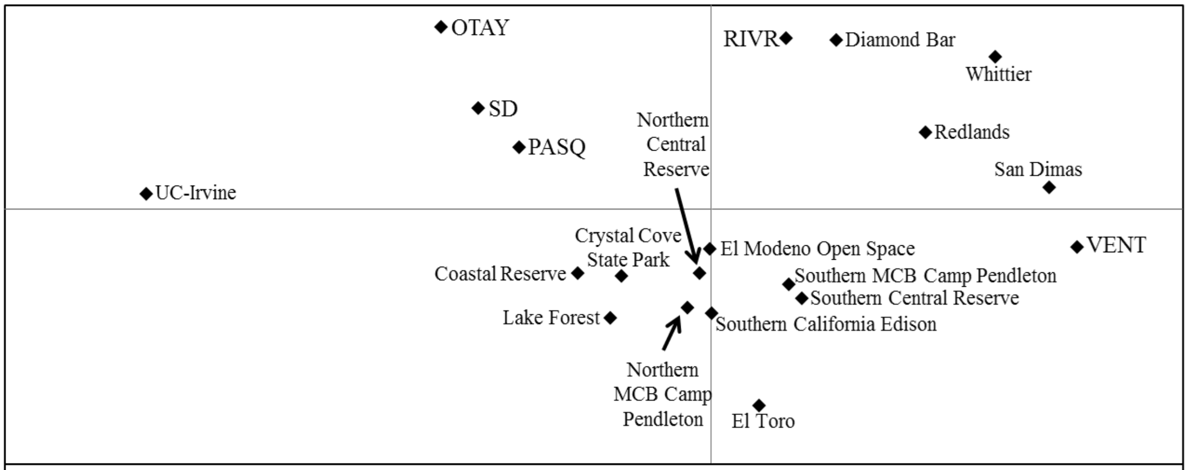


Figure 7. Principal coordinates analysis on FSTs between populations designated by the Waples and Gaggiotti (2006) method. The axes plotted explain 51.05% of the data.

Spatial autocorrelation analyses were focused on groups of individuals sampled across areas near San Dimas, Whittier, and Diamond Bar (noted as LASB), the central cluster in OCPN, and over San Diego and Otay (SD-OTAY). Results indicated positive relationships up to 1km in LASB (Fig. 8; $r = 0.039$, $p = 0.001$) and 4km in SD-OTAY ($r = 0.129$, $p = 0.001$). A much different spatial autocorrelation profile is evident in the central cluster in OCPN, where r is significant within 1km ($r = 0.022$, $p = 0.001$) and then again at 8km ($r = 0.048$, $p = 0.001$). None of the bins between these distances show significant spatial autocorrelation.

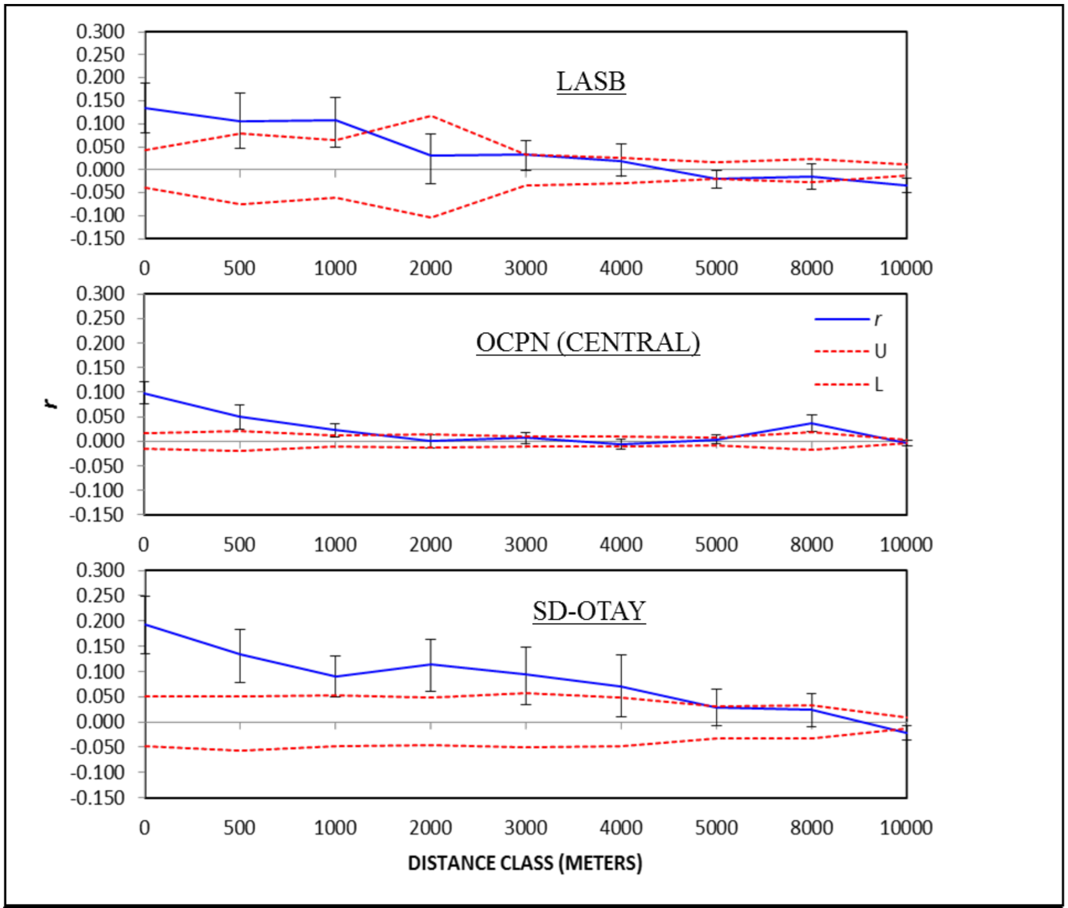
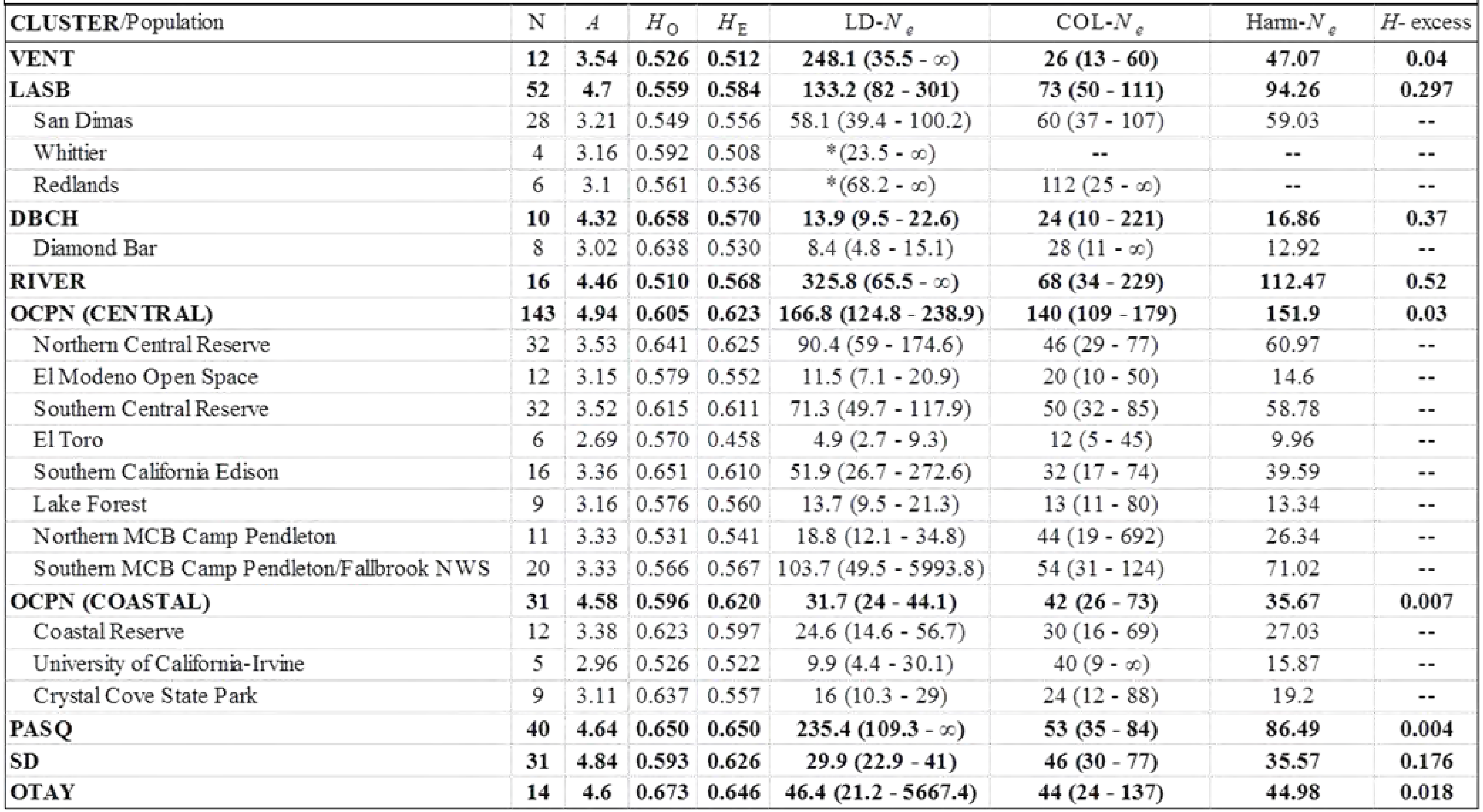


Figure 8. Spatial autocorrelation at three concentrations of cactus wrens. LASB includes birds sampled in the vicinity of Glendora, Pomona, and Chino in Los Angeles County. OCPN (CENTRAL) includes birds sampled over Orange County and Marine Corps Base Camp Pendleton/Fallbrook Naval Weapons Station. SD-OTAY includes birds in the vicinity of San Diego and the Otay River area.

Genetic Diversity

Observed and expected heterozygosity and allelic richness were similar across clusters (Table 2). One exception was in VENT, where allelic richness (VENT: 3.54; overall mean: 4.64) and expected heterozygosity (VENT: 0.512; overall mean: 0.611) were lower than observed throughout the remainder of the study area. Effective population sizes varied across the study area and between the methods we employed. Waples and Do (2010) suggest using the harmonic mean of results from multiple methods for the most reliable estimates; thus we report these as well. The largest effective population sizes were observed in the central cluster in OCPN (151.9), RIVR (112.47), and LASB (94.26). Much smaller effective population sizes were evident in DBCH (16.86) and in the coastal cluster in OCPN (35.67). We detected recent genetic bottlenecks in the form of significant heterozygote excesses in VENT, OCPN, both clusters within OCPN, PASQ, and OTAY.

Table 2. Genetic diversity indices for the populations detected via the Waples and Gaggiotti (2006) method and clusters detected in GENELAND. N = number of samples, A = allelic richness, H_O = observed heterozygosity, H_E = expected heterozygosity, F = inbreeding coefficient, LD-N_e = effective population size from LDNE, COL-N_e = effective population size from COLONY, Harm-N_e = harmonic average effective population size between LDNE and COLONY, H-excess = p-value of test for heterozygote excess. In a few locations, not enough information is available in the data to estimate either N_e (*) or the upper limit of the confidence interval (∞).



CLUSTER/Population	N	A	H_O	H_E	LD-N_e	COL-N_e	Harm-N_e	H- excess
VENT	**12**	**3.54**	**0.526**	**0.512**	**248.1 (35.5 - ∞)**	**26 (13 - 60)**	**47.07**	**0.04**
LASB	**52**	**4.7**	**0.559**	**0.584**	**133.2 (82 - 301)**	**73 (50 - 111)**	**94.26**	**0.297**
San Dimas	28	3.21	0.549	0.556	58.1 (39.4 - 100.2)	60 (37 - 107)	59.03	--
Whittier	4	3.16	0.592	0.508	*(23.5 - ∞)	--	--	--
Redlands	6	3.1	0.561	0.536	*(68.2 - ∞)	112 (25 - ∞)	--	--
DBCH	**10**	**4.32**	**0.658**	**0.570**	**13.9 (9.5 - 22.6)**	**24 (10 - 221)**	**16.86**	**0.37**
Diamond Bar	8	3.02	0.638	0.530	8.4 (4.8 - 15.1)	28 (11 - ∞)	12.92	--
RIVER	**16**	**4.46**	**0.510**	**0.568**	**325.8 (65.5 - ∞)**	**68 (34 - 229)**	**112.47**	**0.52**
OCPN (CENTRAL)	**143**	**4.94**	**0.605**	**0.623**	**166.8 (124.8 - 238.9)**	**140 (109 - 179)**	**151.9**	**0.03**
Northern Central Reserve	32	3.53	0.641	0.625	90.4 (59 - 174.6)	46 (29 - 77)	60.97	--
El Modeno Open Space	12	3.15	0.579	0.552	11.5 (7.1 - 20.9)	20 (10 - 50)	14.6	--
Southern Central Reserve	32	3.52	0.615	0.611	71.3 (49.7 - 117.9)	50 (32 - 85)	58.78	--
El Toro	6	2.69	0.570	0.458	4.9 (2.7 - 9.3)	12 (5 - 45)	9.96	--
Southern California Edison	16	3.36	0.651	0.610	51.9 (26.7 - 272.6)	32 (17 - 74)	39.59	--
Lake Forest	9	3.16	0.576	0.560	13.7 (9.5 - 21.3)	13 (11 - 80)	13.34	--
Northern MCB Camp Pendleton	11	3.33	0.531	0.541	18.8 (12.1 - 34.8)	44 (19 - 692)	26.34	--
Southern MCB Camp Pendleton/Fallbrook NWS	20	3.33	0.566	0.567	103.7 (49.5 - 5993.8)	54 (31 - 124)	71.02	--
OCPN (COASTAL)	**31**	**4.58**	**0.596**	**0.620**	**31.7 (24 - 44.1)**	**42 (26 - 73)**	**35.67**	**0.007**
Coastal Reserve	12	3.38	0.623	0.597	24.6 (14.6 - 56.7)	30 (16 - 69)	27.03	--
University of California-Irvine	5	2.96	0.526	0.522	9.9 (4.4 - 30.1)	40 (9 - ∞)	15.87	--
Crystal Cove State Park	9	3.11	0.637	0.557	16 (10.3 - 29)	24 (12 - 88)	19.2	--
PASQ	**40**	**4.64**	**0.650**	**0.650**	**235.4 (109.3 - ∞)**	**53 (35 - 84)**	**86.49**	**0.004**
SD	**31**	**4.84**	**0.593**	**0.626**	**29.9 (22.9 - 41)**	**46 (30 - 77)**	**35.57**	**0.176**
OTAY	**14**	**4.6**	**0.673**	**0.646**	**46.4 (21.2 - 5667.4)**	**44 (24 - 137)**	**44.98**	**0.018**

Discussion

The dataset analyzed here, with a large number of samples and many highly variable microsatellites, should be sensitive enough to detect fine-scale and recently developed patterns of genetic population structure in the cactus wren. Using multiple, layered analyses, we detected multiple geographically distinct genetic clusters and populations, and significant isolation by distance. These patterns correlate with observed levels of fragmentation.

Genetic Population Structure

Detected genetic structure patterns appear to largely mirror available open space over the study area. For instance, the largest spatial extent of open space with the least urban fragmentation is encompassed by the central OCPN cluster (Fig. 3). This is separated from the coastal OCPN cluster by the Interstate 5 corridor and coincident urbanization. Extensive field surveys also confirm a lack of movement between the central and coastal clusters in OCPN (Preston & Kamada 2012). Though substructure analyses in GENELAND provide evidence for two clusters within the central OCPN cluster, these results must be interpreted in light of the significant isolation by distance also observed. Here, clustering may be influenced by sampling gaps rather than reflecting true divisions. Field observations have detected dispersal between several of the populations within the central OCPN cluster (Preston & Kamada 2012). Additionally, a second, Bayesian clustering method (STRUCTURE; Pritchard et al. 2000) employed in Barr et al. (2012) provides evidence for stepping stone gene flow in this area. For these reasons, we infer central OCPN to be a single genetic cluster. The VENT, RIVR, and PASQ clusters are also widely separated from others by fragmentation from urban development, agriculture, and fire (Fig. 1). The patterns detected at DBCH and OTAY may provide an indication of the scale at which fragmentation may disrupt genetic connectivity in the cactus wren. Both of these clusters are separated by very short distances from nearby aggregations. At OTAY, the distance is approximately 9km (Fig. 4), while DBCH occupies open space fragmented from neighboring clusters by major roadways (Fig. 2). Despite their close proximity, GENELAND results suggest significant disruptions in connectivity between these sites.

Lesser or more recent disruptions in gene flow may be indicated by the Waples and Gaggiotti (2006) method for detecting panmictic populations. For instance, aggregations of cactus wrens sampled in the El Modeno Open Space, El Toro, and the remainder of NROC's Central Reserve are differentiated from one another (Fig. 5). Notably, El Modeno and El Toro are isolated from the other sites by major roads and urbanization. Though many other aggregations within the large open space occupied by the central OCPN cluster are identified as independent populations, genetic distances between these are far lower than observed throughout the rest of the dataset (Fig. 7). For instance, genetic distance between the Northern Central Reserve and Northern Camp Pendleton 35km away is much lower (F_{ST} = 0.011), than that between the Northern Central Reserve and El Modeno population 15km to the west (F_{ST} = 0.035). Such patterns are prevalent throughout the study area, with higher genetic differentiation coinciding with more severe fragmentation by urban development.

Despite an overall signal consistent with habitat fragmentation and isolation, there are a few sites suggested by clustering analyses to be connected despite being ostensibly isolated. In particular, although it appears to be a habitat island in a huge urban expanse, Palos Verdes clusters into LASB (Fig. 2). LASB also includes cactus wrens sampled along an extended area on the southern fringe of the San Gabriel Mountains, from Big Tujunga Wash to Redlands 120 km to the east, and includes a group occupying a fragment of open space in the vicinity of Whittier. Making this cluster even more surprising is the signal of a break in genetic connectivity between it and the nearby DBCH. Both clustering analyses (Fig. 2) and the Waples and Gaggiotti (2006) method (Fig. 5) show restricted gene flow between LASB and DBCH. Small sample sizes at some collection locations and large geographic distances among collection locations may have confounded our ability to detect genetic patterns in the Los Angeles Basin (Kalinowski 2010, Meirmans 2012). For instance, while the Waples and Gaggioti (2006) method may conclude that gene flow is not panmictic between a group of cactus wrens generally around Pomona at the heart of the LASB cluster and others near Whittier or those near Redlands, this method is not robust to the confounding effects of isolation by distance. When isolation by distance is significant, distant sites would naturally have different allele frequencies and appear genetically differentiated from one another. Overcoming this issue would require sampling intermediate sites, which, since much of the area is privately owned and the presence of cactus and cactus wrens is unknown, may not be possible. Finally, small sample sizes at Big Tujunga Wash (N = 2) and Palos Verdes (N = 3) restricts our ability to make conclusions about connectivity at either of these sites.

It is possible that the levels of differentiation observed among fragmented sites may result from a lack of successful breeding by dispersing individuals, rather than a lack of movement. Some of these areas have very limited available habitat, and therefore may be at carrying capacity. Field observations have detected dispersal between several of the populations detected by the Waples and Gaggiotti (2006) method (Fig. 5; Southern California Edison and the Southern Central Reserve; Preston & Kamada 2012). In this area, recent fires (Laguna Fire, 1993; Santiago Fire, 2007) have limited available habitat, and available territories may be fully occupied. If individuals disperse between sites without breeding, those individuals would neither confer gene flow between those sites nor contribute to genetic structure. These are questions that warrant further study.

While much of the extant cactus wren habitat is highly fragmented, the central cluster in OCPN may provide some insight on a dispersal regime through more contiguous open space. Spatial autocorrelation analyses indicate significant relatedness at 1km and again at 8km (Fig. 8). This pattern may be the product of many cactus wrens staying nearby or even inheriting natal territories—a pattern also reported from field observations (Preston & Kamada 2012)--but with others making regular movements up to 8km from natal areas. This is a very different pattern than detected throughout the rest of the study area, where connectivity is more limited between sites. Within the two other areas analyzed for fine-scale population structure, LASB-DBCH and SD-OTAY, patterns indicate cactus wrens are not dispersing as far. Rather, localized spatial autocorrelation was detected both in the area analyzed in LASB-DBCH (Fig. 8; 1km) and SD-OTAY (4km), indicating a limitation on dispersal distance. Notably, the coefficient of spatial autocorrelation, *r*, at 1km in the central cluster in OCPN (0.022, CI: 0.009 – 0.035) is particularly lower than detected in either the LASB-DBCH analysis (0.109, CI: 0.05 – 0.157) or SD-OTAY (0.09, CI: 0.051 – 0.134). This indicates aggregations are much more genetically related within SD-OTAY and LASB-DBCH than detected in the central OCPN cluster, where more cactus wrens seem to make movements beyond their natal territories.

Genetic Diversity

Genetic diversity is evenly distributed across many of the clusters (Table 2); however, disruptions in gene flow are often evident in population structure long before genetic diversity is affected (Leberg et al. 2010). This is because genetic drift, the random survival of alleles from one generation to the next, causes populations to differentiate from one another more rapidly than it confers loss of alleles. The lower levels detected in VENT may be the product of several processes. For instance, a significant heterozygote excess indicates the cluster has experienced a genetic bottleneck, which would inherently reduce genetic diversity. Isolation combined with a relatively small effective population size may also have conferred a loss of alleles over time. Populations at the edge of a species' range often exhibit lower genetic diversity than those nearer to the core, and VENT is found at what has likely long been the margin of the cactus wren's range in southern California. Finally, it is also a possibility that this lower diversity is the product of a founder effect, with some small number of cactus wrens having initially colonized the area. Our dataset does not allow us to determine the extent to which each of these processes have contributed the lower genetic diversity detected at VENT.

Estimations of effective population sizes over the dataset can also provide some indications of connectivity levels. The discrepancies between the LD and sibship methods for estimating effective population sizes should not be discouraging in terms of their accuracy. Estimations of effective sizes are interpreted in a comparative manner, and to determine the extent to which populations have lost adaptive potential (Leberg 2005). Theory predicts minimum effective population size thresholds of 50 to avoid the negative effects of inbreeding, 500 to prevent the loss of diversity through genetic drift, and 5000 to persist in evolutionary time (Traill et al. 2010); however, it should be noted that gene flow has been shown to counter the loss of genetic diversity even when weak (Palstra & Ruzzante 2008). After estimating the harmonic mean between the methods for each site, some patterns stand out. The highest effective population sizes were detected in the central cluster in OCPN (Table 2; 151.9), RIVR (112.47), and PASQ (86.49). These are home to the largest numbers of cactus wrens in the study area (Data Not Shown). Meanwhile, the smallest effective sizes were detected within DBCH (16.86), the coastal cluster in OCPN (35.67), and in SD (35.57). These are areas we have identified as being highly isolated from other proximate aggregations. Since high levels of on-going gene flow would confer larger effective sizes to local populations, the smaller results reported here are congruent with the levels of genetic structure we report.

Importantly, populations with lower effective sizes more rapidly experience genetic drift. This may explain the striking levels of genetic differentiation between relatively proximate aggregations, such as between SD and OTAY or LASB and DBCH. With strong isolation by distance and low effective population sizes, the removal of stepping stones between groups may have led to rapid differentiation among these sites.

Signals of genetic bottlenecks evident across the study area are not unanticipated given the known recent declines in cactus wren abundance in coastal southern California (Shufard & Gardali 2008). Notably, three of the five populations that exhibited signatures of bottlenecks were burned by recent wildfires, including PASQ (Witch Creek Fire, 2007) and both the coastal and central OCPN clusters (Table 2). The bottleneck signals in OTAY may be the result of recent limitations on connectivity with other populations, as disrupted gene flow can also cause rapid drops in effective population size (England et al. 2010). Finally, the significant signal detected in VENT could be related to any of the numerous scenarios outlined above in the discussion of the lower genetic diversity at that site.

Management Implications

Perhaps the most important inference from these genetic analyses for cactus wren management is localized gene flow. Distant aggregations of cactus wrens are only genetically connected through intermediate sites. In the absence of such sites, limited dispersal capability and small effective population sizes may cause distant aggregations to rapidly differentiate, especially when faced with fragmentation by urbanization. Consequently, it appears that much of the study area is divided into numerous, small clusters. Habitat fragmentation by urbanization and agriculture is spatially coincident with many of the observed population and cluster boundaries, and may be the main cause in maintaining the observed genetic structure in the cactus wren.

Several large aggregations may warrant focused conservation effort to preserve or increase genetic connectivity. Clearly, the highest levels of connectivity in the study area exist within the central cluster in OCPN (Fig. 3). This cluster may be the most robust to stochastic processes, and efforts to limit further habitat fragmentation should help retain genetic exchange among existing aggregations. Cactus restoration in burned areas within this cluster may also be naturally recolonized by dispersers. In other more fragmented locations, small, isolated aggregations may be more susceptible to extinction by environmental perturbations, and may not be easily recolonized without additional efforts. Restoration of scrub habitat, and cactus patches sufficient for nesting may allow for increased connectivity among some of these aggregations. For example protecting and establishing additional stepping stones between SD and OTAY could help to restore connectivity in these areas (Fig. 4). Some efforts are already in place to re-establish cactus habitat lost to wildlife on the San Diego National Wildlife Refuge. In other areas where geographic distances between sites are large and the intervening landscape has been severely altered (such as between PASQ, RIVR, and VENT and other clusters), re-establishing stepping-stone connectivity may be difficult; consequently, augmentation and translocations may be necessary if local aggregations are extirpated or become too small. Cactus wrens have previously been translocated with success by NROC (Kamada & Preston 2012); however, the experiences in Orange County illustrate the necessity of understanding dispersal capabilities and natural connectivity patterns prior to performing translocations. A small group of cactus wrens was translocated to an isolated habitat patch on the Upper

Newport Bay in this area. Field observations indicated no individuals have moved into or out of this patch since the translocation (Kamada & Preston 2013). Indeed, GENELAND analyses cluster cactus wrens in this patch with those in central OCPN (Supp. Fig. 3), confirming field observations.

Notably, the central OCPN cluster extends over an area putatively occupied by two cactus wren subspecies, *C. b. anthonyi* and *sandiegensis*. Significant morphological differentiation was detected by Rea and Weaver (1990) between cactus wrens occupying coastal San Diego County and southern Orange County versus those found throughout the rest of their extensive range in the US and Mexico, leading to the designation of a unique *sandiegensis* subspecies in the region. Our data are not congruent with the suggestion by Rea and Weaver (1990) that a separation between subspecies exists along San Juan Creek in southern Orange County, but rather that gene flow is on-going through and beyond this area. Multiple genetic analyses here suggest cactus wrens from MCB Camp Pendleton to the northern extent of NROC's Central Reserve, 35km northward of San Juan Creek, are part of a common gene pool.

Future Study

Several questions are apparent for future study. For instance, great geographic distances separate the cactus wrens in LASB, largely along the southern slopes of the San Gabriel Mountains despite low genetic differentiation (Fig. 2). This may indicate that cactus habitat, and cactus wrens, are present throughout this area. It is also possible that cactus wrens are capable of making long dispersing movements through this area. Furthermore, several areas exhibit surprising high levels of genetic structure between relatively proximate sites without obvious and extended impediments to gene flow. For instance, only narrow roadway corridors separate DBCH from aggregations clustered into LASB to the north and west, and the central cluster in OCPN to the south (Fig. 1). In contrast, several aggregations within LASB are divided by major roads and appear to have shared recent gene flow. Investigating the fine-scale constraints on cactus wren dispersal, such as through a focused radio telemetry study, would greatly help to understand the patterns of population structure reported here.

There is also known movement between several aggregations that have been designated as separate populations by the sensitive method we employed here (Waples & Gaggiotti 2006). Further study is warranted to determine the fate of dispersing cactus wrens in the face of limited available habitat. Preston and Kamada (2012) report that after cactus wren populations recovered in Orange County, for instance, more "floaters" were observed in the field on the margins of occupied territories. It is not known if these individuals are conferring gene flow via extrapair paternity or if they are failed dispersers. Floaters that fail to pair may do so in subsequent seasons (Preston & Kamada 2012); however, the delay decreases their likelihood of survival to breeding.

Developing a historical phylogeographic perspective would also help to better understand current genetic structure in the cactus wren. The methods utilized here are best for understanding contemporary levels of genetic structure, and it is difficult to determine how historical distribution patterns may be influencing these results. Cactus wrens are thought to have colonized coastal southern California from the desert through the San Gorgonio Pass after the uplift of the Transverse and Peninsular Ranges. This is based upon mitochondrial evidence, which does not detect a deep phylogenetic divergence between cactus wrens in the desert and our study area (Eggert 1996; Teutimez 2012); however, questions about the directionality of colonization and expansion remain. Several other potential corridors between coastal and desert habitats exist, including Antelope Valley, the El Cajon Pass, passes through the San Jacinto Mountains, and through northern Baja. Certainly, multiple colonization events are possible, and the footprint of such events may exert some influence on contemporary genetic patterns. Analyses of gene sequence data may be able to provide further insight into the phylogeographic history of coastal cactus wrens. The extent to which desert and coastal populations currently exchange genes is also unknown. Many lower elevation passes are now largely developed or otherwise disturbed, and measureable gene flow may be unlikely. With additional samples from desert cactus wrens and additional genetic analyses, both historical and contemporary genetic connectivity can be quantified.

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City of Thousand Oaks, Conejo Recreation and Parks District, CACW Working Group, AECOM, San Diego Gas & Electric, Pala Band of Mission Indians, Helix Water District, San Diego Audubon Society, Southern California Edison Viejo Conservation Easement, Outdoor Resorts Rancho California Inc., San Bernardino Co. Dept. of Public Works, Vulcan Materials Company, Dept. of Recreation and Parks of the City of Los Angeles, City of San Dimas, and the City of Moorpark. The use of trade names does not imply endorsement by the U.S. Geological Survey.

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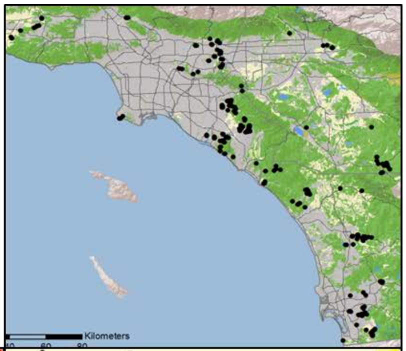
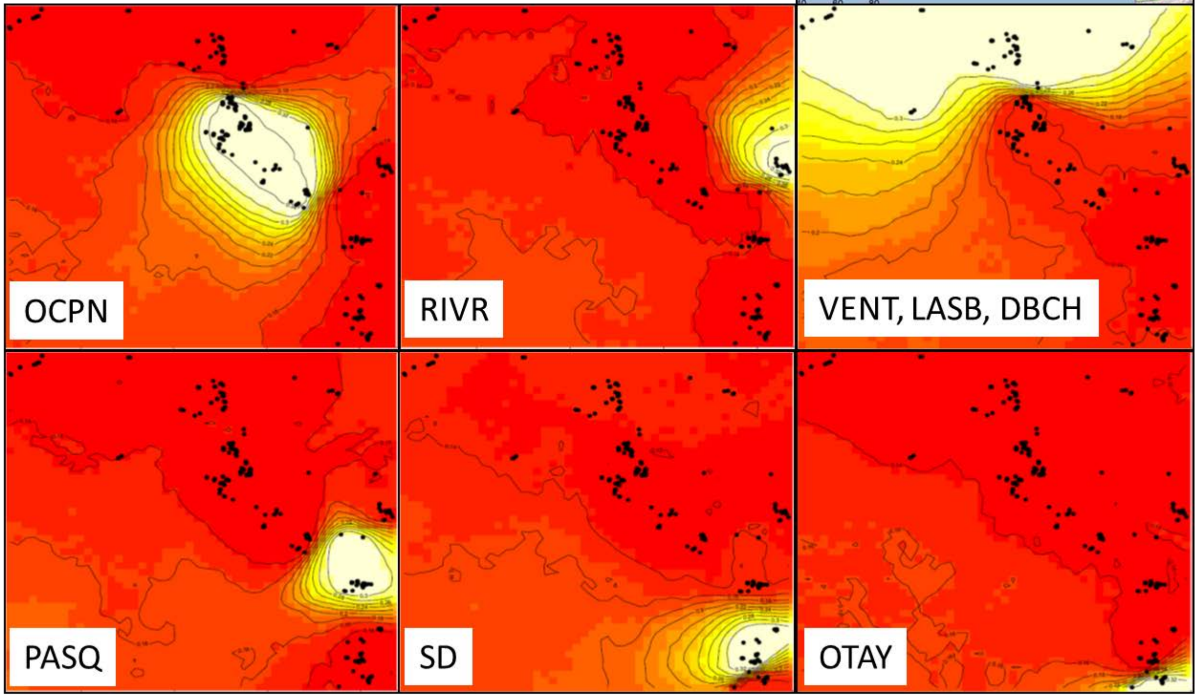
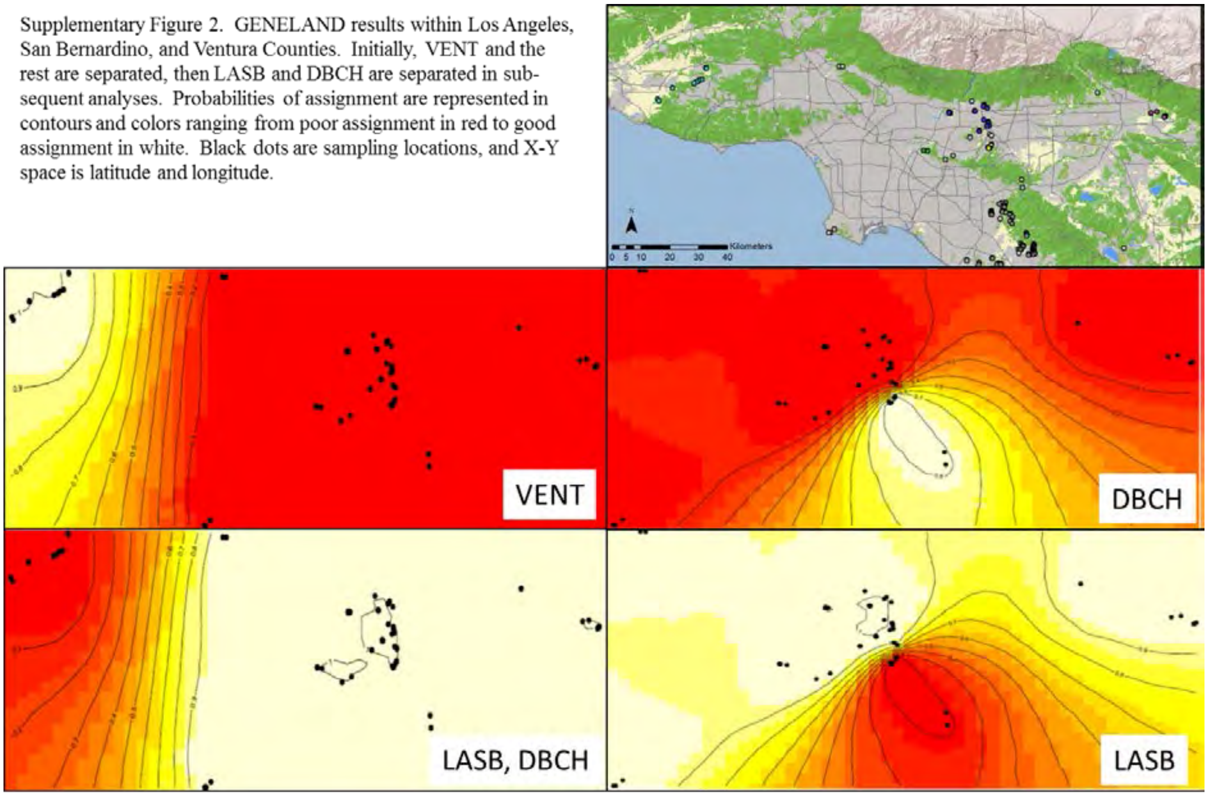
Supplementary Figure 1. GENELAND results on overall dataset. In each figure, probabilities of assignment are represented in contours and colors ranging from poor assignment in red to good assignment in white. Black dots are sampling locations, and X-Y space is latitude and longitude.

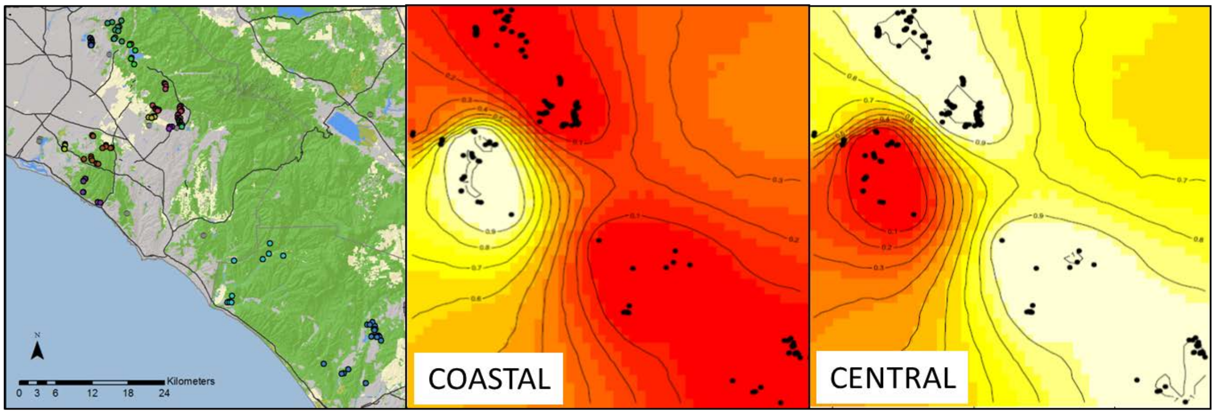




Supplementary Figure 2. GENELAND results within Los Angeles, San Bernardino, and Ventura Counties. Initially, VENT and the rest are separated, then LASB and DBCH are separated in subsequent analyses. Probabilities of assignment are represented in contours and colors ranging from poor assignment in red to good assignment in white. Black dots are sampling locations, and X-Y space is latitude and longitude.



Supplementary Figure 3. GENELAND results from within OCPN. Probabilities of assignment are represented in contours and colors ranging from poor assignment in red to good assignment in white. Black dots are sampling locations, and X-Y space is latitude and longitude.



Appendix F: Volunteer Program

1 INTRODUCTION AND SUMMARY

1.1 Volunteer Programs

This Annual Report describes the components included within the larger Volunteer Program that serviced the Palos Verdes Nature Preserve. Specific activities are detailed for the reporting period January 1, 2014 to December 31, 2014. The PVPLC continues to work to implement grants geared toward improving this program.

Since 1988, volunteers have played an essential role in fulfilling the Palos Verdes Peninsula Land Conservancy's (PVPLC) mission to preserve land and restore habitat for the education and enjoyment of all. PVPLC is a non-profit organization that relies heavily on the support of community involvement to perform many of the tasks necessary to manage the Nature Preserves. Volunteers donate thousands of hours each year to help with office assistance, event planning, community education, habitat restoration, trail maintenance, and much more. This report divides the various volunteer programs into two categories: Community Involvement Volunteers and Stewardship Volunteers.

The first category, Community Involvement Volunteers, supports volunteer activities that focus on friend making, fundraising, and recommendations to staff on a variety of topics. This category is further divided into four sections which are detailed within the report:

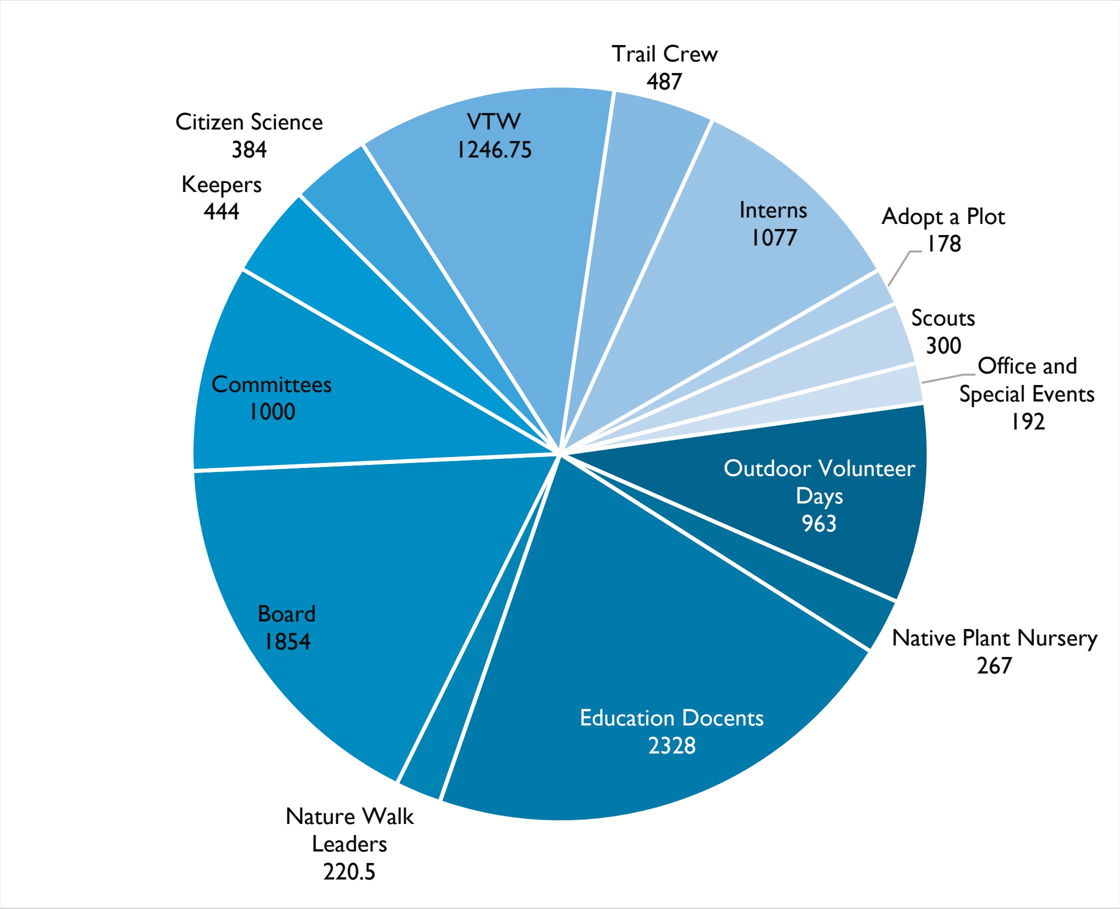
- Board of Directors
- Committees and Advisory Boards
- Special Events and Office Assistance
- Education Docents and Nature Walk Leaders
- Interns

The second category, Stewardship Volunteers, supports activities that are performed on the land to assist with habitat management of the Preserve. In all, there are six elements within this category that are described in more detail in the Stewardship Volunteer section of this report. The backbone of the program is our regularly scheduled Saturday Outdoor Volunteer Days that are open to participation by all and require no long-term commitment. Periodically, there are also individuals or groups that complete stewardship projects outside of the normally scheduled outdoor events. Boy Scouts and Girls Scouts interested in obtaining their final awards are two such groups. There are also several Stewardship Volunteer opportunities that require long term commitments. The six programs are listed below:

- Outdoor Volunteer Days
- Team Leaders
- Scout Projects
- Trail Crew
- Keeping an Extra Eye on the Preserve for Environmental Review and Stewardship (KEEPERS)
- Volunteer Trail Watch
- Citizen Science

In 2014, volunteers provided a grand total of **10,941** hours of service (Figure 1) to support conservation, restoration and management of the Palos Verdes Nature Preserve. According to the Independent Sector, volunteer time in California is valued at $26.87 per hour (based on Dollar Value of a Volunteer Hour, by State: 2014, Independent Sector), thus generating a total of **$293,985** of in-kind services. The amount of volunteer hours donated at each Nature Preserve or for a specific volunteer category depends on the size of property or specific projects that transpired during the reporting period.

Figure 1. Distribution of volunteer hours by program or location of activity.



2 COMMUNITY INVOLVEMENT

2.1 Board of Directors

PVPLC is driven and supported by a seventeen-member volunteer board, which meets on a regular basis to strategize and direct the organization's mission. This year, the board contributed about 1854 hours in serving the Land Conservancy's mission.

2.2 Committees and Advisory Boards

The PVPLC maintains numerous committees and advisory boards for the following purposes:

- To provide review and recommendations regarding organizational plans and policies
- To provide assistance with the operations of the organization
- To provide community input for PVPLC activities

- To provide a training and evaluation ground for potential members of the Board of Directors

Committee volunteers donated a total of 1000 hours, with many committees meeting on a quarterly basis. Hours for committee-involved board members are compiled with their board volunteer time. The committees that were active during the reporting period are listed below:

- Audit Committee
- Finance Committee
- Development Committee
- Investment Committee
- Science Advisory Panel
- Special Events Committee(s)

2.3 Special Events and Office Assistance Volunteers

The PVPLC relies on individual volunteers and community groups, such as the National Charity League (NCL), Los Hermanos, and Assisteens, to assist PVPLC staff with all major fundraising and friend-raising events. We have built very strong and fulfilling relationships with these groups and strive to provide an environment that lets volunteers know they are indispensable and an integral part of our organization.

Special events supported by committees and volunteers this year included the Trump Wine Festival, Palos Verdes Pastoral and the Abalone Cove Grand Reopening Event.

In the office, volunteers handle routine tasks such as labeling newsletters, stuffing envelopes, assembling event materials, planning and preparation for special events, and much more. During the 2014 reporting year, office volunteers and special event volunteers, donated 192 hours of assistance.

2.4 Nature Walks

Nature Walk Leaders donated a total of 220 hours in 2014. Former PVPLC Board of Directors member Anke Raue coordinates this group of dedicated volunteers and each prospective walk leader must have a high level of knowledge the local ecosystem, particularly the native and non-native plants found on the Peninsula. Leaders must go through extensive training and be willing to research and learn about local history, geology, flora and fauna. Continued research and exploration serves to add to a walk leader's knowledge base, preparing them to give accurate and in-depth presentations to the public.

Walks are held all over the Peninsula, from the edge of the coast to deep within the canyons. Each leader designs his or her presentation to include special attributes and stories particular to a site. Nature walks occur once a month every month throughout the year, featuring a different location every time.

2.5 Internships

Interns dedicate much of their volunteer time to helping the Land Conservancy's mission to educate and restore. In 2014, 16 interns dedicated a total of 1077 hours to various projects such as educational outreach, field trips, weed mapping, native plant propagation, wildlife monitoring and much more.

3 STEWARDSHIP VOLUNTEERS

Volunteers play an integral part in helping PVPLC staff exceed our goals for restoring land in the Preserve. Outdoor volunteer days provide an opportunity for public volunteers to contribute to habitat and trail restoration efforts. Team Leaders provide leadership on Saturday events, the Trail Crew class volunteers build skills to maintain the trail system, and KEEPERS help "keep an eye" on the Reserves on a monthly basis. The Volunteer Trail Watch, Adopt-a-Plot program, Citizen Science wildlife monitoring, scout projects, local HERO Club chapters and nursery volunteers are also Stewardship volunteers that support Conservancy conservation efforts within the Palos Verdes Nature Preserve, the native plant nursery and other management areas (PNVP and nursery are the only metrics outlined for this report).

Palos Verdes Nature Preserve Stewardship volunteer highlights in 2014:

- 5347 hours of outdoor stewardship volunteer time
- Grants from Room&Board, Toyota TogetherGreen and REI Inc. to support volunteer programs, youth engagement, and restoration initiatives

3.1 Outdoor Volunteer Days

The PVPLC holds outdoor volunteer days nearly every Saturday of the year, held from 9am-12pm, excluding holiday weekends and during the month of August. The focus of these events is to restore native habitat, maintain the trail system, and do general clean-ups. All age groups are encouraged to participate though the common demographic of half of the participants are volunteers under 18 years of age. There is a particular focus on getting young people involved as a mechanism to ensure education and stewardship on the Preserves in perpetuity. We work with local schools and colleges to have teachers bring groups of students or give incentives such as extra credit and service-learning hours for students who participate on the Saturday volunteer events. Also included in this summary are events catered for special groups and corporations.

A detailed account of volunteer days and group events are listed below. Events are listed chronologically by Preserve with the Palos Verdes Nature Preserve (PVNP) further separated by Reserve.

3.1.1 Palos Verdes Nature Preserve (PVNP)

Abalone Cove Reserve

January 4 – Four volunteers planted and watered 50 bluff plant species.

November 21 – 32 Volunteers planted 30 shrubs and removed iceplant from Portuguese Point.

Agua Amarga Reserve

January 3 – Nine volunteers planted 43 coastal sage scrub plants.

February 22 – 26 volunteers planted 45 shrubs.

May 1 – 15 volunteers planted 40 mulefat in the riparian area.

Alta Vicente Reserve

January 9 – Six volunteers weeded around shrubs in the restoration area.

January 11 – 14 volunteers weeded around shrubs in the restoration area.

May 2 – 26 Salvation Army volunteers removed iceplant from the Phase 2 restoration area.

May 17 – Big Sunday: 53 volunteers removed iceplant, closed spur trails and made seed balls.

September 18 – 8 Toyota volunteers planted 100 *Astragalus* and 20 *Artemisia*.

Portuguese Bend Reserve

February 15 – 64 volunteers planted 200 coastal sage scrub plants and grasses in the Peacock Flats area.

March 29 – 35 volunteers weeded around new shrubs in Peacock Flats.

May 3 – 29 volunteers weeded mustard from the Peacock Flats area.

3.1.2 Native Plant Nursery/DFSP

Activities in the Native Plant Nursery include transplanting seedlings from flats into individual containers, removing weeds from the containers. On occasion, groups and scouts help maintain the shade structure, build plant benches and repair the weed barrier cloth. Volunteers help at the nursery on select Saturday events as well as during the week throughout the year. A total of 267 volunteer hours were contributed to nursery efforts in 2014.

3.2 Team Leader Program

The Team Leader program was started in 2007 in response to the growing number of volunteers that were attending the Outdoor Volunteer Days. Team Leaders are volunteers, sixteen years or older, who assist in supervising the Saturday outdoor volunteer activities. They ensure that volunteers have adequate instruction and the tools necessary to complete the task. They also assist in educating the public about the PVPLC.

The program requires that interested volunteers go through an application and interview process. Candidates then attend a half-day weekend workshop where they learn the skills necessary to motivate and supervise volunteers during Saturday Outdoor Volunteer Days. Training involves practicing leadership skills and communicating restoration techniques. Team Leaders commit to working at least four volunteer days within one season or half-year. The goal of the PVPLC is to hold two Team Leader workshops each year and train a minimum of six new Team Leaders at each one. In 2014, only one workshop was held which trained three leaders at Portuguese Bend Reserve on September 6.

The Team Leader Program has helped develop leadership skills in participants and has greatly contributed to the success of our Outdoor Volunteer Days. The quality of work from regular volunteers has increased with the guidance of Team Leaders. In addition to adult participants, many of the Team Leaders attend local high schools and universities. During the reporting period, the program has allowed these students to build leadership skills that they will find useful in their future.

3.3 Scout Projects

The PVPLC encourages Boy Scouts and Girl Scouts who are looking for projects to complete their final awards, Eagle Awards for Boy Scouts and Gold Awards for Girl Scouts, by providing them with opportunities to complete their projects on preserves the PVPLC manages. This collaboration is beneficial to the scout groups, the PVPLC, and the public that uses the preserves. Scouts work under the mentorship of one of the PVPLC staff to complete their projects and are steered toward objectives that meet the PVPLC stewardship goals. In 2014, scout projects accumulated 300 hours of volunteer service.

3.4 Trail Crew Program

In 2014, the volunteer Trail Crew contributed a total of 487 hours to maintaining the Preserve's trail system. These hours include the second-Saturday monthly class trainings as described below, as well as additional trail work, such as weed whacking or spur trail closures, executed by Trail Crew members outside of the classes. This year, Leadership Training was offered for graduates and dedicated Trail Crew members through two workshops to help prepare volunteers to initiate additional trail projects with smaller teams outside of the monthly Trail Crew classes.

The Volunteer Trail Crew class offered is based on the Basic Trail Maintenance class developed by Frank Padilla, Jr. (retired California State Parks Supervisor), and Kurt Loheit. Originally started in 1992, the class focused on both volunteer and agency skill building. Adopted by the Los Angeles District of California State Parks and later the Southern California Trails Coalition, it became the first step in advanced classes for crew leader training and design and construction classes, allowing a structured path for participants to build skills associated with trails from basic maintenance to highly advanced techniques. The class is a combination of classroom and hands-on training to familiarize the participants in all aspects of trail maintenance. The course emphasizes safety, assessments, basic maintenance skills, water control, erosion sources, terminology, proper tool use, basic survey skills, resource considerations, and user experience and maintenance value. Volunteers who demonstrate proficiency in each learned skill and fulfill a yearly indoctrination will maintain status as a qualified Trail Crew member.

Participants must be at least 18 years old and must first take the introductory course. The 50-hour course can be taken at the participant's own pace and it is estimated to take about a year to complete. There are scheduled Trail Crew Skills Classes that coordinate with the trail instructor's availability and the PVPLC Outdoor Volunteer Workday schedule.

Table 1. Trail Crew training classes

Date	# Volunteer Hours	Location	Project/Skill Learned
January 11	31.5	Portuguese Bend	Toyon Trail Assessment
February 8	33	Portuguese Bend	Tread repair on Toyon and Ishibashi Trails
March 8	38.5	Abalone Cove	Rock retaining wall installed on Cliffside Trail
May 10	36	Filiorum	Tread repair on Kelvin Canyon Trail
May 16	12	Forrestal	Remove t-bar stubs from Mariposa and Flying Mane Trails
June 14	54	Abalone Cove	Tread repair and erosion control on Sacred Cove & Cliffside Trails
July 12	39	Portuguese Bend	Rim Trail assessment and spur trail closure
August 9	39	PVPLC Office	Introductory Class
August 16	19	Abalone Cove	Install rock stairs on Cliffside Trail
September 13	27	Vista Del Norte	Indian Peak Loop Trail realignment assessment
October 11	36	Forrestal	Erosion control and tread repair on Flying Mane Trail
November 15	27	Portuguese Bend	Toyon Trail Assessment

3.5 Keeping an Extra Eye on the Preserves Stewardship (KEEPERS) Program

In 2014, The KEEPERS program contributed 444 hours to monitoring the Preserve. The program was developed in April of 2007 to help monitor the nearly 1600 acres of land that is managed by the PVPLC. Keepers are volunteers who monitor an area within a preserve and fill out monthly property review forms. These forms are reviewed by staff and consolidated into a monthly report that is sent to all of the current Keepers.

The property review form is a one page form that requires some knowledge of basic trail maintenance and plant identification. The skills needed to fill out these forms are provided in a training session with a PVPLC staff person and are continually developed with an ongoing relationship between the volunteer, the PVPLC staff, and regular visits to the preserve being monitored. This volunteer opportunity is a one year commitment (a total of 12 visits) to the chosen preserve area. Some of the properties managed by the PVPLC are large enough to require more than one Keeper to monitor them. The person or group that accepts this responsibility also helps, if necessary, to train the following year's replacement volunteer Keeper. Currently, there is no term limit.

3.6 Volunteer Trail Watch Program

This is the first year of the Volunteer Trail Watch Program, a program initiated to help educated trail users about appropriate trail use and monitor preserve misuse. Volunteers dedicated 1247 hours to the program through training and field implementation activities, and reporting observations through the web portal for record keeping. A large portion of this year's hours was contributed by Barbara Ailor (an estimated 600 hours), the Volunteer Trail Watch coordinator, who dedicated much of her time to training and coordinating the program's volunteers in addition to her time as a VTW volunteer on the trail. The pilot project report is attached.

3.7 Citizen Science

Volunteers help the PVPLC monitor wildlife on the Preserve in order to document populations and their response to restoration efforts. Citizen Science volunteers contributed 384 hours to documenting the behavior of cactus wrens and the evidence of mammalian populations like coyotes and foxes through tracking efforts.

4 GRANTS SUPPORTING VOLUNTEER ENGAGEMENT

In August 2014, REI awarded the PVPLC with a $10,000 grant to support stewardship volunteer events and programs with supplies and tools.

Room&Board awarded PVPLC $35,000, some of which is to support volunteer and education programs. They aim to build a strong partnership with PVPLC by supporting volunteer events, plant sales, and fundraising functions utilizing their unique resources.

PILOT PROJECT REPORT

PALOS VERDES NATURE PRESERVE VOLUNTEER TRAIL WATCH

Issued March 26, 2015

I. Background

In response to the increasing impacts of visitor use in the Palos Verdes Nature Preserve (the Preserve) and a gap in enforcement efforts, community members suggested the formation of a volunteer trail patrol, later formally named the Volunteer Trail Watch (VTW Program). The Palos Verdes Peninsula Land Conservancy (PVPLC) presented the concept to the Rancho Palos Verdes City Council on October 2, 2012 with a recommendation to proceed with the VTW Program for a trial period. After receiving a favorable response from City Council, community representatives worked with the staff of PVPLC and the City of Rancho Palos Verdes (the City) to develop a charter for the all-volunteer watch group, to develop a training manual and training program for trail watch volunteers, to solicit and train volunteers (including 3-day in-person training), to develop a web-based reporting system, and to implement the first trail watch teams. The VTW Program began patrolling the Preserves in October, 2013. Community member Barb Ailor served as the first volunteer coordinator of the VTW Program, working under the auspices of the PVPLC's Conservation Director and Board-directed Stewardship Committee.

The VTW Program operates as follows:

- Trail watch volunteers travel through the Preserve on foot, by horse or on mountain bike at times and on trails they choose.
- During their time in the Preserve, volunteers take notes of their observations about rules violations—such as unauthorized trail use, off-trail use and vandalism—as well as trail conflict issues, and serve as extra "eyes and ears" in the Preserve to support enforcement efforts.
- Trail watch volunteers may also speak with visitors to educate them on the status of the Preserve as land set aside for habitat preservation (or conservation or protection), on the rules of the Preserve, and on trail "etiquette." This might occur when visitors break rules, or volunteers may simply engage visitors in conversation.
- Following each visit to the Preserve, volunteers complete an online report. This report is available to the City staff and the PVPLC staff, as well as to the MRCA rangers.

In its recommendation, the Council requested a report on the progress of the VTW Program following a pilot period. This Report is delivered in satisfaction of the Council's request. The pilot period covered by this report is October 2013 to October 2014, which coincides with the one year period starting with the go-live date of the City's web-based reporting portal.

II. VTW Program Mission, Goals and Objectives

Pursuant to its charter document, the mission of the VTW Program is to serve as the eyes and the ears of the City and PVPLC with a view to:

1) Protecting the natural resources of the Palos Verdes Nature Preserve, including the flora and the fauna as well as the geology, topography and scenic landscape, and
2) Enhance the safety of, and promote an enjoyable experience for, all Preserve visitors.

In furtherance of this mission, the charter document provides goals and objectives for the VTW Program:

1) Foster volunteerism in support of the mission
2) Through education and information sharing, increase compliance with laws, rules and policies governing the Preserve by visitors and minimize trail user conflict.
3) Obtain information to assist the City, PVPLC and enforcement personnel, including the Mountains Recreation and Conservation Authority (MRCA), in prioritizing their focus.

As discussed below, the Program's precise contribution to these goals and objectives can be difficult to measure. Nevertheless, this Report assesses the progress of the VTW Program based as closely as possible on the goals and objectives of its charter document.

III. Progress of the VTW Program

A. *Foster Volunteerism in Support of the Mission*

No minimum targets were established for volunteer participation in the VTW Program charter document. However, the more volunteers who participate, the better the VTW Program can achieve its objectives of increasing Preserve rules compliance and obtaining information to assist enforcement efforts. The following table describes the results of recruitment efforts.

Trail watch volunteers trained July 2013	Number of July 2013 trainees who returned	Percentage retention	New trail watch volunteers trained March 2014	Number of March 2014 trainees who returned	Percentage retention	Number of active volunteers as of date of Report
25	14	56%	14	11	79%	25

The low retention rate between the first and second training sessions was likely caused by a long delay between the initial training (July 2013) and the introduction of the reporting web portal

(October 2013), during which time volunteers' interest may have waned.[1] Retention was significantly improved following the second training as the VTW Program was fully up and running and as expectations of the volunteers became more clearly defined. In the first year of the program, VTW volunteers recorded 663 hours of volunteer time, including time in the Preserve as well as time in training and administering the VTW Program.

In a survey (the Survey) conducted by PVPLC of VTW Program volunteers in October 2014, 100% of respondents answered that they believe others would also be interested in becoming a trail watch member, 88% of respondents answered that they had attempted to recruit others into the VTW Program, and 36% of respondents answered that they had successfully recruited other volunteers for the VTW Program. Some respondents provided suggestions to support recruitment. See Appendix 1 attached to this report for the full results of the Survey.

In addition to the numbers of volunteers and return rates, the VTW Program's volunteer development efforts led to positive activities that support volunteer recruitment:

- Volunteer Recruitment Cards were developed and have been instrumental in helping trail watch volunteers introduce the VTW Program to other visitors in the Preserve.
- Volunteers in different user groups developed an awareness of shared interests in Preserve protection, thereby promoting good will among all user groups.
- Some volunteers went above and beyond the minimum requirements to make other long term contributions to Preserve management [2]

Summary

While two recruitment sessions creates minimal data on which to draw conclusions regarding the VTW Program's progress in fostering volunteerism, the data indicates that (1) interest by new participants may be waning and greater outreach will be required to attract new volunteers, but (2) retention is increasing as a core group of interested volunteers coalesces. Going forward, more regular volunteers will be needed, indicating that the VTW Program will need to focus on outreach, perhaps leveraging PVPLC volunteer outreach efforts.

B. *Increase Compliance with Laws, Rules and Policies Governing the Preserve*

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[1] In February 2014, a web survey was taken of trail watch volunteers to improve training and to gauge VTW Program interest. Results of the survey are reported in Appendix 1: Analysis of VTW Program Volunteer Data, September 2013 through August 2014.

[2] Examples are production of an educational video on "Sharing the Trails" (link below), development of simple-to-use visual instruction manuals on use of the Web Portal for reporting volunteers' observations on the Preserve, instruction of volunteers on computer skills via Join.me, an effort to map trail spurs using GPS, analysis of web portal data and generation of PowerPoint summaries of the data, and trail watch volunteers participating in occasional group walks where they learned about each other's interests and expertise and seasoned volunteers helped train the less experienced.

Initial efforts to assess the VTW Program's progress against its compliance goals and objectives focused on numerical and statistical evaluations.[3] On closer review of the data, it was determined that baseline data is incomplete at present[4] (although over time the VTW Program may serve to create its own baseline), and VTW Program data during the trial period was subject to some reporting inconsistencies that have since been the subject of ongoing corrections.

Because of these limitations, this Report evaluates the VTW Program's progress in causing increased compliance with laws, rules and policies governing the Preserve through evidence that is not statistical in nature but is otherwise probative. Using this methodology, the following examples of VTW Program progress are noteworthy:

- The VTW Program supported the recruitment of people to help with the Rapid Response Team, now led by a full time PVPLC staff member, to address spurs and trail closures for restoration and provide more prompt attention to damaged signs, damaged post and rope/cable, and off-trail use.
- The VTW Program has provided more frequent observation and documentation of Preserve use and activities than was previously available through other means. Therefore, through the VTW Program, increased data collection will occur in the succeeding years thereby benefiting compliance efforts.
- VTW Program education efforts led to development of a short training video titled "Sharing the Trails" to increase the opportunities for public education. The video may be viewed at http://pvplc.org/_volunteer/index.asp
- The VTW Program supported City staff's more aggressive steps to protect high impact areas and areas where VTW documentation indicated there were repeated rule violations, such as the installation of a "NO BIKES" sign at the beginning of Landslide Scarp Trail to discourage repeated use of this no-bikes trail by mountain bikers.
- The VTW Program influenced the production of dog cards for distribution to Preserve visitors. Dog cards have been instrumental in helping VTW volunteers approach Preserve users to broach the topic of having dogs on leash.
- The three half-day training sessions served as an excellent introduction to the PVPLC, its history, how the land was preserved and why, and the Preserve rules and the reasons for

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[3] Consideration was given to determining a baseline for compliance for periods prior to implementation of the Volunteer Trail Watch Program using records from the PVPLC K.E.E.P.E.R. program, reports from the MRCA rangers, records of photo points, and other data, and then comparing compliance as determined by those reports to compliance on or around the one year anniversary of the VTW Program. Consideration was also given to reviewing data from the VTW Program monthly reports to look for trends in compliance activity.

[4] For example, PVPLC's K.E.E.P.E.R. inspections of the property, which are conducted pursuant to best practices for land trust stewardship programs, occur only once per month for a limited duration (generally 1-2 hours) on varying dates and at varying times fitting the schedule of the K.E.E.P.E.R. volunteers. The focus of KEEPER reports is primarily Preserve condition, rather than visitor behavior, thus appropriate for general stewardship management, but inadequate for establishing baseline data for user activity and compliance. Similarly, MRCA Ranger data is generally focused on citations, which are not issued under consistent parameters. Other data is available, such as photo records that show improper trail widening, spur trail creation, and improper Preserve use. These photo points will be valuable over time as a record of the same points is developed, but the time horizon for using photo points is longer than the one-year anniversary of the VTW Program.

them, so that even those trainees who drop out of the VTW program leave with a better understanding and appreciation for the Preserve. In the Survey discussed above, 94% of responses by VTW Program volunteers indicated that the volunteers learned the "Mission and Vision of the Land Conservancy" and "Preserve Rules and Trail Etiquette."

While education remains a vital part of the compliance effort and a key role for VTW Program volunteers, it is worthwhile to note that reports of the VTW Program volunteers themselves indicate that in approximately one-third of educational contacts the Preserve visitor was not open to the educational efforts, indicating limits on the effectiveness of voluntary education and underscoring the continued need for other efforts, including enhanced signage and enforcement (especially frequent law enforcement visibility and more issuance of citations).

Summary

Ample evidence exists that the VTW Program is positively influencing efforts at compliance with laws, rules and policies governing the Preserve. Such evidence supports continuance of the VTW Program. However, for purposes of this first year Report, reliable and consistent data is not available to isolate the VTW Program's effect on compliance.

C. *Obtain Information to Assist Enforcement*

In the first year of the VTW Program, 908 volunteer reports were generated. The table below summarizes these volunteer reports. Of the 908 survey reports submitted, 55 (6%) reported no noncompliant behavior. In addition to aggregate reporting of issues, the trail watch volunteer reports also yielded data indicating repeated problem areas in terms of types of use, locations and, to a lesser degree, time of day. A more in-depth analysis of the reports appears in Appendix 2: Analysis of VTW Program Reporting.

	Number of Noncompliant Mountain Bikers Observed	Number of Noncompliant Hikers Observed	Number of Noncompliant Equestrians Observed
Unauthorized trail use observed	39	44	1
Evidence of unauthorized trail use	82	None reported	1
Unsafe behavior*	37		
Dogs off leash		119	
Education: yes, received	16	166	1
Education: refused**	44	41	1
Education: unable to provide	14	26	None reported

* Includes reported "near miss" incidents and excessive speed
** Declined an education attempt or could not be contacted (too far away, moving too fast, earbuds or other listening device, etc.)

While the VTW Program does produce information of value in assisting in enforcement efforts in the Preserve, it is unclear how effectively enforcement personnel are incorporating or are able to incorporate VTW Program information into enforcement efforts. A comparison of MRCA Ranger quarterly citation reporting and VTW Program incident reports shows a correlation gap that should be explored to determine the underlying cause of the gap.[5] One of the recommendations in this Report (below) is for the City to provide a forum wherein the City, MRCA and PVPLC can determine how to make sure the VTW Program is maximizing its effectiveness in supporting MRCA enforcement activity.

Moreover, and as discussed above in footnote 4, photos from multiple points in the Preserve taken over a period of time show that improper trail widening, spur trail creation, and improper Preserve use continue despite the VTW Program efforts at education. This indicates the need for aggressive law enforcement efforts to punctuate the educational message and signal the City and PVPLC will have zero tolerance for non-compliance with Preserve laws and rules.

Summary

Over a period of years, data collected by the VTW Program will give a picture of compliance in the Preserve that would not be available without the VTW Program and, as a result, the VTW Program is expected to contribute materially both to volunteerism in the Preserve and to supporting compliance efforts, so long as other efforts by the City and the MRCA Rangers continue to cooperate and work in conjunction with the VTW Program.

IV. Variables Influencing VTW Program Progress

Many factors influence volunteerism in Preserve-related activities and compliance with Preserve laws and rules. The VTW Program is only one tool to encourage volunteerism and to address compliance. Other factors may have a proportionately greater effect on volunteerism and compliance, and in fact the absence or failure of other factors may result in declines in both volunteerism and compliance despite solid efforts by the VTW Program. These factors include:

- Volume of use, which varies by time of day, day of week, month, season and weather
- Clearly articulated rules designed to protect the Preserve and the safety of Preserve users
- Effective signage
- Effective spur trail closures
- Law enforcement, specifically in the form of citations
- Court/judicial support of citation efforts
- Consistency of messaging about what behavior is acceptable/permissible, including how the City, PVPLC and the MRCA Ranger communicate the rules and respond to violations
- Receptiveness of visitors to education efforts
- Effectiveness of PVPLC rapid response team
- Climatic conditions
- Community competition for a limited pool of volunteers

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[5] For example, comparing VTW Program data to the 9 months of MRCA Ranger reports publicly available for the period covered by this Report, users with dogs off leash were cited at a disproportionate rate to observed unauthorized trail users, and the difference would be even greater if evidence of unauthorized trail use was taken into account. The VTW Program endeavored during this period to provide times and locations of repeated unauthorized trail use to support Ranger citation enforcement.

Therefore, while this Report reports on the progress of the VTW Program against its goals and objectives, any conclusion as to the effectiveness of the VTW Program must take these other factors into consideration, as there is no effective means to control for these other factors when evaluating the VTW Program.

V. Recommendations to Support the Effectiveness of the VTW Program

The goals and objectives of the VTW Program reflect the broader conservation requirements and objectives of the City. Therefore, the following list identifies specific actions recommended to be taken by the City (and in some cases by the City's contract party, MRCA) to support and improve the work of the VTW Program. To the extent any of these recommendations are already under discussion or implementation, they are identified here to create a comprehensive reference and to keep focus on these efforts.

It is recommended that the City:

- Amend its contract with MRCA to include service level requirements creating metrics for enforcement, with citations, of laws and Preserve rules.
- Work with PVPLC to identify ways to address MRCA Ranger-identified enforcement constraints (including problems with signage, trail design and other factors) more promptly and more consistently, especially those constraints which have been identified as preventing judicial enforcement of citation activity.
- Amend its contract with MRCA to create a service level requirement that creates an outside delivery date for MRCA's submissions of its Quarterly Reports, such as 30 days from the end of the calendar quarter for which the report relates. As of the time of this report, the last publicly posted MRCA Quarterly Report covered the period ending June, 2014, more than 8 months old and creating a gap of 2 reporting periods.
- Place cameras in areas where there are continuous violations of laws and Preserve rules, and/or in location s where excessive habitat damage is occurring as a tool to help identify the cause of recurring damage.
- Amend its contract with MRCA to require that MRCA Quarterly Reports mirror the format of the VTW Program reports by including the area of the Preserve, the trail name, and the date and time of event (education or citation). This detail will help coordinate and prioritize the work of the VTW Program and PVPLC's Rapid Response Team.
- Provide a forum wherein the City, MRCA and PVPLC can determine how to make sure the VTW Program is maximizing its effectiveness in supporting MRCA enforcement activity and to find ways for the MRCA Rangers and the VTW Program to work together collaboratively.

While not directly included within the scope of the Report requested by the City Council, the following additional recommendations for Preserve improvement have surfaced as a result of the operation of the VTW Program:

- Protect all visitors and their pets by reducing speed of mountain bikers when in the vicinity of hikers and equestrians.
- Use education opportunities outside of the VTW Program—such as the City website or notices on signage and publication—to educate visitors that continuous violations may result in the loss or reduction of recreational use of the Preserve.

The foregoing recommendations for improvement are not intended to diminish the continuing efforts being made by VTW Program volunteers and by the City, PVPLC, MRCA Ranger and other stakeholders to advance a culture of volunteerism and compliance in the Preserve.

In addition to the above recommendations, the PVPLC Stewardship Committee (a committee of the PVPLC Board of Directors), which advises the PVPLC Conservation Director with respect to matters of Preserve management and stewardship, will be separately recommending to the PVPLC Conservation Director ideas for improvements to the VTW Program operations.

APPENDIX 1

ANALYSIS OF VTW PROGRAM VOLUNTEER DATA, SEPTEMBER 2013 THROUGH AUGUST 2014

A survey was conducted in October 2014. Out of 25 volunteers who received the survey, 12 responded. A summary of the results follow:

- Did the training classes provide a clear idea of what the volunteers would be asked to monitor as VTW :
    - n = 7 (58%) Yes, I knew exactly what the tasks would include
    - n = 3 (25%) I was slightly confused about what the tasks would include
    - n = 1 (8%) I don't think the tasks were clear at all
    - n = 1 (8%) Other
- Did you feel that your time was well spent in the training program?
    - n = 8 (67%) Yes, I learned a lot during the 12 hours
    - n = 2 (17%) I'm not sure that it was worth the time
    - n = 2 (17% Other
- Did you feel the format for the class was effective to train and launch you?
    - n = 6 (50%) Yes, the format worked well
    - n = 0 (0%) I would have preferred more role playing
    - n = 4 (33%) I would have preferred walking with an experienced leader for my first few times in the Preserve
    - n = 2 (17%) Other
- Do you walk in the Preserve regularly without being a VTW participant?
    - n = 9 (82%) Yes
    - n = 2 (18%) No
- Are you currently an active participant in the VTW program?
    - n = 7 (64%) Yes, I spend more than four hours per month as a volunteer
    - n = 4 (36%) Yes, but I don't spend quite four hours per week
- Would you be interested in coming to the next training session for a refresher?
    - n = 2 (17%) Yes
    - n = 3 (25%) Later, but not this February
    - n = 7 (56%) No
- If you are NOT active as a VTW member, please check all boxes that apply
    - n = 1 (100%) My availability for volunteering has changed
    - n = 0 I did not like data entry in the web portal
    - n = 0 I did not enjoy educating users who were violating preserve rules
    - n = 0 Other

APPENDIX 2

ANALYSIS OF VTW PROGRAM REPORTING

Source of all data below is the web-based trail watch volunteer reporting tool supported by the City of Ranch Palos Verdes through August 31, 2014. The data below combines information entered under specific category headings with information obtained from the box provided for additional information. As data entry was tedious and time consuming, trail watch volunteers often typed additional observations into the box rather than use the specific data categories.

Total reports analyzed: 814
Total hours for the year 2013/2014: 663
Total reports per hour: 1.23

- All Reserves included; Dog infractions per hour: 0.19
    - Total: 127
        - Portuguese Bend: 58
        - Filiorum: 21
        - Forrestal: 21
        - Three Sisters: 10
        - Abalone Cove: 9
        - Other: 8
    - Dogs off leash: 112
    - Not picking up dog feces: 15

- Top Trails for Dog Infraction Reports
    - Burma Road Trail: 26
    - Zote’s Cutacross: 8
    - Abalone Cove: 7
    - Rattlesnake: 6
    - Peppertree: 5

- All Reserves included; Observed Unauthorized Trail users per hour: 0.1
    - Total: 65
    - Hikers: 36
    - Bikers: 28
    - Equestrians: 1

- Top Trails for Off-Trail Reports by Reserve
    - Landslide Scarp: 24
    - Panorama: 13
    - Golden Cove: 9
    - Ishibashi: 9
    - Burma Road: 8

- All Reserves included;
    - Creating new trail: 45
    - Damaging existing trail and habitat: 45
    - Defacing or removing signs or barriers: 69
    - Littering: 22
    - Poaching: 2
    - Vandalism: 2

- Combined Damage Reports by Reserve
    - Total: 185
        - Portuguese Bend: 91
        - Filiorum: 31
        - Forrestal: 25
        - Abalone Cove: 21
        - Alta Vicente: 7
        - Other: 10

- Top Trails for Combined Damage Rep
    - Abalone Cove: 16
    - Landslide Scarp: 14
    - Ishibashi: 13
    - Toyon: 12
    - Rattlesnake: 11

- Education
    - Total: 120

- No Noncompliant Activity Observed
    - Total: 63

APPENDIX G

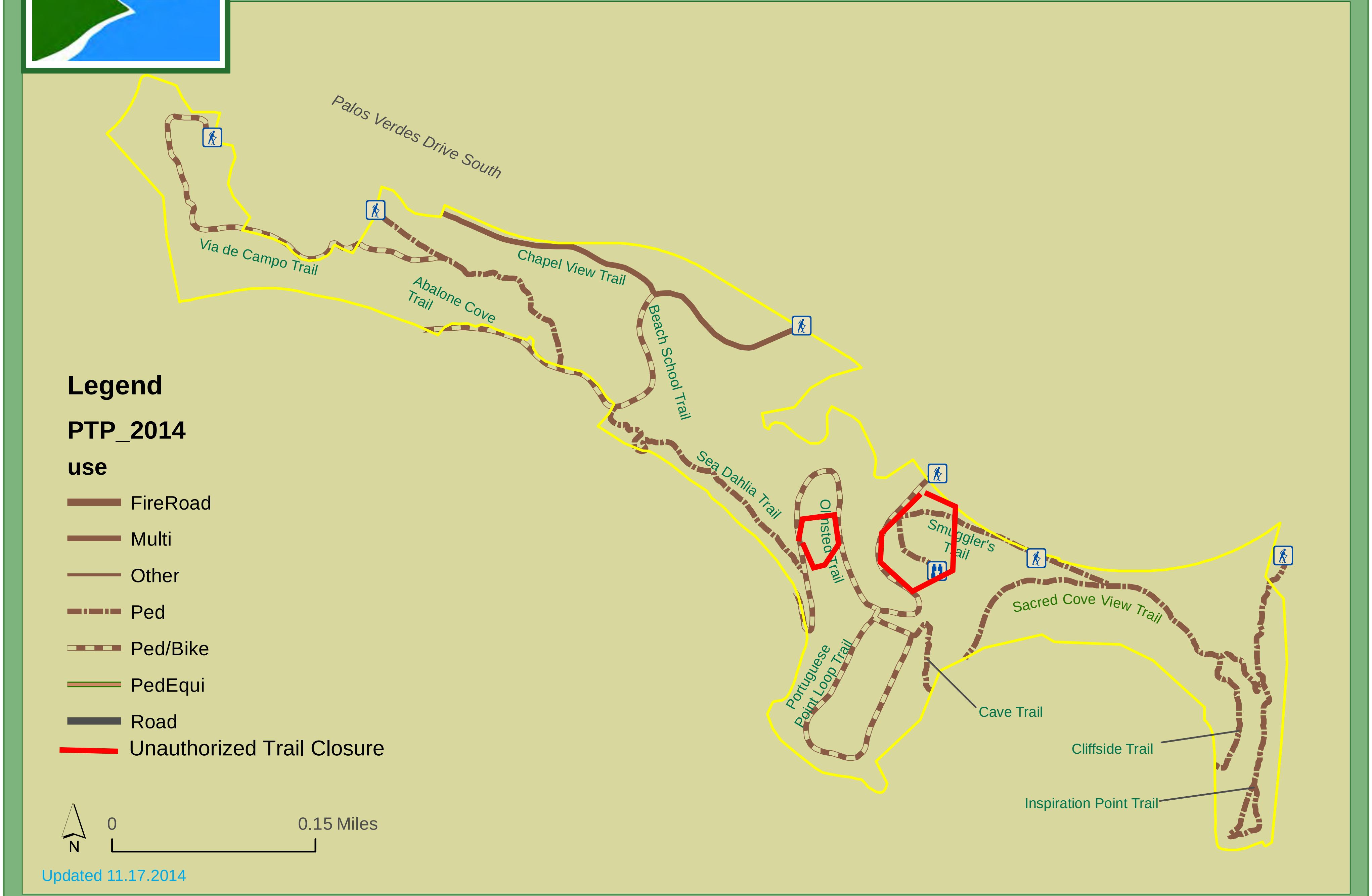
UNAUTHORIZED TRAILS CLOSED IN 2014

PALOS VERDES PENINSULA LAND CONSERVANCY

RANCHO PALOS VERDES

Abalone Cove Reserve

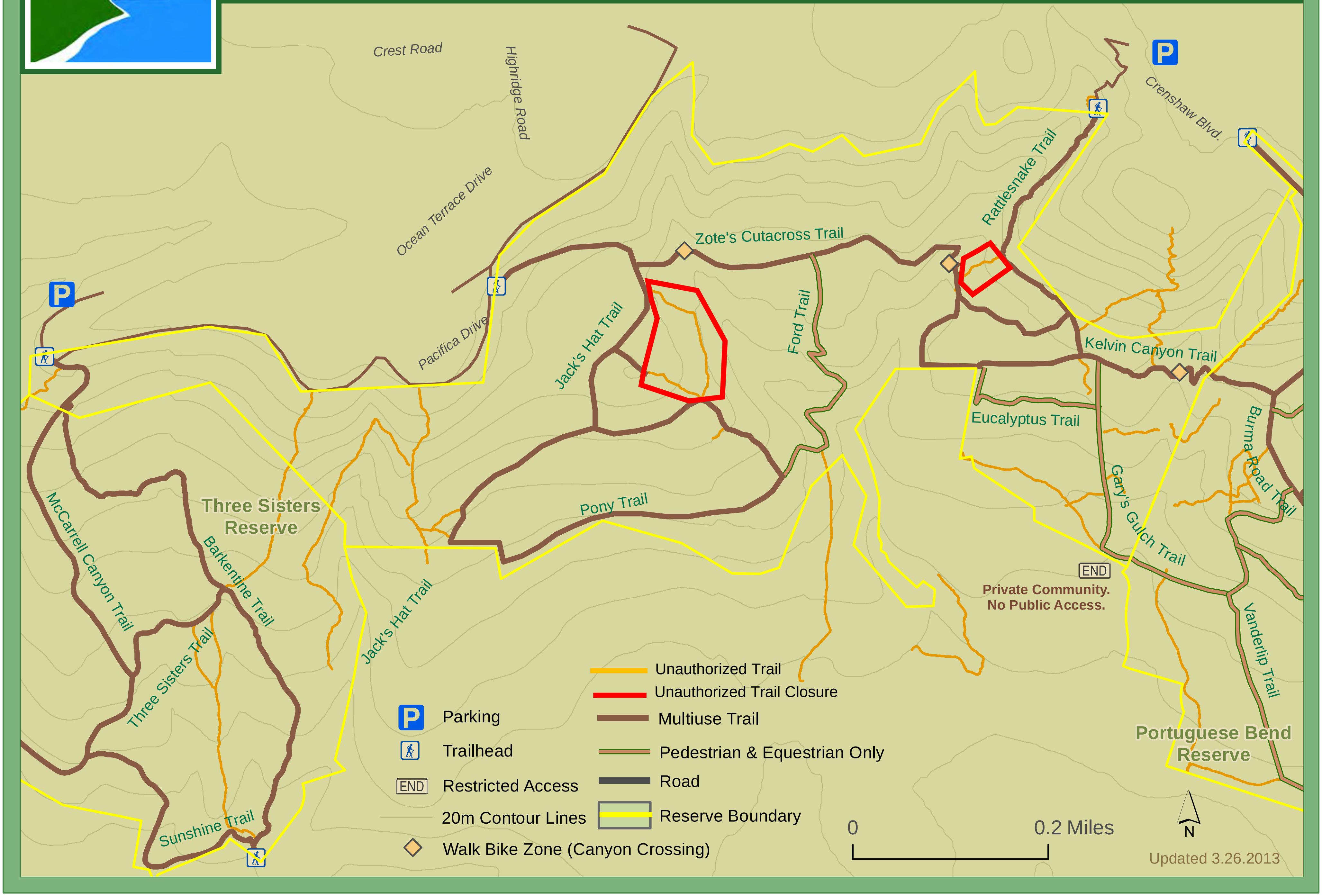
Palos Verdes Nature Preserve



Updated 11.17.2014

Filiorum Reserve

Palos Verdes Nature Preserve



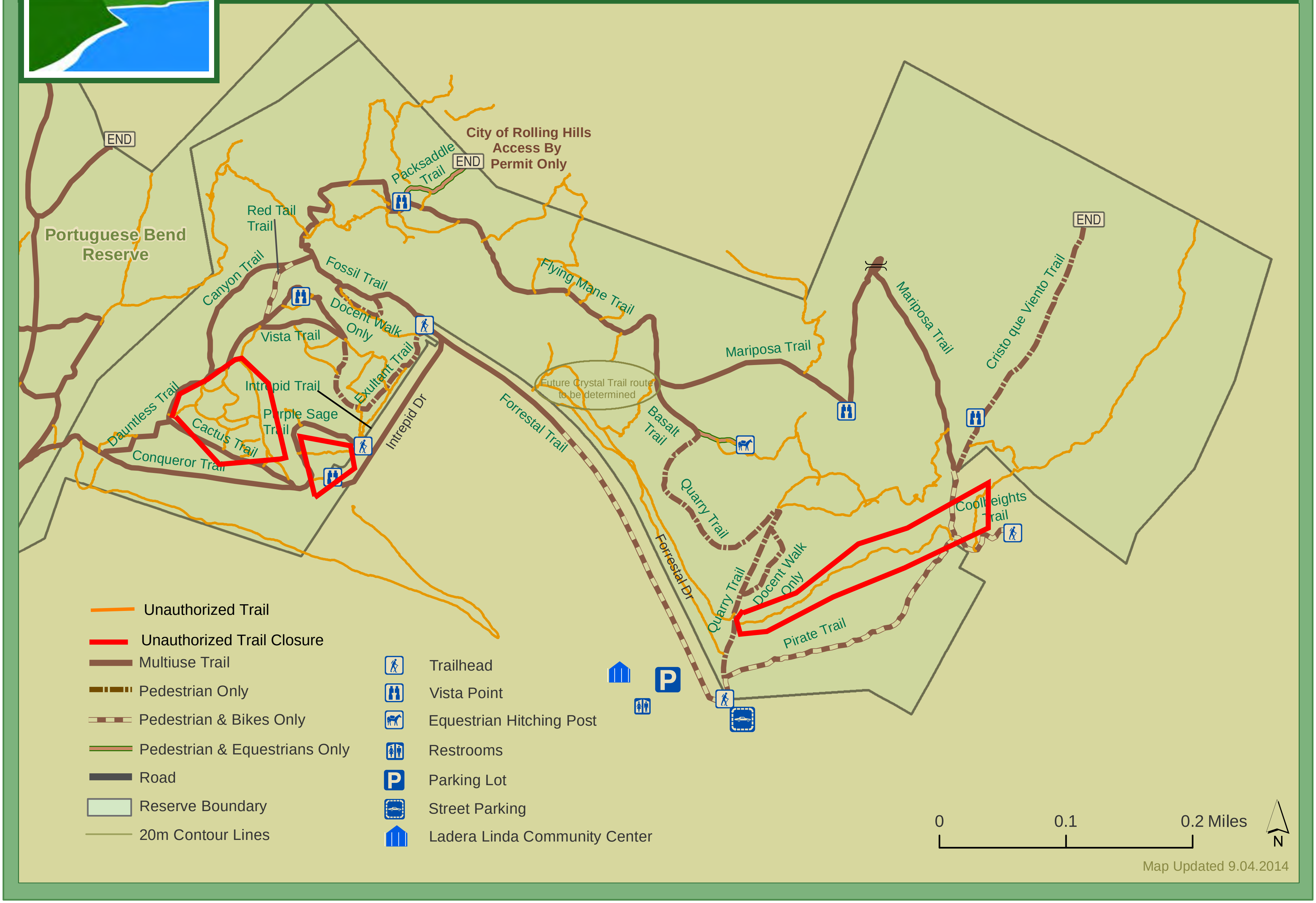
Updated 3.26.2013

PALOS VERDES PENINSULA LAND CONSERVANCY

RANCHO PALOS VERDES

Forrestal Reserve

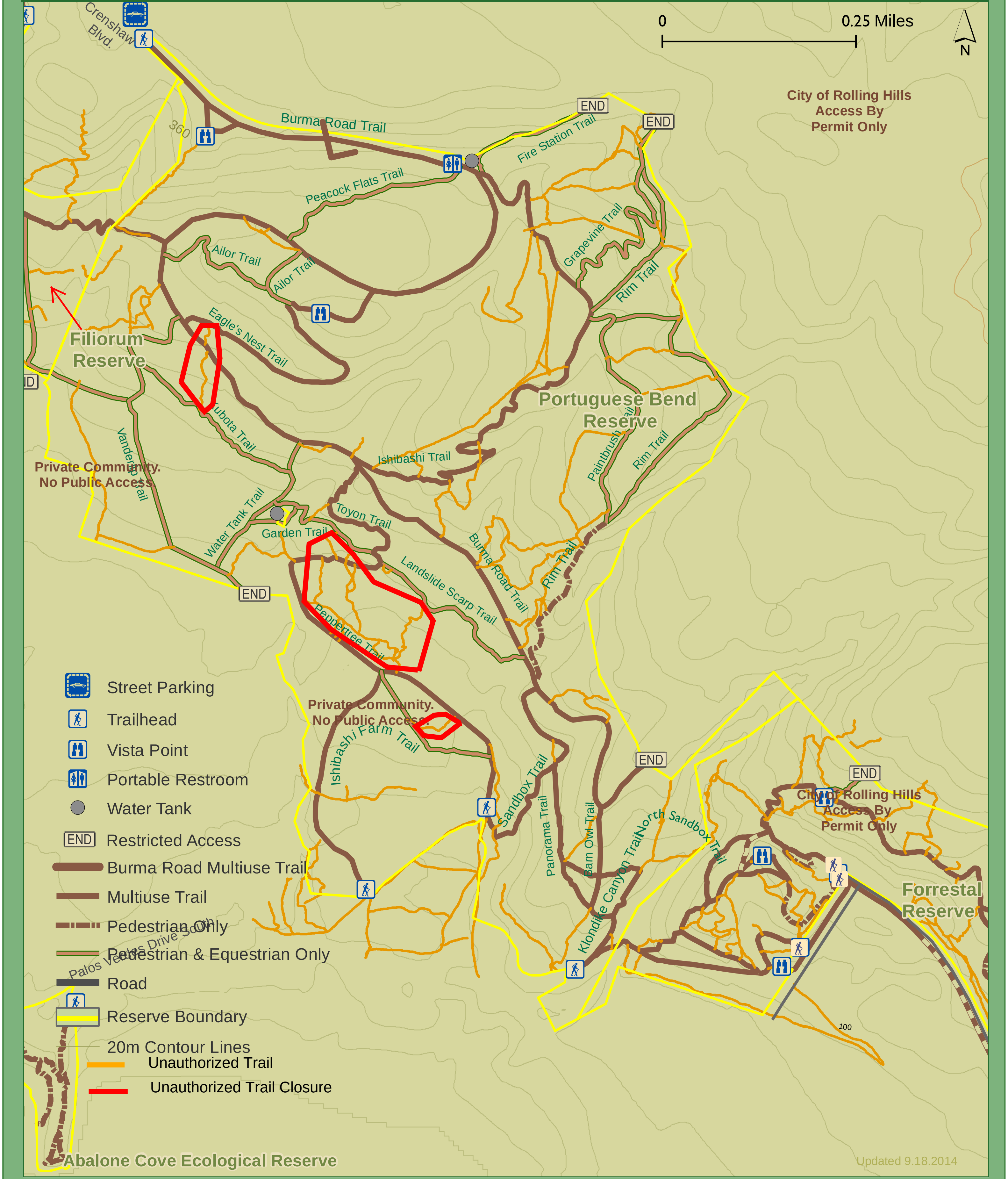
Palos Verdes Nature Preserve



Map Updated 9.04.2014

Portuguese Bend Reserve

Palos Verdes Nature Preserve



APPENDIX H. 2015 Trail Projects List

The following is a list of trail needs that may be implemented in 2015 based on priority and funding opportunities. This list is intended to outline potential projects including trail repairs, spur trail closures and signage improvements but may be amended. While all projects are important, a priority ranking system has been established to optimize implementation. Projects not completed will carry over to the following year and projects may be added to the list on an ongoing basis. In addition to the list below, smaller-scale projects may be accomplished by the Volunteer Trail Crew on an as-needed basis.

Reserve Name	Trail Name	Issues	Priority
Abalone Cove			
	Cave Trail	Trail erosion control	Medium
	Sacred Cove (West to beach)	Trail erosion	Low
	Olmstead Trail	Spur trail closures	Medium
Agua Amarga			
Alta Vicente			
	Prickly Pear Trail	Spur trail closures	Medium
Filiorum			
	Jack’s Hat	Spur trail closure and signage replacement	Low
	Pony Trail	Trail reroute and spur closure	High
	Rattlesnake Trail	Spur trail closure	Medium
	Closures at York property	Signage replacement	Medium
	McBride Trail	Spur trail closures	Medium
	Trail connection	Develop trail connection to Three Sisters	High
Forrestal			
	Conqueror Trail	Trail erosion	Medium
	Crystal Trail	Trail delineation and signage	Medium
	Quarry Trail	Spur trail closure	Low
	Cool Overlook	Spur trail closure	Medium
	Dauntless Trail	Spur trail closure (upper section) and trail erosion (lower section)	Medium
	Mariposa Trail	Bridge replacement	Medium
	Vista Trail	Spur trail closure	Medium
	Exultant Trail	Spur trail closure	Low
	Cristo que Viento Trail	Spur trail closure	Medium
	Packsaddle Trail	Close	Medium
	Flying Mane Trail (west)	Spur trail closure	Medium

	Pirate Trail	Post and cable repair and trail erosion	Medium
Portuguese Bend			
	Sandbox Trail	Trail erosion	Medium
	Ishibashi Trail	Spur trail closure	Medium
	Barn Owl Trail	Trail erosion and spur trail closure	Medium
	Fire Station Trail	Maintain closure into private property; Signage (ongoing)	Low
	Toyon Trail	Restore widened trail to appropriate trail width	High
	Rim Trail (lower section)	Spur trail closure	High
	Panorama Trail	Spur trail closure	Low
	Paintbrush Trail	Spur trail closure	Medium – Ongoing
	Grapevine Trail	Spur trail closure	Low
San Ramon			
	Switchback trail	Install bridge over gully	Medium
	Marymount Trail	Repair erosion at upper trail head	Medium
Three Sisters			
	Sunshine Trail	Trail Delineation in fuel modification area	Medium
	Barkentine Trail	Spur trail closure	High
	Trail conntection	New trail creation to Filiorum Reserve	High
	McCarrell Canyon Trail	Trail erosion and spur trail closure	Medium – Ongoing
Vista del Norte			
	Indian peak loop trail	Trail delineation to connect to new development’s trail easement	Medium