Ballona Wetlands Restoration: Community Iceplant Removal Project

Year 3 Annual Report

August 2019

Prepared for the California Coastal Commission, California Department of Fish and Wildlife, and National Fish and Wildlife Foundation

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Annual Report (Year 3)

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Coastal Development Permit No. 5-15-1427

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Prepared for:

California Coastal Commission
California Department of Fish and Wildlife
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Report Summary

The Bay Foundation (TBF), in partnership with California Department of Fish and Wildlife (CDFW), Friends of Ballona Wetlands (FBW), and community volunteers are conducting a project to remove invasive vegetation while broadening public involvement and stewardship at the Ballona Wetlands Ecological Reserve (Reserve). This report serves as the third annual report of the "Ballona Wetlands Restoration: Community Iceplant Removal Project" prepared for the California Coastal Commission to meet the annual reporting requirements for Coastal Development Permit No. 5-15-1427. This report summarizes restoration activities and monitoring results from 1 September 2016 through 31 July 2019.

The project focused on the removal of *Carpobrotus spp*., or iceplant, from a targeted area within Area B of the Reserve and maintaining the area to benefit native vegetation. Removing iceplant and other non-native vegetation on site will help protect the remaining native flora that will be critical to the revegetation of the Reserve for the larger multi-year restoration effort. Iceplant is a creeping, mat-forming group of species that form dense monocultures, causing a reduction in biodiversity and competing directly with native wetland species. Its removal and the continued maintenance of the site through the removal of other invasive vegetation species will provide an increase in the health and condition of the wetland habitats at the Reserve in Area B – south of Culver Boulevard and has allowed for community engagement in hands-on restoration efforts. Pre- and post-restoration monitoring will evaluate the progress of the project over time and will provide recommendations for additional community-level restoration opportunities on-site and at other, similarly-impacted urban wetland systems throughout Southern California.

Two iceplant removal methods were implemented by project participants. The first method involved traditional hand-restoration through pulling out iceplant mats by the roots, shaking them to remove dirt and debris, and removing them from the site to be green-waste processed or composted. The second method involved covering iceplant monocultures with large black plastic tarps to eliminate radiant sunlight and leaving the desiccated iceplant in place as mulch. Tarping was only conducted during the first summer of Year 1 and all subsequent activities have been hand removal or clipping of seed heads.

During Year 3, the project footprint expanded to a total of 1.15 acres. This is an increase of 0.40 acres from the 0.75 acres maintained in Years 1 and 2. Nine public restoration events were held in Year 3, with 108 volunteers contributing 324 hours of service to the project (Figure 1). Nine non-public restoration events were also opportunistically conducted by TBF staff and interns focused on removing non-native and invasive vegetation, like radish, mustard, iceplant, and castor bean. One additional restoration event took place within the public portion of the permit, but was not open to the public, as it was targeted event with the LA Conservation Corps (LACC) and staff from TBF and Friends of the Ballona Wetlands (Figure 2). During Year 3, an estimated nine tons of iceplant were hand-pulled during restoration events. An additional 119 bags (72-gallon bags) of other non-native and invasive vegetation, such as radish, mustard, and castor bean, were also removed. During Year 3, TBF coordinated with CDFW to implement plans for revegetation efforts in portions of the restoration area that had higher proportions of bare ground. A coastal upland scrub seed mix was established in partnership with CDFW and a Native American consultant and distributed on the hillside of the project site on 8 February 2019.

Additionally, TBF installed *Distichlis spicata* (saltgrass) rhizome cuttings in a small portion of the site from 27 February through 5 March 2019.

Long-term restoration of the project site will likely require a continued period of ongoing maintenance and adaptive management efforts to remove non-native, invasive vegetation. Even though Year 3 saw a significant increase in the dominant cover of native vegetation compared to pre-restoration, some portions of the site (especially in areas that previously had the densest and deepest iceplant cover) remain unvegetated. Ongoing communications with CDFW and their Native American consultant continue, per soil disturbance and cultural resource protocol implementation. Long-term monitoring will continue to inform adaptive management decisions.

Lastly, on 1 August 2019, the public permit conditions of CDP No. 5-15-1427 began again, and the first public events for Year 3 are scheduled for 14 and 18 September, in conjunction with National Estuaries Week. Please sign up for future events via TBF's website, www.santamonicabay.org, click on "events".

Figure 1. Restoration event with interns and community members on 27 February 2019.

Figure 2. Hillside in restoration area following weeding, seeding with native coastal upland species, and installation of erosion control mats on 21 February 2019.

Restoration Activities

Restoration events for this project began on 1 September 2016, in accordance with Coastal Commission permit conditions (CDP No. 5-15-1427). Desiccating iceplant through solarization required installing tarps over iceplant monocultures during the hot summer and early fall months; therefore, TBF prioritized installing tarps as part of initial restoration efforts in 2016. Two events per day were held during the first three restoration days to maximize tarp deployment time. All tarps were fully deployed by 8 September 2016. Additional restoration events focused on hand-removal of iceplant. Tables 1 and 2 provides summary details of all restoration activities from 1 September through 31 July 2019. Table 1 includes statistics on the number of volunteers, number of hours, restoration activities, and site details for all community restoration events, whereas Table 2 displays restoration activity dates outside of the public restoration permit with TBF staff and interns only.

Over the duration of Year 1, over 15 tons of iceplant (more than 200 cubic yards) were removed from the restoration area to a green waste dumpster for composting. Weight was calculated by the dumpster rental company before processing the invasive vegetation waste and cubic yard area was estimated by the total dumpster space used. During Year 2, 39 large tarps and 15 trash bags of non-native, invasive vegetation were removed from the same restoration area as Year 1 activities. Only small-scale hand restoration maintenance activities were conducted during Year 2, so the total weight removed, and effort reflect that focus. Over Year 3, an estimated nine tons of iceplant were hand-pulled during restoration events. Estimations were calculated by multiplying the total number of bags removed by the average weight of 10 full bags. An additional 119 bags (72-gallon bags) of other non-native and invasive vegetation, such as radish, mustard, and castor bean, were also removed. Figures 3, 4, and 5 are photographs of restoration events.

Exact total acreages of both the hand-restored and tarped restoration areas were calculated using a Trimble Geo7x GPS and mapped using GIS (Figure 7). Initial restoration efforts in Year 1 included hand restoration in an area of 0.39 acres (1,585 m^2), and tarped restoration area in an area of 0.36 acres (1,460 m^2) for a total project footprint of 0.75 acres. During Year 2, the restoration area of 0.75 acres was maintained, primarily removing opportunistic invasive annual weeds. During Years 1 and 2 years, hand restoration efforts occurred as part of ongoing site maintenance throughout the restoration footprint. In Year 3, project expansion began by strategically targeting buffer perimeters to the Year 1 and 2 restoration footprint and then expanding to remove iceplant by hand in an area directly north of Site 1 (now designated as Site 1-A). This expansion area consisting of mixed saltgrass and iceplant dominant species is designated in the project map as Site 1-B (Figure 7). The total aerial extent ("footprint") of the restoration area at the end of Year 3 covered 1.15 acres (4,654 m^2) within the 3-acre permitted proposed restoration area. Maintenance through weed removal continued through Year 3.

Overall, restoration events were highly successful, with enthusiastic groups of engaged community members, local residents, and student participants. During Year 1, 181 volunteers contributed 525 hours of service across 12 restoration events (Figure 1, Table 1). During Year 2, 66 volunteers contributed 165 hours of service across eight public restoration events. Over the duration of Year 3, 108 volunteers contributed 324 hours over nine community restoration events (Figures 3-5). At the start of each event, an informational safety and cultural resource speech was given that also included a brief history of the Reserve, and the importance of healthy wetlands. All participants signed-in and turned in a waiver to

track participation over time. Additional hours were contributed by several students and interns helping with scientific monitoring, as well as two events focused on transferring biomass from restoration events to a green waste dumpster off-site (Figure 6). As in past years, Year 3 event dates were restricted by permit conditions. Nine non-public restoration events were also opportunistically conducted by TBF staff and interns focused on removing non-native and invasive vegetation, like radish, mustard, iceplant, and castor bean. One additional restoration event took place within the public portion of the permit, but was not open to the public, as it was targeted event with the LA Conservation Corps (LACC) and staff from TBF and Friends of the Ballona Wetlands. The amount of non-native vegetation removed was not quantified on this day. This event is discussed further in the Revegetation section.

One of the project goals was to increase community engagement, stewardship, and volunteer participation, and this goal was met successfully. Participants were engaged in many ways, including direct participation, a public project webpage, social media, word-of-mouth, and directly reaching out to schools and community members. All public restoration events (during the public time of the CDP permit) were open to sign-ups from the public, and everyone who offered help was met with a positive response. Santa Monica College, Loyola Marymount University, and University of California Los Angeles all regularly had volunteer participation in Year 3. This project allowed well managed temporary public access in a restricted coastal habitat area of the Reserve that was previously inaccessible, encouraging educational and hands-on opportunities for learning in an urban wetland environment.

Figure 3. Volunteers remove invasive iceplant in Site 1-B on 19 September 2019.

Figure 4. Volunteers pulling invasive iceplant (*Carpobrotus edulis*) and before (bottom left) and after (bottom right) photos of a portion of the restoration area on 22 September 2018.

Figure 5. Interns from LMU and TBF's Coastal Research Institute (CRI) participating in a monitoring and weeding event on 21 June 2019. The bottom two photos are before (left) and after (right) photos of the restoration area.

Table 1. Summary of community restoration event statistics through March 2019.

Year	Event Date / Time	Site	# Volunteers	# Volunteer Hours	Restoration Method
Year 1	1 September 2016	1-A	9	27	Tarping + Hand-restored
	1 September 2016	1-A	9	27	Tarping + Hand-restored
	6 September 2016	2-A	11	25.5	Tarping + Hand-restored
	6 September 2016	2-A	13	39	Tarping + Hand-restored
	8 September 2016	3	9	19.5	Tarping + Hand-restored
	8 September 2016	1-A; 3	8	24	Hand-restored
	13 September 2016	1-A; 2-A	9	16.5	Hand-restored
	16 September 2016	1-A; 2-A	5	15	Hand-restored
	20 October 2016	1-A	10	22.5	Hand-restored
	10 November 2016	1-A	2	6	Hand-restored
	15 November 2016	1-A; 2-A	60	240	Hand-restored
	18 November 2016	1-A	36	63	Hand-restored
	Subtotal	**----**	**181**	**525**	**----**
Year 2	27 September 2017	1-A; 3	5	12.5	Hand-restored
	13 October 2017	1-A	7	17.5	Hand-restored
	17 October 2017	1-A	2	5	Hand-restored
	25 October 2017	1-A	6	15	Hand-restored
	15 November 2017	2-A	13	32.5	Hand-restored
	27 February 2018	1-A	6	15	Hand-restored
	6 March 2018	1-A	1	2.5	Hand-restored
	13 March 2018	1-A	26	65	Hand-restored
	Subtotal	**----**	**66**	**165**	**----**
Year 3	19 September 2018	1-B	15	45	Hand-restored
	22 September 2018	1-B	36	108	Hand-restored
	27 September 2018	2-A; 1-B	1	3	Hand-restored
	4 October 2018	1-B	3	9	Hand-restored
	24 October 2018	3; 1-B	11	33	Hand-restored
	14 November 2018	1-B	15	45	Hand-restored
	30 January 2019	1-A; 3-A	4	12	Hand-restored
	27 February 2019	1-A	14	42	Hand-restored
	13 March 2019	1-A	9	27	Hand-restored
	Subtotal	**----**	**108**	**324**	**----**

Table 2. Restoration events during non-public portion of permit with TBF staff and interns only. The asterisk indicates a targeted event with TBF staff and project partners (Friends of the Ballona Wetlands and the LA Conservation Corps).

Year	Event Date / Time	Site
2	23 August 2017	1-A; 3-A
	20 March 2018	1-A
	18 April 2018	1-A
	24 April 2018	1-A
	1 May 2018	1-A
	8 May 2018	1-A; 2-A
	11 May 2018	1-A; 2-A
	17 May 2018	1-A
	19 May 2018	1-A
	11 July 2018	2-A
	19 July 2018	1-A; 2-A
3	1 August 2018	1-A
	8 August 2018	1-A; 1-B
	29 August 2018	1-B
	* 8 February 2019	3-B
	26 April 2019	1-A; 3-B
	22 May 2019	1-A
	11 June 2019	1-A; 3-A; 3-B
	12 June 2019	1-A; 3-A; 3-B
	21 June 2019	1-A; 3-A; 3-B
	24 July 2019	3-A; 3-B

Figure 6. Coastal Research Institute interns and TBF staff conduct monitoring on 19 July 2019.

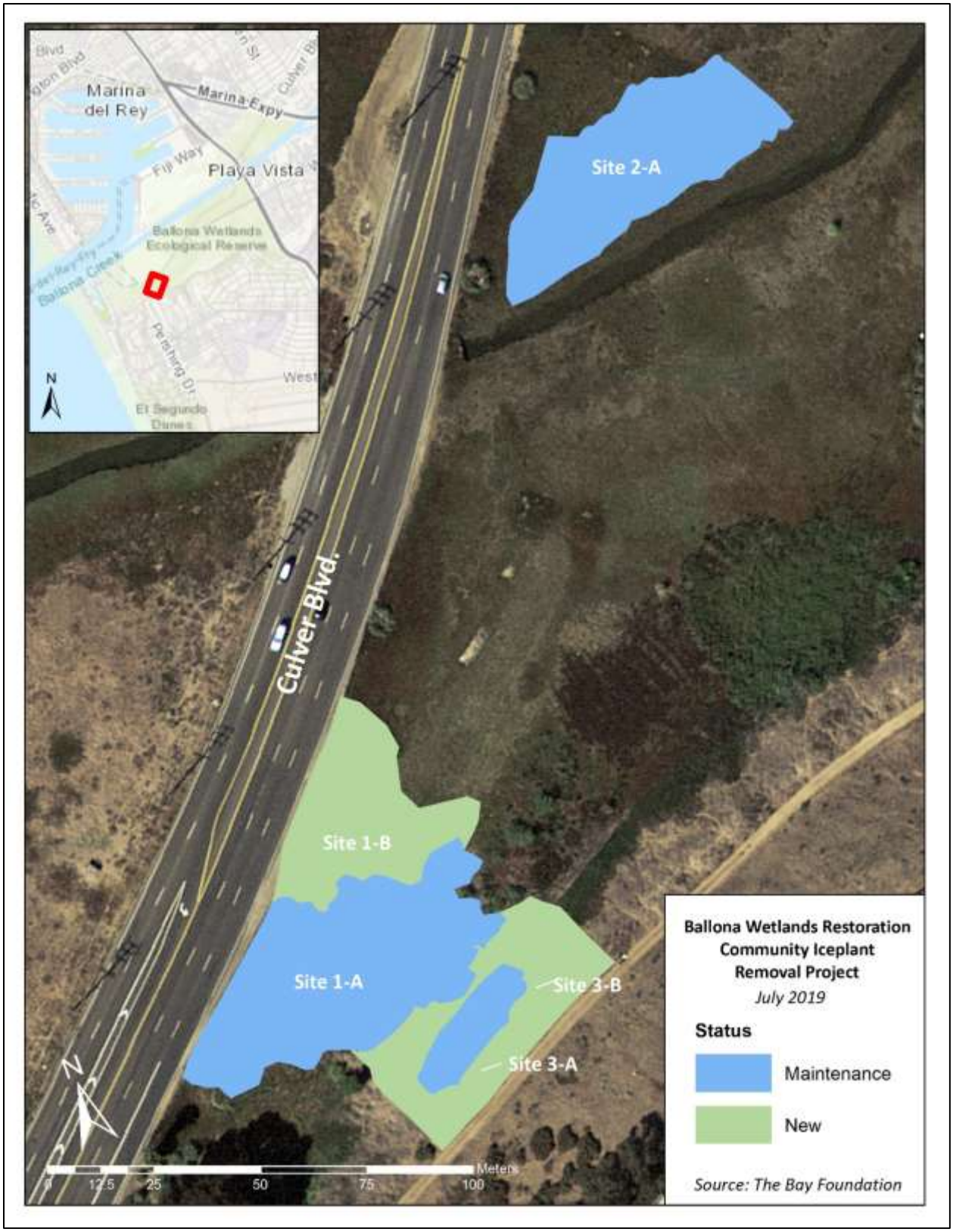


Figure 7. Map of restoration site showing new restoration for Year 3, August 2018 to July 2019 (light green) and maintenance areas (light blue).

Revegetation Activities

During Year 3, TBF coordinated with CDFW to develop plans for revegetation efforts in portions of Site 1-A and Site 3-A / 3-B, which had higher proportions of bare ground. Revegetation Protocol 2 and Protocol 3, as detailed in the project Implementation and Monitoring Plan, were used in targeted areas of the initial restoration area with a goal of increasing native plant recruitment (TBF 2016). A coastal upland scrub seed mix was established in partnership with CDFW and a Native American consultant and distributed on the hillside of Site 3-A and portions of Site 3-B on 8 February 2019. Additionally, TBF installed *Distichlis spicata* (saltgrass) rhizome cuttings in a small portion of Site 1-A in late February into early March. These revegetation activities are discussed in detail in the following sections.

Coastal upland seed mix

The coastal upland native seed palette used on the hillside (sandy, unconsolidated soils) of Site 3-A and portions of Site 3-B is listed in Table 3. The plant pallet represents native vegetation species characteristic of Southern California coastal upland habitats. Seeds were sourced (purchased) from S & S, an organization specializing in California native seeds for habitat restoration projects. An assessment was conducted of the areas and densities of native vegetation on site at the Ballona Wetlands Ecological Reserve (BWER) needed for the seed mix, average seed production per plant, germination rates, seed quantities needed, cost-effectiveness, potential seed collection impacts, and additional factors such as location and unpredictability associated with recruitment of several annual species. It was determined that for the species listed in Table 3, seed collection on site within BWER was not a feasible option to obtain the quantities and species of seed needed for the coastal upland seed mix. For example, in a cost-effectiveness assessment, it was determined, based on the number of seeds collected in a sustainable manner across five days of collection in Year 3 by TBF and interns, and the number of seeds needed to reach the amount provided by S & S, that *more than 500 collection days* would have been needed to acquire the mix at a cost over $100,000. Additionally, several species are either not found on site, or are in numbers too low to allow for sustainable collection, e.g., *Salvia apiana, Lupinus bicolor*, especially when considering potential impacts of collection on a limited population at an already degraded site.

The S & S seeds were pre-mixed and hand-broadcast on the hillside on 8 February 2019 (Figure 10). The Los Angeles Conservation Corps (LACC) aided in preparing the site for seeding by removing non-native vegetation (Figures 8 and 9). Following site preparation, seed was broadcast, and biodegradable erosion control mats were installed. Erosion control mats were used for seed retention, weed control, and sediment retention during winter storms. The erosion control mats were certified weed-free, following best management practices, to prevent new weed introduction to the site. As of the end of the Year 3 reporting period (31 July 2019), native plants germinated from the seed that were broadcast in February 2019 (Figure 11) and will continue to be tracked through ongoing scientific monitoring efforts.

Table 3. Coastal upland native seed palette. Asterisk indicates pure live seed pounds per acre.

Scientific Name	Common Name	Type	Source	Lbs / Acre*
Salvia apiana	White sage	Shrub	Irvine Ranch	2.00
Salvia mellifera	Black sage	Shrub	Irvine Ranch	1.00
Artemisia californica	California sagebrush	Shrub	CPEN	0.10
Eschscholzia californica	California poppy	Annual or perennial herb	Commercial	2.00
Lupinus bicolor	Bicolor lupine	Annual or perennial herb	Commercial	4.00
Acmispon glaber	Deerweed	Perennial herb	Broome	4.00
Stipa pulchra	Purple needlegrass	Perennial grass	Santa Monica Mountains	6.00
Elymus condensatus	Giant wild rye	Perennial grass	Newhall Ranch	1.00
			Total Lbs / Acre	**20.1**

Figure 8. Los Angeles Conservation Corps and TBF conducting site preparation, seeding, and erosion control installation on 8 February 2019.

Figure 9. Photograph of installed erosion control matting completed on 8 February 2019.

Figure 10. Photograph of coastal upland native seed mix (8 February 2019).

Figure 11. Native plants beginning to establish from the Coastal Upland Scrub seed mix. (top left: *Salvia mellifera*; top right: *Artemisia californica*; bottom: *Eschscholzia californica*)

Distichlis spicata (saltgrass)

In addition to seeding, TBF staff installed *Distichlis spicata* (saltgrass) plugs on a portion of the area of Site 1-A, where iceplant was removed in 2016. Saltgrass propagates both vegetatively (cloning) and via seeds. However, seed germination requires more specific microenvironmental conditions; thus, vegetative propagation is the main avenue of establishment (Eppley et al. 1998). Intraspecific variation of growth occurs based on environmental conditions such as soil type and salinity. Therefore, it is suggested to include multiple genets of a species in revegetation of restoration areas to increase diversity and resilience (Howard and Rafferty 2006, Howard 2010). Saltgrass was harvested locally from Area B and immediately planted in Site 1-A. Rebar was used to make pilot holes for planting the saltgrass plugs and allowed for little ground disturbance. Weeding was conducted in the area where saltgrass was to be planted before installation. Saltgrass cuttings from donor sites and planting in Site 1-A occurred on 27 February 2019, 4 March 2019, and 5 March 2019.

The plantings occurred within a 9 x 25-meter grid (225 m^2) area. Within the grid, five permanent 25-meter transects were established and saltgrass plugs were planted in eight 1 x 1-meter quadrats along each transect. In total, 40 1 x 1-meter quadrats within the 225m^2 area were installed with saltgrass plugs. In each quadrat, 16 plugs were planted encompassing less than 3% of the total 1 x 1-meter quadrat (Figure 12). In total, approximately 1.2 m^2 of saltgrass was installed within the 225 m^2 grid, equaling approximately 0.5% of the total grid area. Saltgrass was installed off transects and within quadrats so that TBF could scientifically monitor the progress of saltgrass establishment over time using the plug method and keep track of management efforts (weeding) within the planted areas. This method has never been applied within BWER, and an initial small assessment area with saltgrass plugs will allow TBF to evaluate this method of revegetation for future use.

The site has been checked frequently since the installation of saltgrass plugs. Observationally, a limited number of salt plugs seem to be green and thriving as of site observations in July 2019, although it is premature to determine the overall survivorship of the plugs due to the survey timing when most salt marsh plants are dormant. Additionally, the dense growth of Canadian horseweed (*Conyza canadensis*), a native annual species, within the revegetation plot occurred following the installation of saltgrass plugs (Figures 15 and 16). TBF will continue to monitor the site and coordinate with CDFW on adaptive management strategies.

Figure 13 shows a quadrat of saltgrass plantings before, immediately after, and approximately two months later on 30 April 2019. Using the quadrat method for vegetation cover assessment, this quadrant had a baseline (pre-saltgrass planting) of less than 5% saltgrass on 5 September 2018. During revegetation efforts on 27 February 2019, an additional 16 plugs were planted in the quadrat area. Post-planting monitoring on 30 April 2019 showed over 10% saltgrass cover, an increase of more than 5% live saltgrass from the baseline. Figure 14 shows a second and different quadrat of saltgrass plantings before, immediately after, and approximately two months later on 30 April 2019. This quadrat had a baseline (pre-saltgrass planting) of 0% saltgrass before saltgrass installation. During revegetation efforts on 27 February 2019, 16 plugs were planted in the quadrat area. Post-planting monitoring on 30 April 2019 showed no live saltgrass but did have Canadian horseweed present within the quadrat.

Figure 12. Saltgrass plug planting within a quadrat on 27 February 2019.

Figure 13. Saltgrass plug planting before, immediately after (February 2019), and on 30 April 2019 in quadrat RD5-18.

Figure 14. Saltgrass plug planting before, immediately after (February 2019), and on 30 April 2019 in quadrat RD5-8.

Figure 15. Representative plots within revegetation grid showing high density of Canadian horseweed. Quadrat on left is a control (no saltgrass planted) and quadrat on right had saltgrass plugs planted on 5 March 2019.

Figure 16. Photo of dense area of Canadian horseweed in re-vegetation grid taken on 24 July 2019.

Revegetation Next Steps

The first step of revegetation of the restoration project allowed for a passive evaluation of natural native vegetation recruitment based on the existing seed bank without soil disturbance (recommended by CDFW and their Native American consultant). This scientific evaluation occurred for a period of two years after iceplant removal. While some areas such as the western half of Site 2-A and most of Site 1-B have experienced significant recruitment of native species like saltgrass and alkali weed, the majority of the restoration areas still have patchy or low levels of native cover and would benefit from additional adaptive management to encourage native plant recruitment. Revegetation activities will be reevaluated in Year 4 after the growth season for the annual species (such as Canadian horseweed) is over. Year 4 revegetation activities may include additional seed placement, more saltgrass plugs, and the possibility of willow stakes placed in appropriate habitat areas. Targeted infill plantings with native species in the restored areas may also be considered for Year 4.

The plant palette for both seed collection and planting reflects hardy, salt-tolerant species which can also withstand seasonal reduced hydrology. Vegetation seeded or planted on site will consist of native plants. The planting plan will be developed in coordination with CDFW and their Native American consultants. The palette may include (but not be limited to) the following native species and will vary based on the recruitment success of the micro-habitats within the project area. Table 8 displays the summary flowering period for each of the native vegetation species by month obtained through Calflora and additional species-specific literature sources. Note the narrower flowering window of some of the native species as compared to the non-natives (Table 7; e.g., castor bean, sowthistle).

> **Marsh habitat species**: *Salicornia pacifica, Distichlis spicata, Frankenia salina, Cressa truxillensis, Distichlis littoralis*, and *Juncus mexicanus* (in or adjacent to brackish areas)
>
> **Transition habitat / upland edge species**: *Heliotropium curassavicum, Atriplex lentiformis, Distichlis spicata, Acmispon glaber, Encelia californica, Lupinus chamissonis, Ericameria ericoides, Salvia mellifera, Camissoniopsis spp, Salvia leucophylla*, and *Elymus triticoides*.

Table 4. Summary flowering period for native vegetation by month and species.

	Bloom Period											
Scientific Name	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Salicornia pacifica								■	■	■	■	
Distichlis spicata									■	■	■	
Frankenia salina									■	■		
Cressa truxillensis							■	■				
Juncus mexicanus			■	■	■							
Distichlis littoralis						■	■	■	■			
Heliotropium curassavicum					■	■						
Atriplex lentiformis						■	■					
Acmispon glaber				■	■	■	■	■				
Encelia californica			■	■	■	■						
Lupinus chamissonis				■	■	■						
Ericameria ericoides									■	■	■	
Camissoniopsis spp.		■	■	■	■	■	■	■				
Salvia mellifera				■	■	■	■					
Salvia leucophylla				■	■	■	■					
Elymus triticoides						■	■					

Figure 17. Photographs of seeding alkali weed (left) and flowering pickleweed (right; credit: H. Lyford, LMU CRI, 26 July 2018).

Scientific Monitoring

A rigorous scientific monitoring plan informs adaptive management of restoration activities. Table 5 summarizes the biological monitoring sampling design. It lists five major parameters, the primary protocol(s) implemented for each parameter, and the frequency of implementation. Event statistics (e.g. volunteer hours) and revegetation efforts are reported above. Additionally, cultural resource monitoring occurred, but since no items were found as part of this project implementation, there are no results presented.

Pre-restoration, or baseline, surveys were conducted in July and August 2016, prior to the initiation of restoration activities. The "during project" surveys were conducted during tarping and restoration events, and the post-restoration evaluation surveys were conducted in accordance with the post-restoration frequency listed in Table 5 from the project Implementation and Monitoring Plan. Additionally, site checks were conducted bi-weekly during tarping implementation (late summer 2016 only), and supplemental surveys (especially for birds and other wildlife) were often conducted in association with restoration events. Additional supplemental monitoring and site checks occurred during the Spring of 2019 following revegetation efforts to monitor progress.

Table 5. Description of biological protocols implemented during pre-restoration baseline monitoring, implementation monitoring, post-restoration monitoring, and their minimum frequency of occurrence.

Parameter	Protocol	Pre-Restoration (Baseline)	During Project	Post-Restoration (Evaluation)	Post-Restoration Frequency
Invasive Vegetation Cover	GPS and GIS; Transect / Quadrat Cover	✓		✓	Semi-annually for two years
Seedling Density	Quadrat Density Counts			✓	Quarterly for two years
Avifauna (Bird)	Visual Surveys for Presence and Behavior	✓	✓	✓	Immediately post-restoration and annually for two years
Other Wildlife (Mammals and Herpetofauna)	Visual Surveys for Presence	✓	✓	✓	Immediately post-restoration and annually for two years
Photo-Point	Permanent Photo-Points	✓	✓	✓	Immediately post-restoration and quarterly for two years

Summaries of the pre- and post-restoration monitoring methods and results are included below. Note that species lists are not meant to be exhaustive, they are just documentation of the variety of flora and fauna that were identified on project surveys and monitoring days.

Vegetation

The composition and distribution of vegetation species across wetland habitats directly affects many ecosystem functions such as productivity, soil composition, and nitrogen and carbon exchange dynamics (Schwartz et al. 2000, Keer and Zedler 2002). Vegetation cover surveys were used to provide a wide range of information and data, including: summarizing the prevalence of native and non-native plant cover in each habitat, determining species cover, and species richness. Additionally, a seedling density survey was conducted on restored areas, with a focus on geospatially tagging new growth of iceplant within the restoration areas and identifying seedlings within fixed transect locations. Restoration efforts expanded in Year 3 (see maps and restoration activity information above), thus the results presented below combine both prior efforts and new restoration activities.

Overall Summary of Vegetation Results

Overall results indicated a significant reduction in non-native vegetation cover in most areas and an increase in native vegetation cover. The initial non-native decrease was due primarily to the removal of 100% of the iceplant cover, followed by the subsequent return of several "weedy" non-native vegetation invaders. The estimates of non-native vegetation reduction are likely conservative, given that pre-restoration "baseline" surveys were conducted in the summer of 2016 after the annual non-native species would have died. Significant expansion and new growth of native vegetation occurred, in some areas several times greater than pre-restoration cover. Mapping results encompass the most area for cover assessment and showed a similar trend. Mapping surveys illustrate the effectiveness of maintenance activities led by TBF, showing a decrease in non-native vegetation cover followed by a recorded increase when the new sites were added to the whole project area. Overall, non-native cover decreased from pre-restoration, and native cover increased, though the specific pattern varied by site. During Year 3, TBF began expanding restoration efforts along the perimeter of the original Year 1 and Year 2 project footprint. Site identification has been updated in the Year 3 Monitoring Report to reflect this expansion. Site 1, Site 2, and Site 3 from the previous monitoring reports correspond to Site 1-A, Site 2-A, and Site 3-A in the Year 3 Monitoring Report, respectively. Site 1-B and 3-B are considered expansion areas and new restoration during Year 3. Site 2-A showed an increase in non-native cover in the middle polygons of the most recent (June 2019) survey. This is likely due to a focus on maintenance in the other sites within the project. Thus, ongoing maintenance is recommended throughout all sites (1-A, 1-B, 2-A, 3-A, and 3-B) for future years.

Adaptive management recommendation actions to continue to improve the condition of the project area and in support of native vegetation are included in other chapters of this report to address non-native vegetation invasion and additional plans for revegetation in Year 4 to further supplement the areas that remain unvegetated after two years. The following Figures 18-21 display a variety of representative locations within the restoration project footprint following iceplant removal with various combinations of native and non-native vegetation assemblages.

Figure 18. Native saltgrass (28 November 2018; top) following iceplant removal in Site 1-B, and Jimsonweed (*Datura wrightii*) (31 July 2018; bottom) in disturbed soils, both within the restoration area.

Figure 19. Mixed native and non-native vegetation assemblages in restoration area (18 September 2018; top), and on 13 March 2019 (bottom).

Figure 20. Mixed native and non-native vegetation assemblages (26 April 2019).

Figure 21. Predominantly non-native vegetation assemblage during restoration event (30 January 2019).

Vegetation Mapping Survey Methods

Vegetation mapping methods employed *A Manual of California Vegetation* (Sawyer et al. 2009) as the standard for classification and delineation of most native and many non-native vegetation alliances and associations based on the presence and relative cover of co-dominant species. An updated version of the Manual can also be found online at explorer.natureserve.org.

Vegetation mapping protocols are described in detail in SOP 3.5 Vegetation Mapping (TBF 2015a). This protocol outlines a synthesized vegetation stand delineation strategy based on a combination of aerial imagery, office digitization (commonly in ArcGIS), and *in situ* field verification. This method used a Trimble GPS unit and ArcGIS software to produce detailed, geospatially rectified vegetation maps, allowing for an analysis of vegetation alliance and association coverage. Post-restoration field surveys were conducted semi-annually in May 2017, October 2017, May 2018, November 2018, and June 2019.

Vegetation Mapping Survey Results

Vegetation mapping results displayed an increase in native cover compared to pre-restoration conditions (as evaluated by the dominant cover classification of each polygon). Results also displayed a decrease in non-native cover compared to pre-restoration, but a higher non-native cover than Year 2, which is accounted for in part by adding newly restored areas (all sites were combined for the mapping analyses). Additionally, a decrease in unvegetated area was documented since October 2017, which identified the highest cover of unvegetated area. Native cover was predominantly made up of saltgrass in the November 2018 survey and Canadian horseweed in June 2019, with other species present. Non-native cover and species varied by polygon. While these results show a significant change in the condition of the site from the baseline of iceplant monocultures and intermixed iceplant with other species, they should not be interpreted alone, and additional data will allow for longer-term trends to be analyzed in future reports.

Figure 22a is a map displaying baseline (pre-restoration) dominant vegetation type GIS polygons classified as iceplant monocultures (approximately 49% of the total project area) or non-native vegetation (approximately 51% of the total project area). The non-native vegetation polygons were also predominantly iceplant, but some areas contained intermixed saltgrass, especially the western border adjacent to Culver Boulevard. The iceplant present in these intermixed areas was hand-pulled.

For post-restoration data, polygons displaying native vegetation classifications may also contain small patches of non-native vegetation; similarly, non-native vegetation classifications may also contain small patches of native vegetation. Additionally, new iceplant growth individual plants are indicated on the map as black triangles. New iceplant growth was mapped in the survey following initial restoration efforts. While current site observations find occasional iceplant sprouts, these iceplant spouts are pulled immediately, and not present during monitoring efforts.

Figure 22b is a map displaying Year 1 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, or mixed nativity surveyed on 2 May 2017. Sites 1-A and 2-A both had some areas with new iceplant growth: 35 small individual plants sprouted in Site 1-A, and 5 small individual plants sprouted in Site 2-A. Desiccated iceplant “mulch” areas where no native or non-native vegetation re-growth had occurred yet accounted for approximately 14% of the total project area.

Polygons dominated by non-native vegetation covered approximately 59% of the total project area, and polygons dominated by native or mixed vegetation assemblages covered approximately 28% of the total project area. The polygons did not account for bare ground or "mulch" areas that are intermixed with native or non-native vegetation.

Figure 22c is a map displaying Year 2 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in October 2017. Over 40% of the site was classified as native, with approximately the same amount of the site classified as unvegetated, spread across all Sites. The western edges of Sites 1-A and 2-A are starting to fill in with native vegetation, predominantly saltgrass. Site 3-A remains primarily unvegetated and non-native, even after adaptive maintenance actions and restoration events took place. A large portion of the sites remain unvegetated during this survey.

Figure 22d is a map displaying Year 2 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in May 2018. During this survey, over 50% of the total restoration area was classified as native, with approximately 9% of the area as non-native and approximately 35% as unvegetated, a decline in unvegetated area from the October 2017 survey. Unvegetated area remains primarily in Sites 1-A and 3-A, with patchy non-native in multiple places, but large areas of dominant native cover, a significant change from pre-restoration baseline conditions.

Figure 22e is a map displaying Year 3 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in November 2018. During this survey, 43.5% of the total restoration area was classified as native, with 23.3% of the area as dominated by non-native vegetation and 25.9% identified as mixed nativity. The largest polygons dominated by non-native cover were in Sites 3-A and 3-B. Approximately 11% was unvegetated, the lowest in mapping analyses to-date. Native polygons were dominated by saltgrass and alkali weed. Common non-native species identified included non-native grasses, particularly brome species, wild radish, and mustard. A small patch of Geraldton carnation weed (*Euphorbia terracina*) continues to be managed in Site 3-A. Site 1-B shows dominant native vegetation cover, primarily saltgrass, in the month following restoration activities removing iceplant in that area.

Figure 22f is a map displaying Year 3 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in June 2019. Predominantly native cover was found on just over 32% of the site, which was more than double the initial May 2017 pre-restoration baseline survey (14.6%). Native cover on this survey was dominated by annual Canadian horseweed. Non-native cover was removed from Sites 3-A and 3-B in February 2019 and replaced with biodegradable erosion control matting and hand-broadcast seeding of native plants. While seedlings of several native plants successfully sprouted (see photographs throughout report), they did not achieve a high enough cover to consider the assessment polygons as dominated by native cover. They are identified in map Figure 8f as predominantly 'unvegetated', although that does not imply that the native seedlings were not present. Mapping results from Site 2-A identified dominant native and mixed-native cover around the periphery, with the interior of the site invaded by non-native brome grasses, wild radish, and annual yellow sweetclover. The majority of non-native invasive vegetation were observed to

be annual species. Site 1-B continued to show dominant native cover, expansion of saltgrass, similar to post-restoration conditions immediately following the removal of iceplant in Fall 2018 (Figure 21).

Figure 21. Photo of Site 1-B, before (top) and after (bottom) showing dominant native cover of saltgrass following restoration event on 19 September 2019.

Figure 23 summarizes mapping results over all surveys and percent of native, non-native, and unvegetated areas. Mapping results differed from the transect-level data (below), due in part to the variation in specific protocols and method implementation. Both sets of results are presented in this report to provide more comprehensive data analyses. It is also important to note that the mapping data represent distinct points in time, and thus, may not represent the “ambient” conditions throughout the whole year, given seasonal variation of plant cover, especially in annual species. Additional years of data will continue to inform long-term trends.

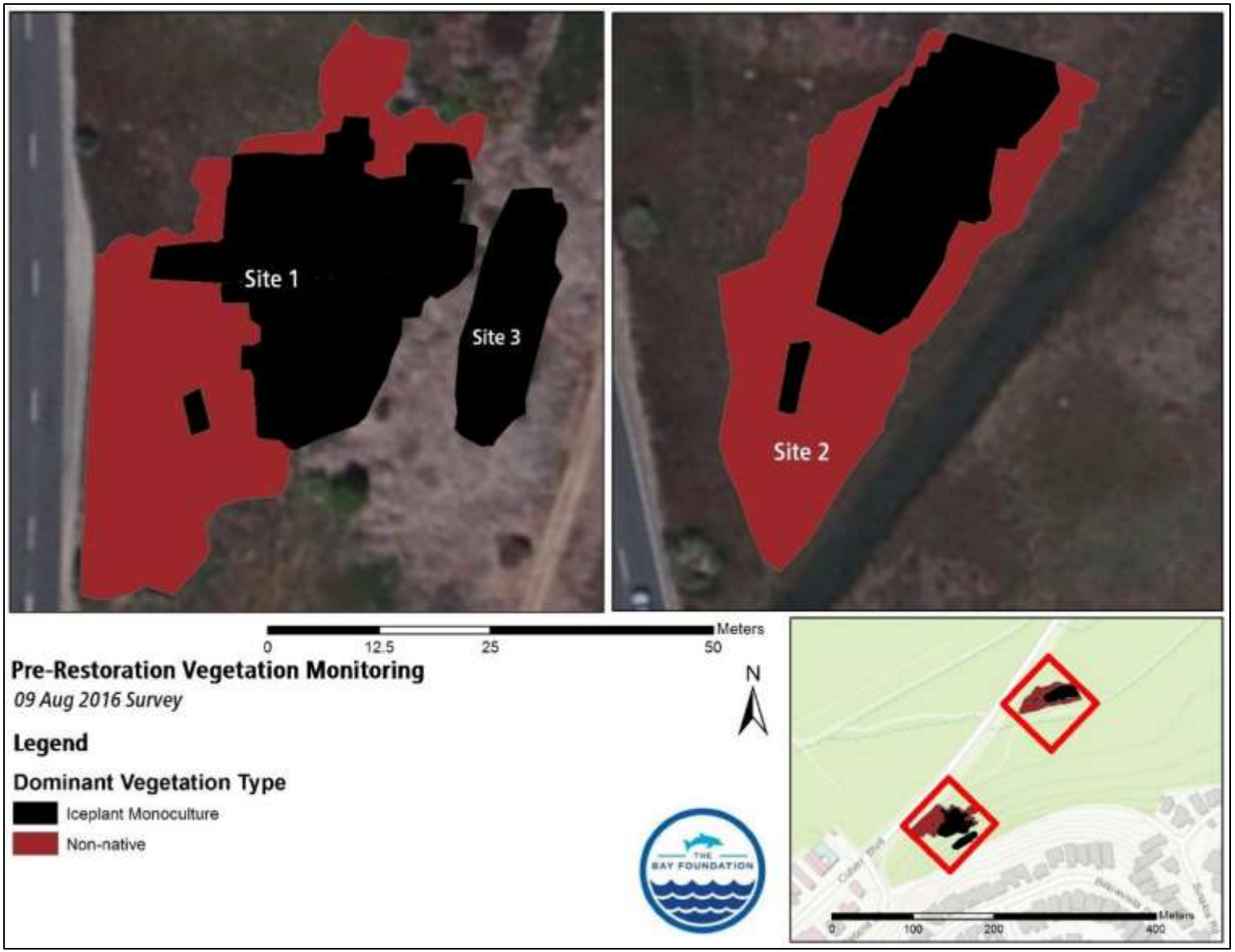


Figure 22a. Map displaying dominant vegetation type within GIS polygons during the 9 August 2016 baseline survey.

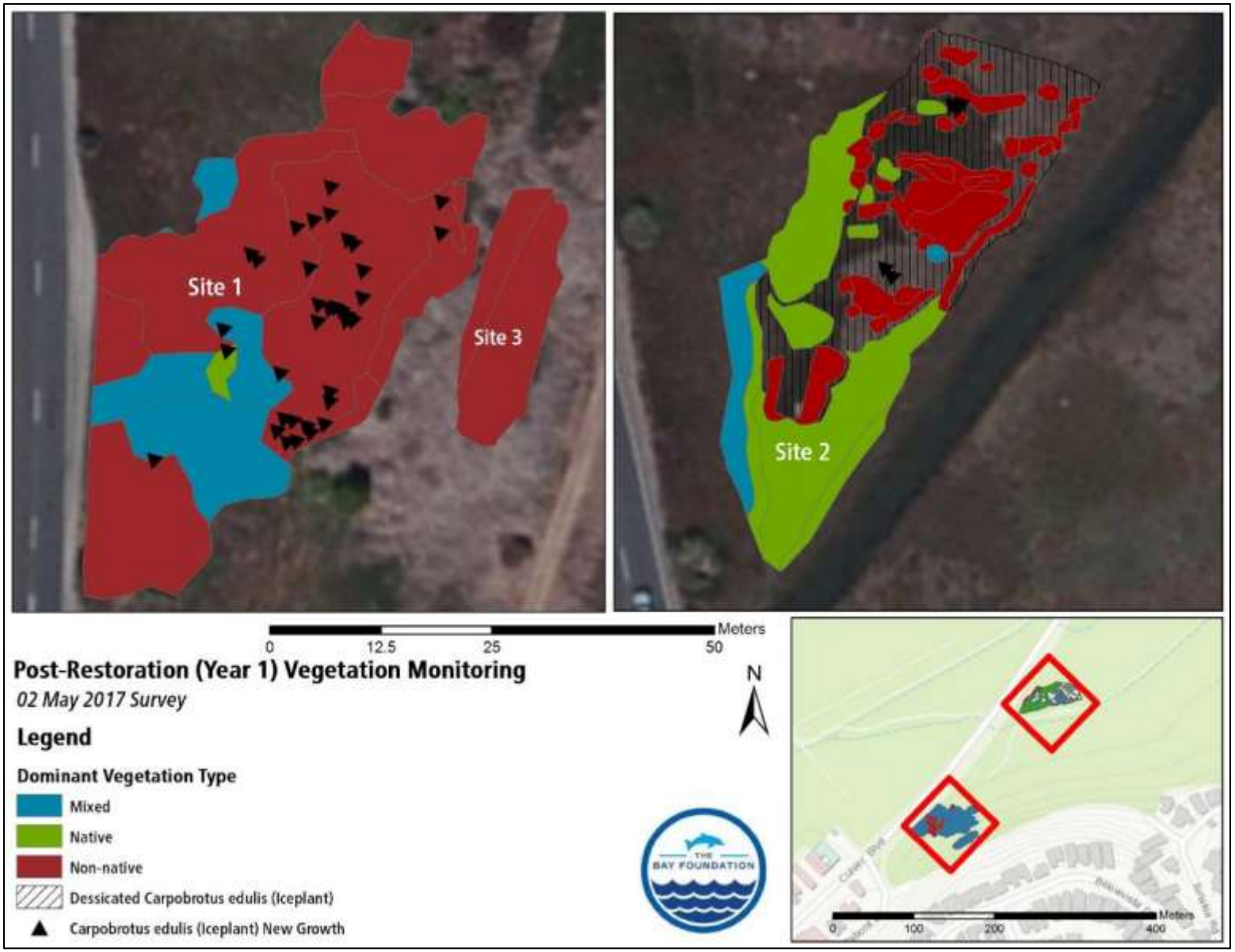


Figure 22b. Map displaying dominant vegetation type within GIS polygons during the 2 May 2017 survey.

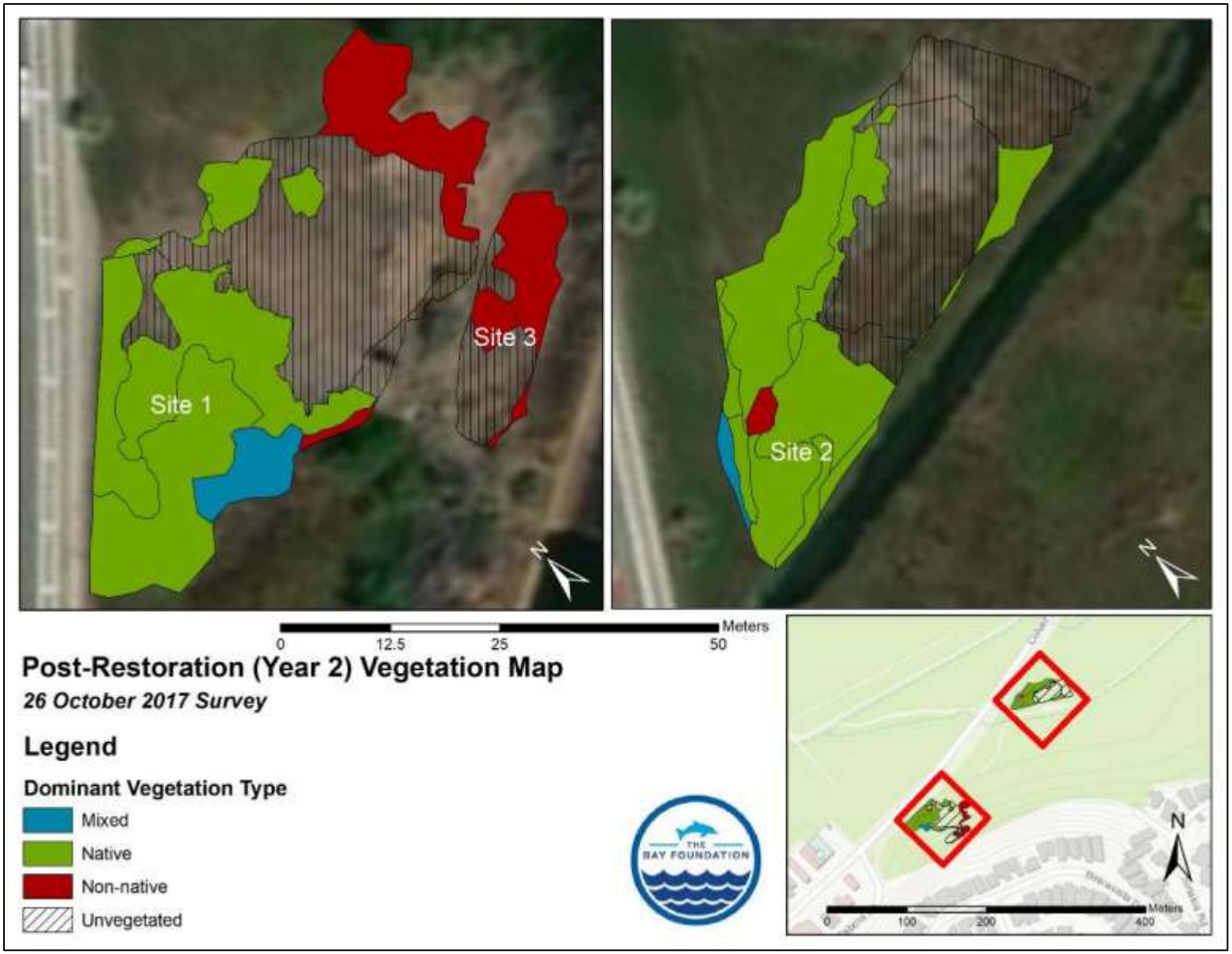


Figure 22c. Map displaying dominant vegetation type within GIS polygons during the 26 October 2017 survey.

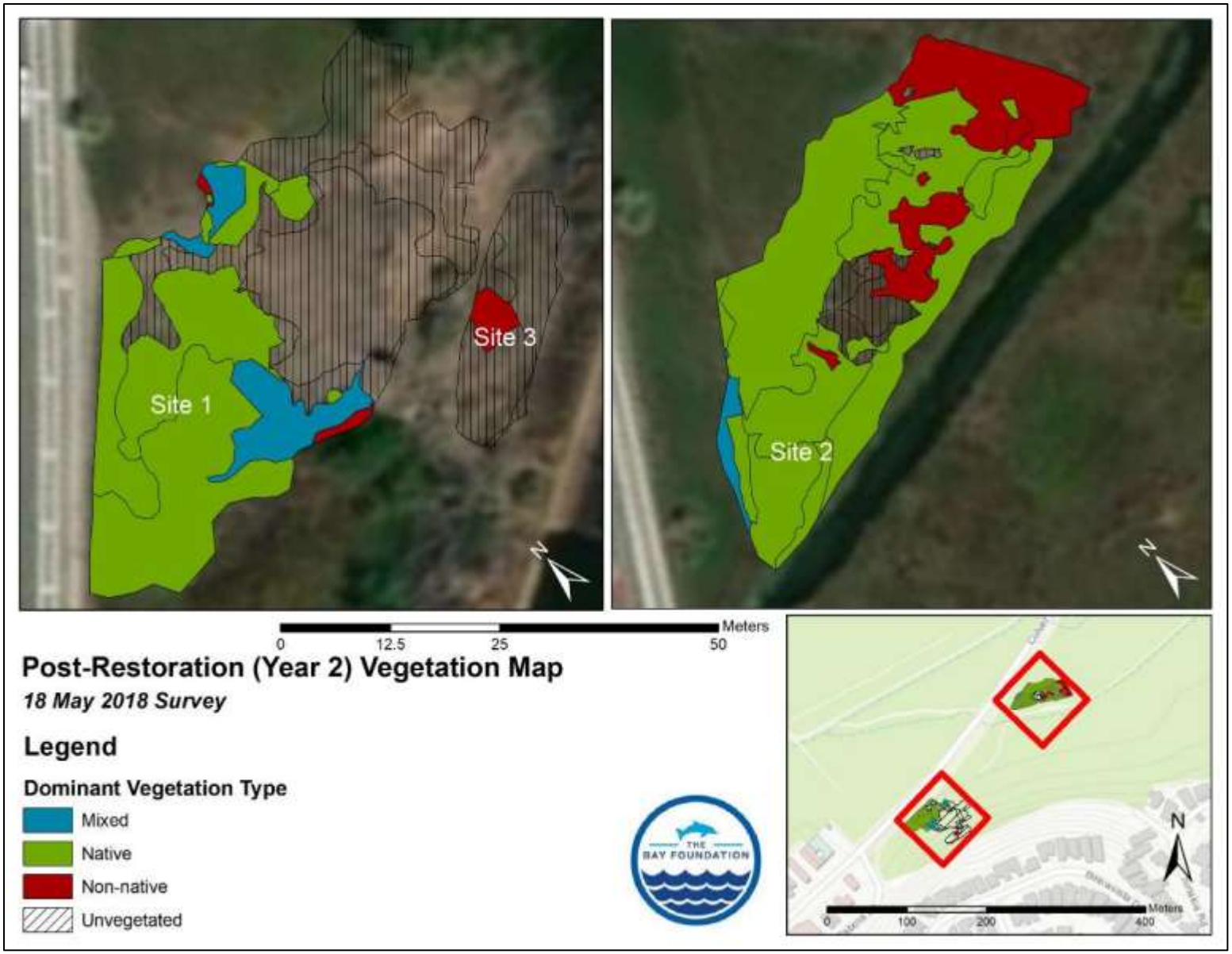


Figure 22d. Map displaying dominant vegetation type within GIS polygons during the 18 May 2018 survey.

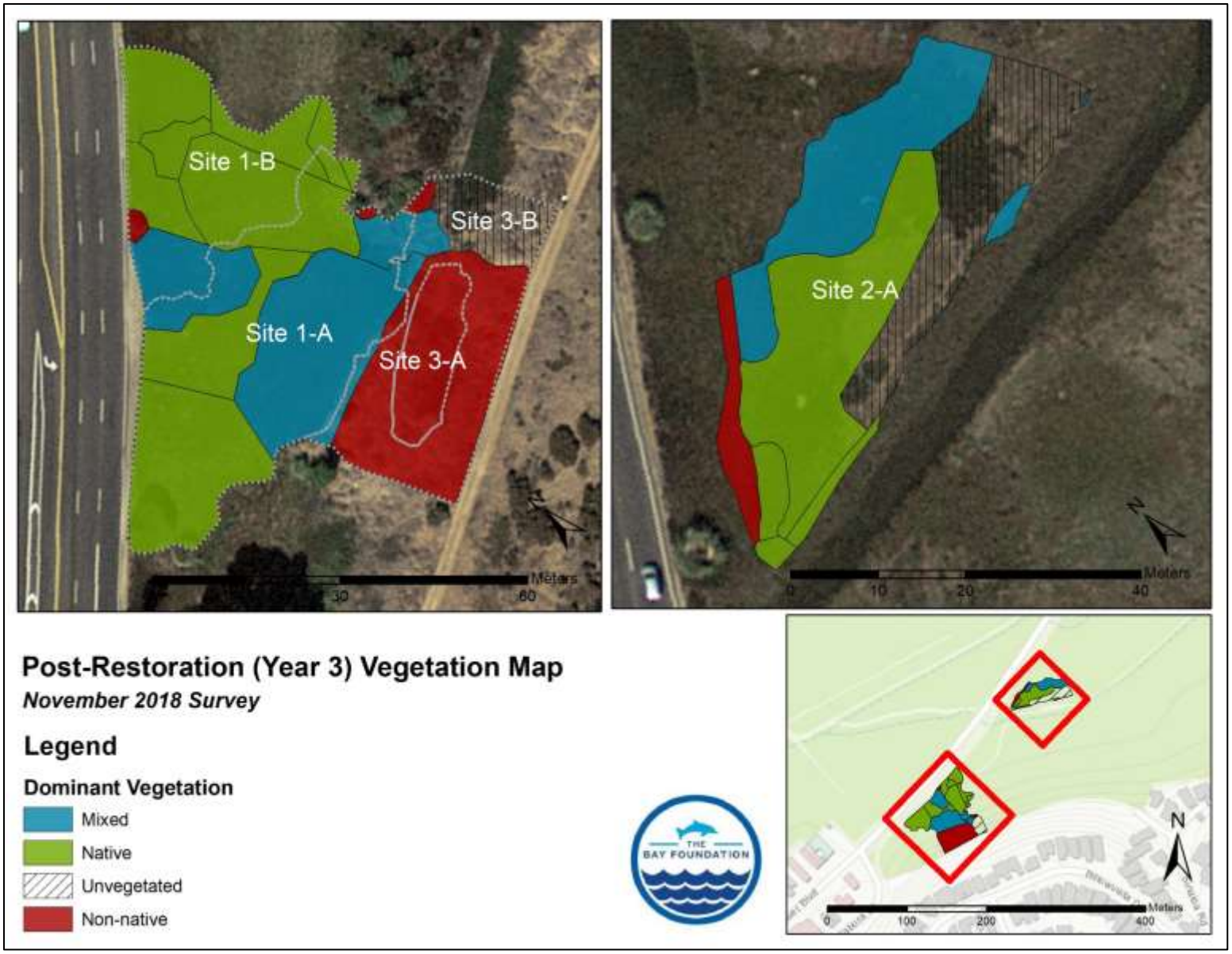


Figure 22e. Map displaying dominant vegetation type within GIS polygons during the 18 November 2018 survey.

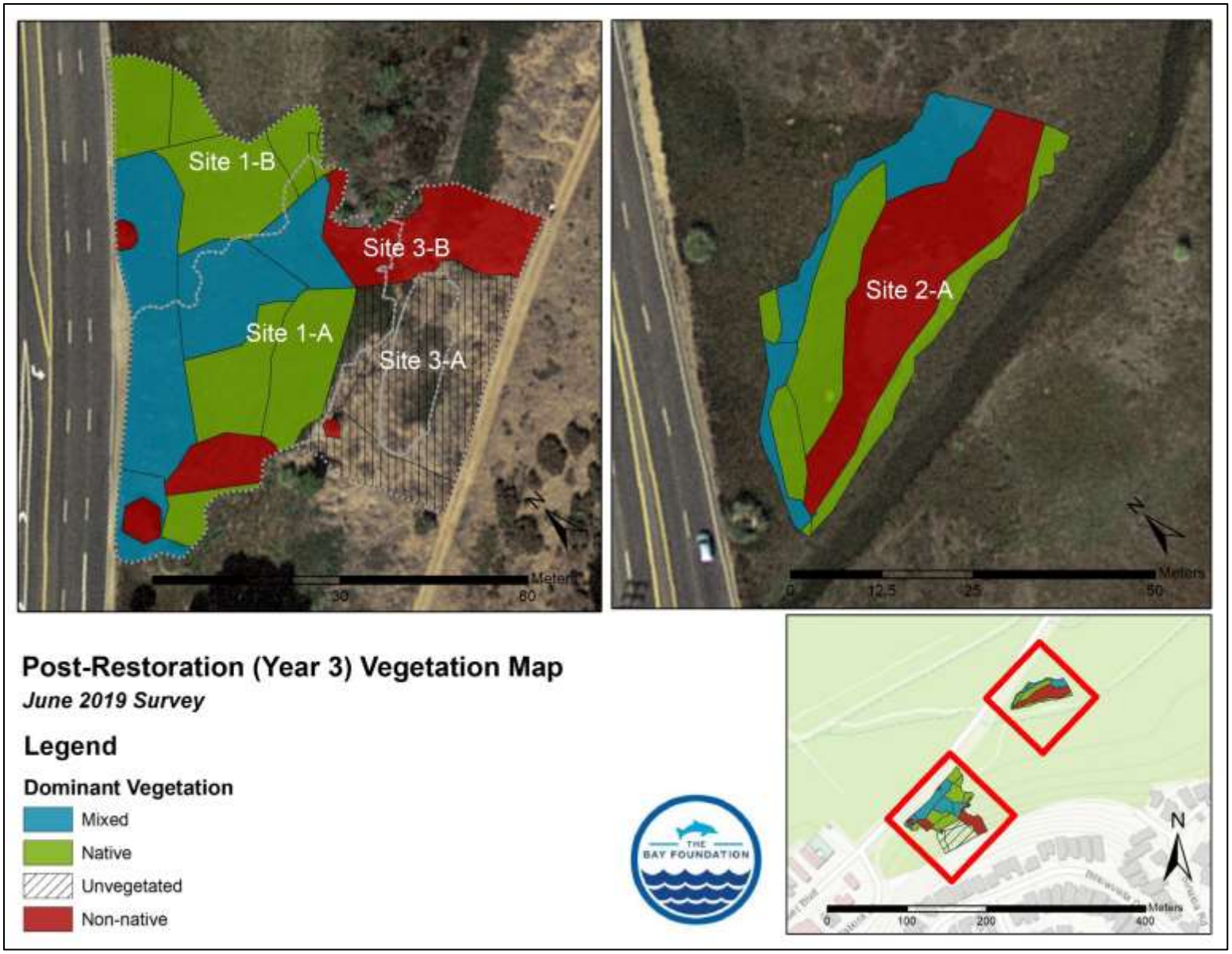


Figure 22f. Map displaying dominant vegetation type within GIS polygons during the 11 June 2019 survey.

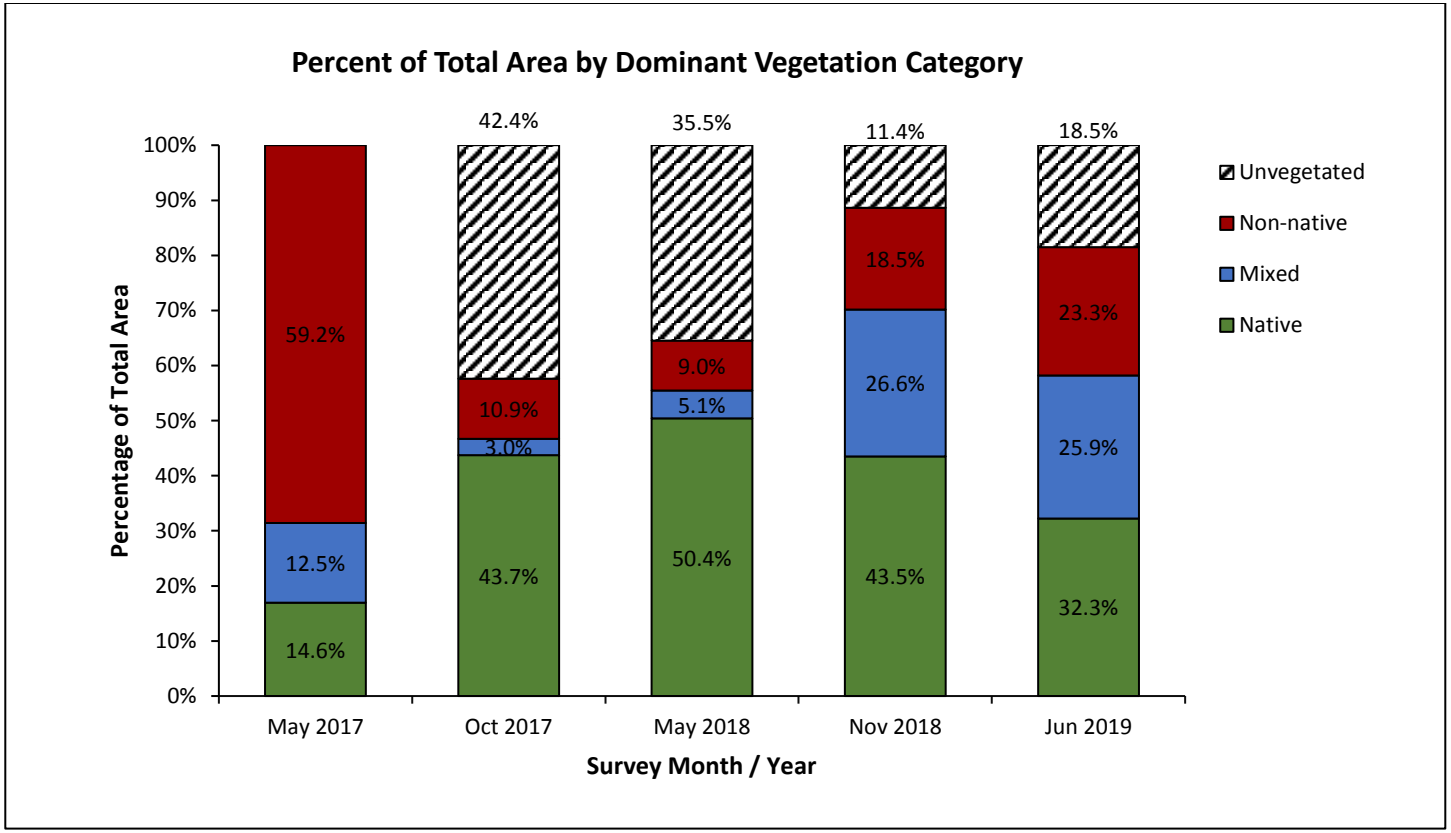


Figure 23. Graph displaying percentage of dominant vegetation type over time.

Vegetation Cover Survey Methods

The primary objective of transect- and quadrat-level cover surveys for this project was to assess the approximate cover of invasive, non-native vegetation over time. Transect- and quadrat-level plant cover data were collected on permanently identified 25-meter transects. Transects were randomly allocated within the "restoration" area and "control" area outside the restoration site. Both "Line-Intercept Transects" and "Cover Class Quadrats" were implemented.

The transect survey methods are described, along with field data sheets, in SOP 3.2 Vegetation Cover Surveys (TBF 2015b). Line-Intercept Transects documented every species observed directly below the transect tape where the vegetation crossed a minimum of 0.01 m. Line-intercept data were summed by species and divided by the total length of transect to determine percent cover for each transect and habitat. Cover Class Quadrat surveys were conducted using 1 m^2 PVC quadrats subdivided into 16 sub-quadrats. Ten quadrats were surveyed along each transect. Cover class species data were analyzed using the median of each Daubenmire cover category and averaged to determine percent cover within each transect with variability represented as standard deviation or error (TBF 2015b). Primary analyses were conducted to compare native versus non-native vegetation assemblages. Baseline vegetation data was collected in August 2016. Post-restoration field surveys were conducted in November 2016, immediately following restoration efforts, and again in May 2017, October 2017, May 2018, November 2018, and May/June 2019. An additional transect was added in 2018 to capture baseline and post-restoration conditions in the expansion of restoration activities (Site 1-B). Results are reported as live absolute cover percentages over time to best inform management actions and recommendations for the site.

Vegetation Cover Survey Results

Site 1-A and 2-A transect results indicated a reduction in live non-native vegetation absolute cover from over 90% and 80%, respectively, pre-restoration, to 5.8% and 5.5% post-restoration on the most recent survey in May 2019 (Figure 24). This indicates a significant reduction in non-native vegetation cover, maintained across all three monitoring years along those representative transects. Conversely, a fluctuating increase in native cover from 0% (pre-restoration, baseline) to 5.8% cover in the most recent survey (May 2019) was identified at Site 1-A, with a peak in October 2017 at 13.8%. Native cover at Site 1-A has included expansion of saltgrass and in Year 3, the presence of annual Canadian horseweed. The significant reduction in non-native cover was primarily due to the successful removal of iceplant from the project area and subsequent weeding and maintenance events. The remaining non-native cover was primarily annual "weedy" vegetation species, including: Geraldton carnation weed (*Euphorbia terracina*), non-native brome grasses (*Brome spp.*), wild radish (*Raphanus sativus*), annual yellow sweetclover (*Melilotus indicus*), and Bermuda buttercup (*Oxalis pes-caprae*), though other non-native species were present. The remaining portions of the restoration area were covered in dead iceplant (acting as mulch) and did not exhibit vegetation growth at the time of the surveys.

Photographs in Figure 27a through Figure 27e illustrate the vegetation transition over time from a monoculture of iceplant (A), to dead iceplant immediately post-restoration (B), to a mix of a variety of native and non-native vegetation species (C-E). In Figure 27c saltgrass is highly discernable in October 2017, and then in May 2018, the most visible species is Geraldton carnation weed. Year 3 post-restoration observations show minimal non-native species with the area dominated by the native annual species, Canadian horseweed (Figure 27d).

Similarly, Site 2-A transect results indicated a shift from over 80% non-native cover to 5.5% non-native cover in the most recent survey (June 2019), again a significant reduction of non-native vegetation cover. Conversely, the native cover experienced patchiness and seasonal variability, with a fluctuation between 0% (November 2016) to a high of 18.6% in the most recent survey (June 2019) (Figure 24). However, there were patches of native vegetation (again, primarily saltgrass) of over 25% cover in some of the Site 2-A restoration areas, especially in October 2017. During Year 3, the non-native vegetation cover at Site 2-A was dominated by annual species including brome species, wild radish, annual yellow sweetclover, and patches of Australian saltbush (*Atriplex semibaccata*).

Restoration Site 1-B was newly restored in Year 3. This Site identified 40.7% non-native vegetation cover in the baseline survey with 57.9% native cover. Native cover was predominantly saltgrass, and non-native cover was predominantly iceplant. The post-restoration surveys showed a dramatic increase in native vegetation (88.9 and 87.9%, respectively) and decrease in non-native vegetation (1.3 and 2.0%, respectively) (Figure 26). Saltgrass, the dominant native in Site 1-B, showed a significant increase from 54.8% in baseline conditions up to 88.1% post-restoration. Figure 28 shows the beginning of Transect 7, within Site 1-B, at baseline conditions (pre-restoration) on 9 August 2018 and within weeks of post-restoration on 28 November 2018.

Control results (transects surveyed outside of the restoration area and not altered during restorations) indicated some stability in the predominantly native areas, with live native cover ranging from a high of 100.0% dropping to a low of 79.4% native cover in May 2018, but then rising again for the Year 3 surveys (100% and 100%, respectively). Additionally, the control results identified resistance to invasion, with less than 1% non-native cover across all surveys (Figure 25). Conversely, control results in the predominantly non-native areas were highly fluctuating, with a range of 44% (May 2018) to approximately 91% (May 2017). In the Year 3 surveys, non-native cover ranged from 46-56% (24). Control transects are indicative of the variability of both native and non-native cover outside of the restoration project footprint area, but within the Reserve during the time period surveyed. Many of the areas adjacent to restoration activities to date and within the project area have high non-native cover (e.g., Figure 29 taken in non-restored area).

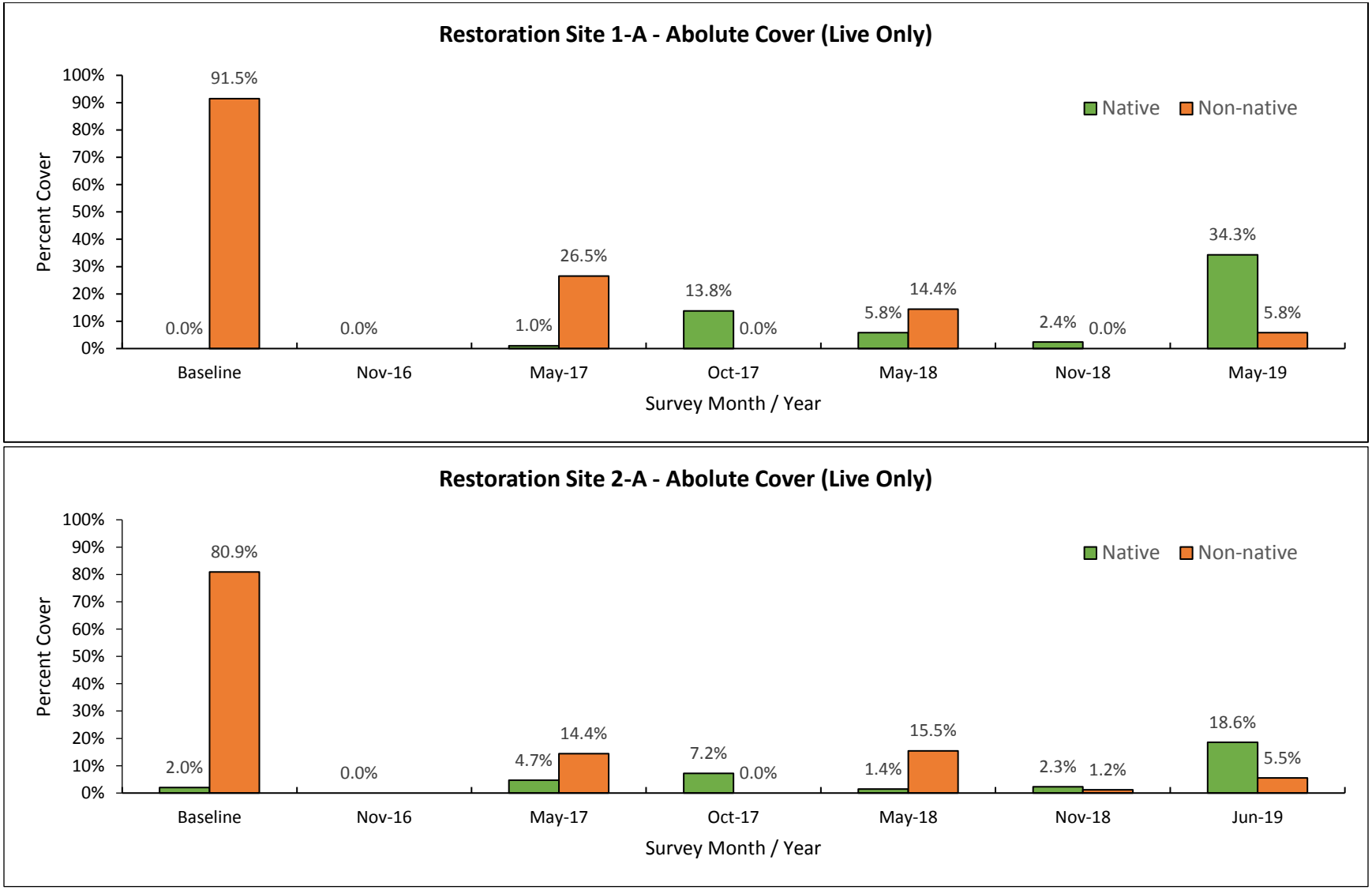
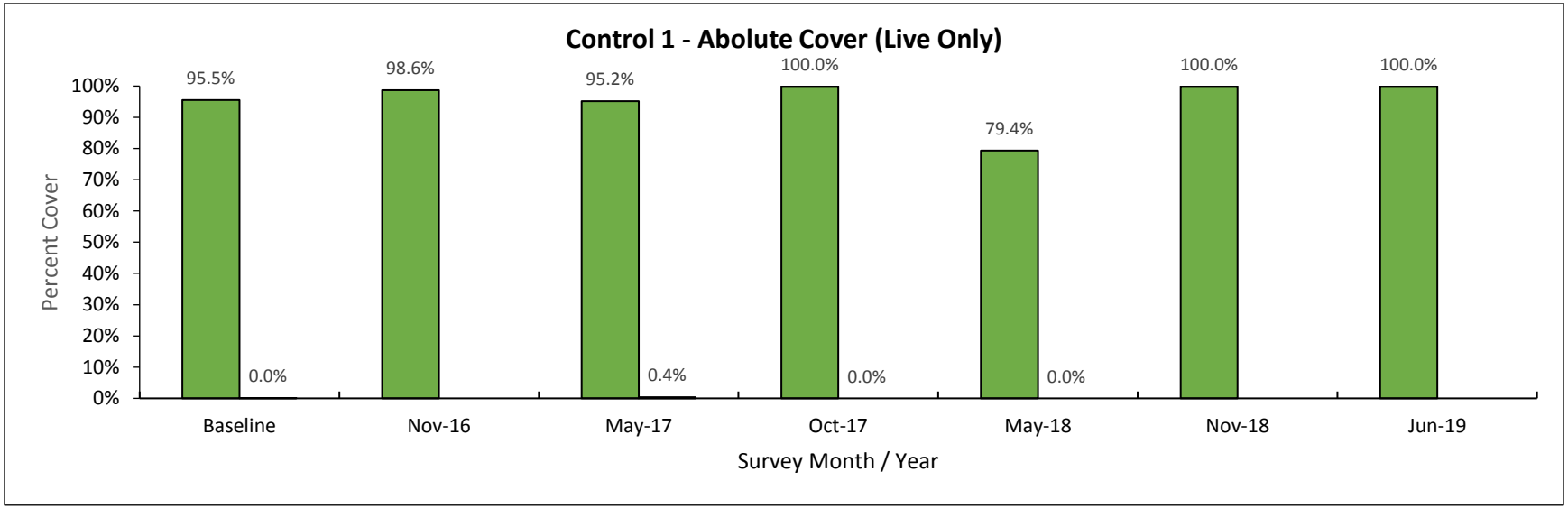


Figure 24. Vegetation data cover results from Site 1-A (top) and Site 2-A (bottom) absolute vegetation cover (live only).



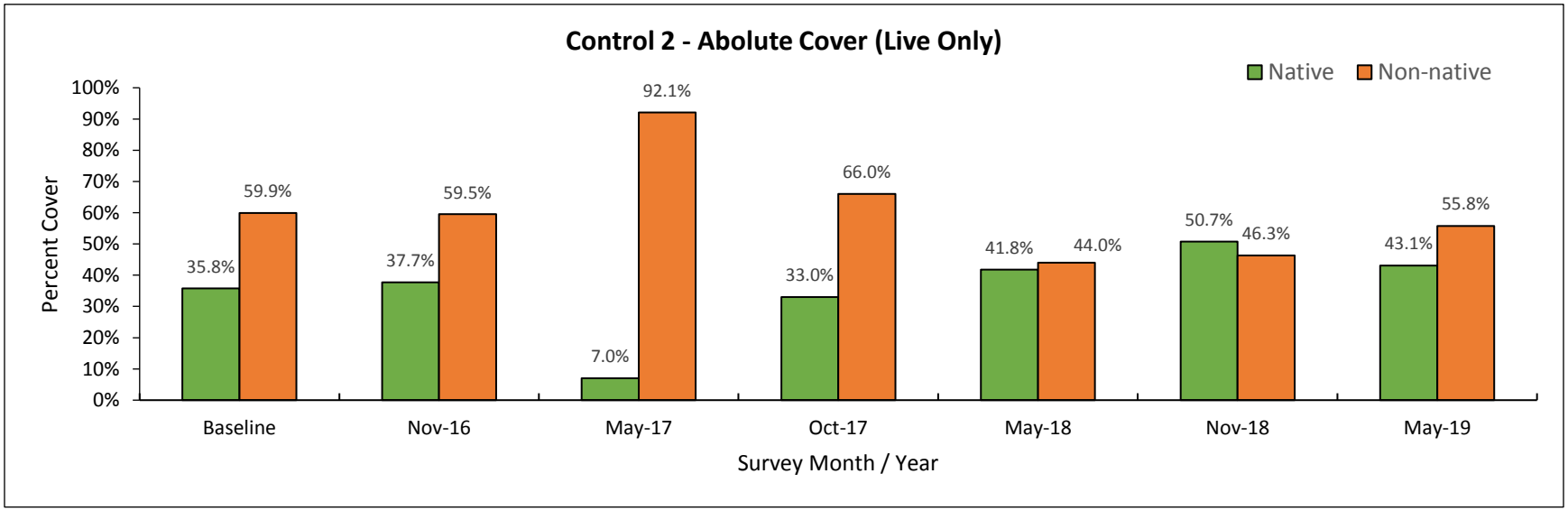


Figure 25. Vegetation data cover results from Control Site 1 (top) and Control Site 2 (bottom) absolute vegetation cover (live only).

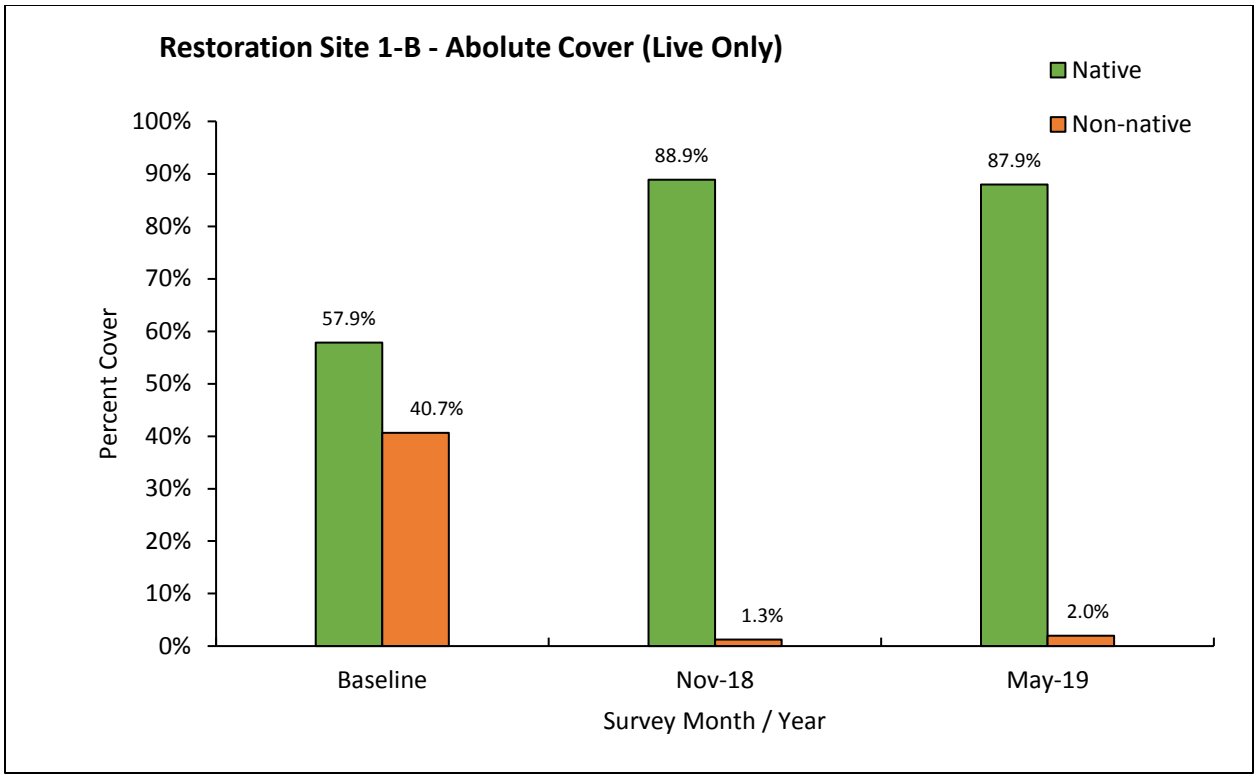


Figure 26. New restoration for Year 3 (August 2018-Jul 2019) Site 1-B absolute vegetation cover (live only).

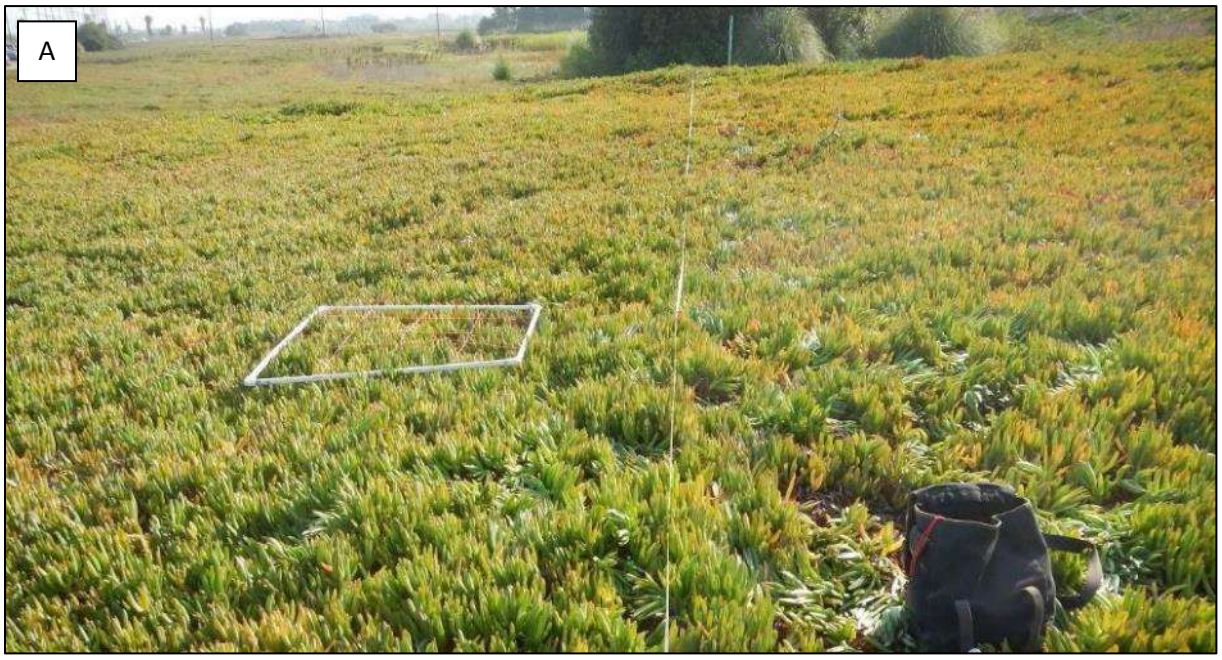


Figure 27a. Photographs of Transect 5 pre-restoration on 23 August 2016 (A).

Figure 27b. Photographs of Transect 5 immediately post-restoration on 29 November 2016 (B), and post-restoration on 1 May 2017 (C).

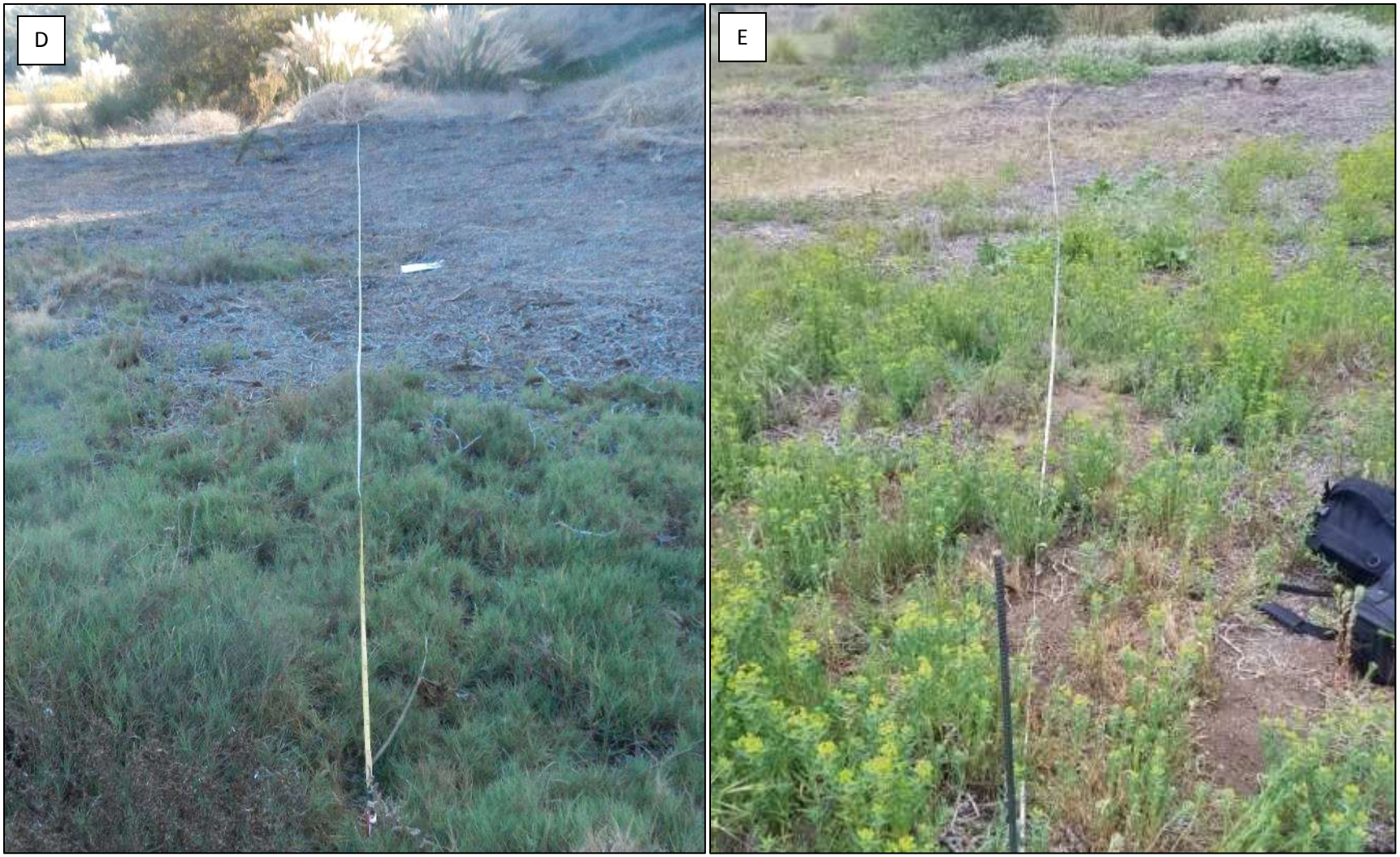


Figure 27c. Photographs of Transect 5, Year 2 post-restoration, on 7 October 2017 (D), and 1 May 2018 (E). Note: photograph (D) was taken at a slightly different starting location, hence the saltgrass patch present in (D) and not after. Subsequent photo start points were corrected.

Figure 27d. Photographs of Transect 5, Year 3, post-restoration on 28 November 2018 (F), 24 July 2019 (G).

Figure 28. Photograph of beginning of Transect 7 at baseline conditions (pre-restoration) on 9 August 2018 and within weeks of post-restoration on 28 November 2018.

Figure 29. Photo of vegetation transect in non-restored area of project site on 5 July 2019 showing predominantly iceplant, curly dox, and non-native grasses

Precipitation

The total rainfall for the wet weather months (October through May of the following year) was 16.32 inches during Year 1, 3.79 inches in Year 2, and 16.94 inches in Year 3, as measured by the Los Angeles International Airport (LAX) rain gauge. Year 2 had noticeably less precipitation than Years 1 and 3. Precipitation is particularly important to monitoring during revegetation efforts and can be meaningful when analyzing vegetation monitoring data. Figure 30 shows the total rainfall for wet weather months throughout the duration of the project.

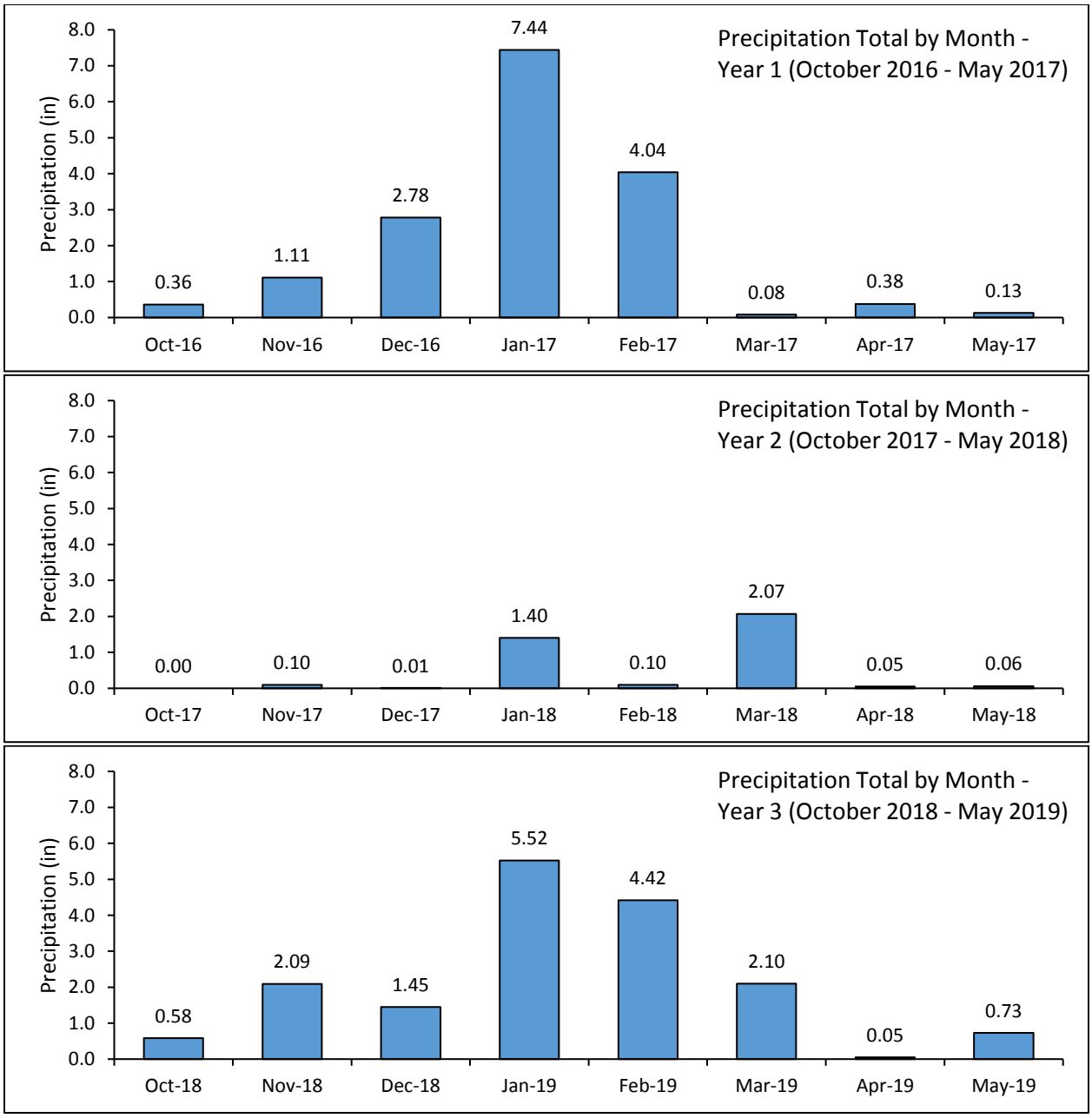


Figure 30. Monthly precipitation totals (inches) for the wet weather months (October-May). Daily precipitation data were downloaded from AccuWeather Premium and originally recorded at the LAX rain gauge.

Avifauna and Other Wildlife

No wildlife was harmed as part of this restoration project. There was no mortality under the tarps, and many species identified on or around the restoration area. It is important to note that the surveys conducted were not standardized for time or effort and are thus just displayed as presence data. The results should not be interpreted as full species lists of wildlife inhabiting the area; rather, they are just indicative examples of some of the species using the site.

Avifauna and Wildlife Survey Methods

The presence and distribution of avifauna within an ecosystem is often used as an index of habitat quality due to their diet and vulnerability to environmental conditions (Conway 2008). Avifauna data are useful to characterize representative avian assemblages and spatial distributions within a particular area. There are two primary purposes of avifauna and wildlife surveys for this project. First, it was to confirm a lack of breeding or nesting behavior for avifauna prior to the commencement of restoration activities to ensure no disturbance. Second, it was to provide a general understanding of the bird and wildlife community in the restoration area before and after restoration.

Bird survey methods are described in detail, along with field data sheets, in SOP 5.1 Bird Abundance-Activity (TBF 2015d). Bird surveys were performed by an ornithologist and entailed both observational visual and auditory bird surveys on 30 August 2016, 15 December 2016, 1 May 2017, 1 December 2017, 13 July 2018, 12 February 2019, and 11 April 2019. Observational data were also collected on wildlife presence during the implementation of other survey protocols and during restoration events; seven supplemental surveys were conducted during Year 2. Additionally, site checks throughout Year 3 noted birds and wildlife in site when observed.

Avifauna and Wildlife Survey Results

No wildlife mortality was observed under the tarps during or after restoration. In fact, several reptiles (Western fence lizards, an alligator lizard, and a juvenile gopher snake) and several amphibians (Pacific tree frogs) were identified and moved during restoration events because they were on, under, or immediately adjacent to the tarps. They were moved to native salt marsh habitats immediately adjacent to the restoration area to avoid disturbance during events.

Avifauna were identified through ornithological surveys conducted by Cooper Ecological Monitoring, Inc. and as part of wildlife observation and monitoring days conducted by TBF and Friends of Ballona Wetlands. Table 6 includes a list of species identified as part of these monitoring surveys within the restoration area. It should be noted that this is not intended as a comprehensive or exhaustive list of species using the restoration area or adjacent habitats; several other species were visually observed by community members during restoration events. These results are intended to provide an overall understanding of some of the wildlife using the restoration area. No Belding's savannah sparrows were identified during the pre-restoration survey, and the ornithologist concluded that use of the pre-restoration area by this species during the project was very unlikely to occur.

Table 6 displays bird presence survey results. Many of the birds were identified immediately adjacent to the project area, rather than within the restoration footprint. This trend was exhibited during both the pre- and post-restoration surveys. The pre-restoration data column also includes species seen during restoration events within the project footprint area. Several raptor species were observed hunting or foraging adjacent to or above the post-restoration project site, such as red-tailed hawk, red shouldered hawk, Cooper's hawk, and American kestrel. One osprey was observed hunting (flying) above the tide channel adjacent to Site 2-A. During the most recent bird survey on 13 July 2018, multiple individuals of several species were seen, including black phoebe, common yellowthroat, house finch, lesser goldfinch, and mourning dove. Snowy egrets were commonly identified in the tide channel adjacent to Site 2-A.

During restoration events and post-monitoring surveys, a number of wildlife were seen and recorded such as butterflies and moths (Table 7). Post-restoration wildlife identified included a variety of herpetofauna, mammals, and invertebrates, with some occasionally photographed such as the western pygmy blue butterfly (Figure 31). Western fence lizards and Pacific tree frogs were frequently observed, and alligator lizards were seen occasionally (Figure 31). A Southern California legless lizard was found in the restoration site on 21 December 2018 (Figure 32), in an area where iceplant was removed in 2016. Butterflies, moths, and other notable invertebrates were also recorded and included wandering skipper, cabbage white butterflies, common buckeye butterflies, and others. California ground squirrel and Botta's pocket gopher burrows were also present throughout the restoration and adjacent areas and seen visually, while cottontail rabbits were frequently seen along the adjacent bluffs. Table 6 displays wildlife presents results.

Figure 31. Photographs of western pygmy blue butterfly (left), and alligator lizard (right).

Table 6. Bird species identified in and around the restoration project area.

Common Name	Pre-restoration (and during) *	Post-restoration *	Cooper (5/1/17) **	Cooper (12/1/17)**	Cooper (7/13/18) **	Cooper & Associates (2/12/19)**	Cooper & Associates (4/11/19)**
Allen's hummingbird			X		X	X	X
American crow					X		X
American kestrel				X	X		
Anna's hummingbird					X	X	X
Black phoebe		X		X	X	X	
Black-crowned Night-Heron							X
Brown-headed Cowbird							X
Bushtit		X	X			X	X
California towhee			X	X			
Cassin's Kingbird				X			
Common raven			X				
Common yellowthroat		X	X	X	X	X	X
Cooper's hawk					X		
Gadwall							X
Great Horned Owl							X
Green-winged Teal						X	
Hooded Oriole							X
House finch			X	X	X	X	X
House Sparrow							X
House wren		X	X				
Least Sandpiper						X	
Lesser Goldfinch					X		X
Lincoln's Sparrow						X	
Killdeer		X					
Mallard						X	X

Common Name	Pre-restoration (and during) *	Post-restoration *	Cooper (5/1/17) **	Cooper (12/1/17)** *	Cooper (7/13/18) **	Cooper & Associates (2/12/19)** *	Cooper & Associates (4/11/19)**
Marsh wren				X		X	
Mourning dove		X	X		X	X	X
Northern Rough-winged Swallow							X
Orange-crowned Warbler				X			
Osprey		X					
Pigeon							
Red tailed hawk				X		X	X
Red shouldered hawk							
Ruby-crowned Kinglet						X	
Savannah sparrow				X*		X*	
Say's Pheobe						X	
Scrub jay							
Song sparrow			X	X	X	X	X
Yellow warbler			X	X			X
Warbling vireo			X				
Western Meadowlark						X	
White-crowned Sparrow				X			
Wilson's warbler			X				X

** Note: Pre-restoration (and during) survey efforts and post-restoration survey efforts are not equivalent.*

*** Note: Cooper Ecological ornithological surveys and observations were identified within approximately 50 feet of the project boundary.*

Table 7. Wildlife species identified within the project footprint area. Note: the pre-restoration column also includes wildlife found during restoration events (see December 2016 report for more details).

Common Name	Pre-restoration (and during)	Post-restoration
Desert cottontail rabbit		
CA ground squirrel	X	X
Western harvest mouse		X
South Coast marsh vole		
Botta's pocket gopher		X
Western fence lizard	X	X
Alligator lizard	X	X
Side-blotched lizard		X
Southern California legless lizard		X
Gopher snake	X	X
Pacific tree frog	X	X
Wandering skipper	X	X
Monarch butterfly		X
Marine blue butterfly		X
Cabbage white butterfly	X	X
Cloudless sulphur butterfly		X
Common buckeye		X
Fiery skipper		X
Grey hairstreak		
Western pygmy blue		X
Unk. black moth		X
Unk. brown moth		X

Figure 32. Southern California legless lizard found on site on 21 December 2018.

Photo-point

A series of geotagged photo-points were established to document change over time at the restoration site. The following photos provide a series of "after restoration" visual representations of tarped and hand-pulled restoration areas over time. To date, four permanent, photo-monitoring locations (Table 6 and Figure 33) have been established to visually document the restoration site over time. Stations were located using GPS and baseline photographs. Photo point station 1 through 3 were established in November 2016, and station 4 was established during Year 3 (September 2018). Station 4 was established to document restoration expansion into new areas during Year 3. Photo point monitoring at each station is represented in Figures 34 through 44.

Table 8. Photo point stations, approximate bearing, and number of photos.

Station	Approximate Bearing	Number of Photos	Date Established
1	70°	8	29 November 2016
2	300°	8	29 November 2016
3	270°	8	29 November 2016
4 (a,b)	173°; 61°	4	20 September 2018

Additional photos of restoration areas over time and before and after restoration events have been included. Figure 45 and 46 show restoration area 3-A before and after weeding, seeding, and erosion control mat installation on 8 February 2019. Representative photos of the hillside before and following seeding are shown in Figure 47. Figure 48 shows an example photo-point over time of a close-up hand restoration site where iceplant was carefully removed around native saltgrass and alkali weed (note yellow flags for reference). Note the expansion of several of the patches of native alkali weed and saltgrass and the dead non-native mixed grasses (bottom). Canadian horseweed, which began growing in Spring 2019 is clearly visible in the recent photo point series for Station 1 (Figure 36L).

Figure 33. Location of photo point monitoring stations.

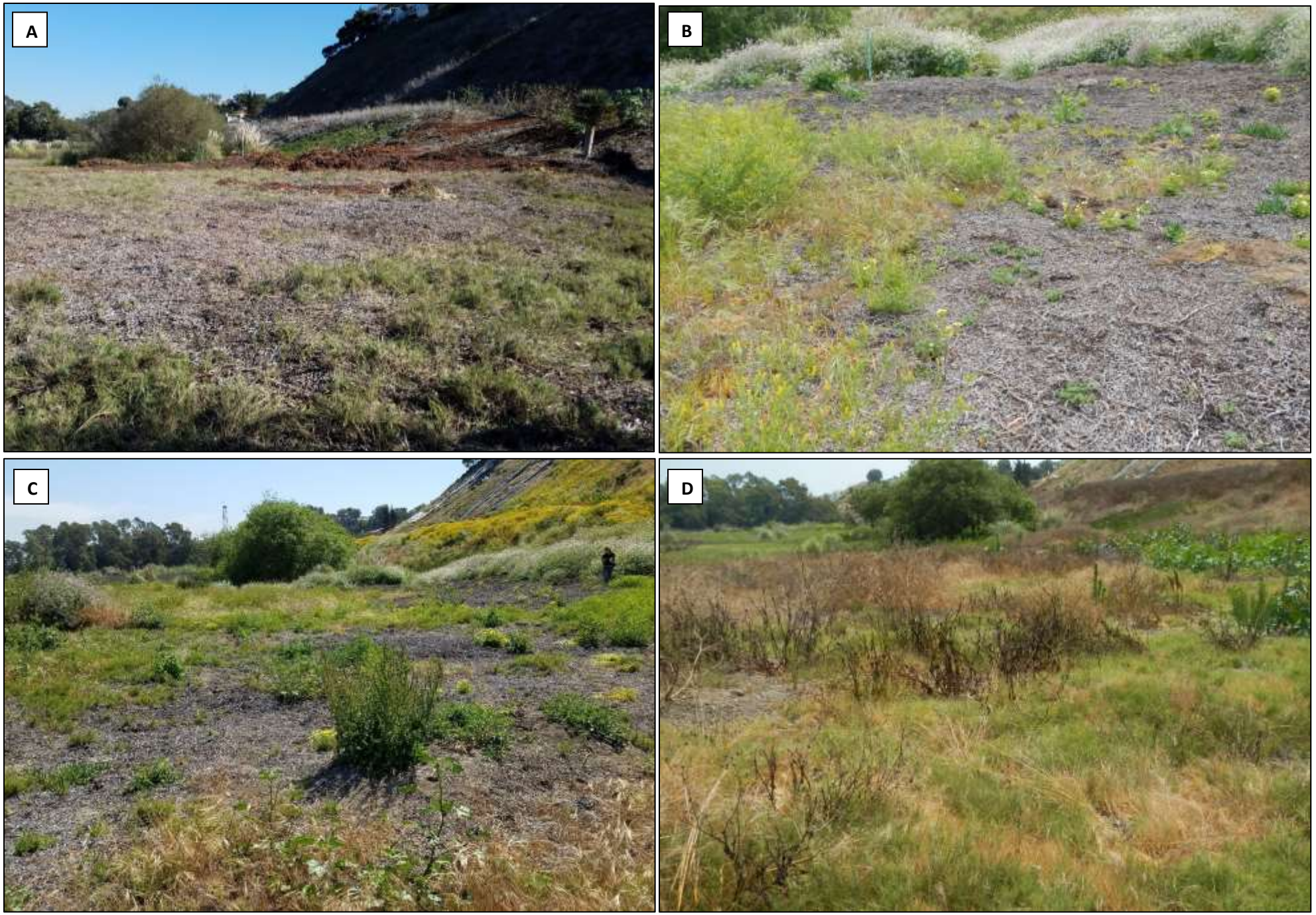


Figure 34. Photo Point 1 at bearing 70° on (A) 29 November 2016; (B) 25 April 2016; (C) 2 May 2017; (D) 12 July 2017.

Figure 35. Photo Point 1 at bearing 70° on (E) 12 August 2017; (F) 6 March 2018; (G) 18 May 2018; (H) 31 July 2018.

Figure 36. Photo Point 1 at bearing 70° on (I) 20 September 2018; (J) 21 February 2018; (K) 30 April 2019; (L) 24 July 2019.

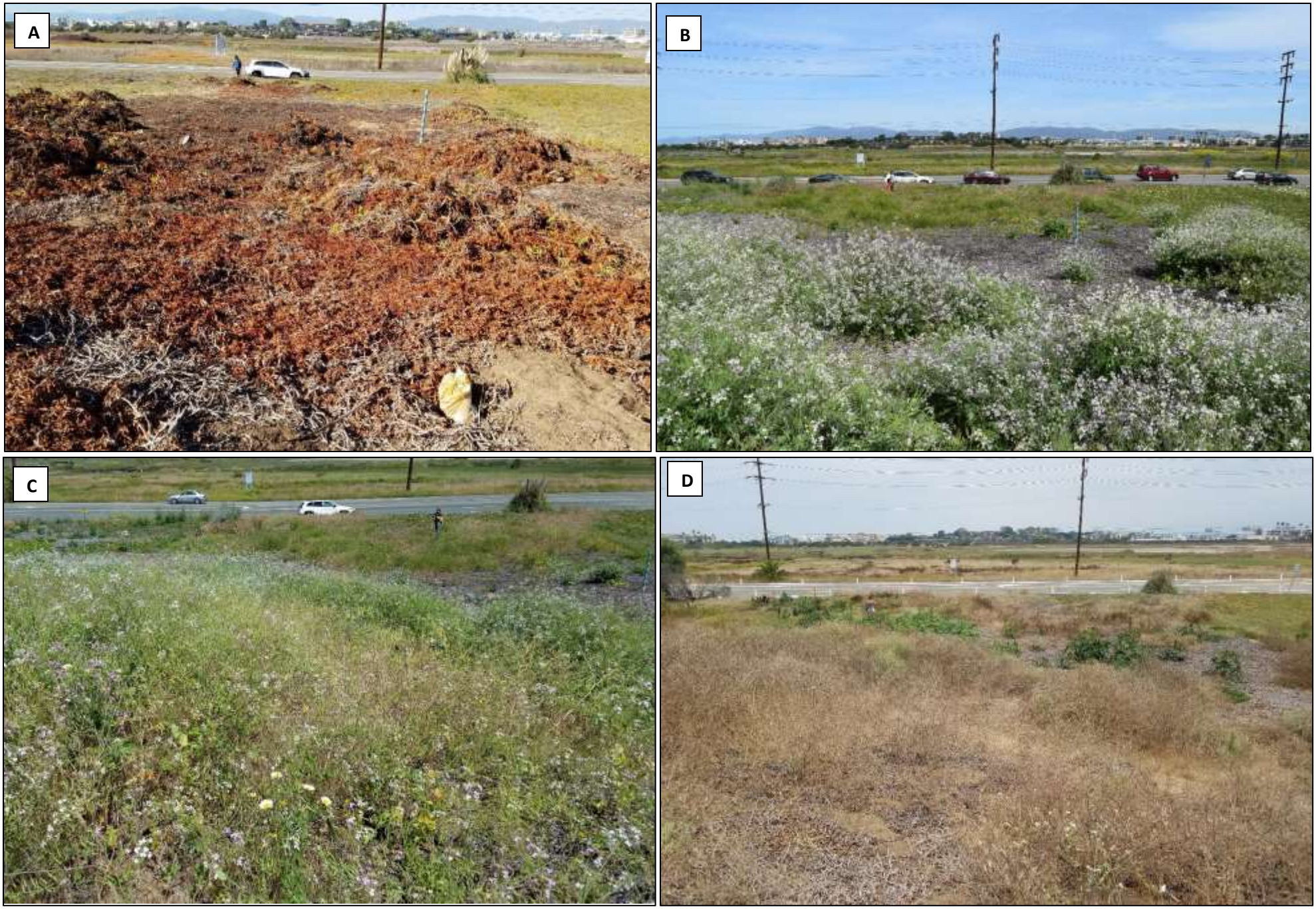


Figure 37. Photo Point 2 at bearing 300° on (A) 29 November 2016; (B) 25 April 2017; (C) 2 May 2017; (D) 12 July 2017- different than Year 2 report, bearing accurate.

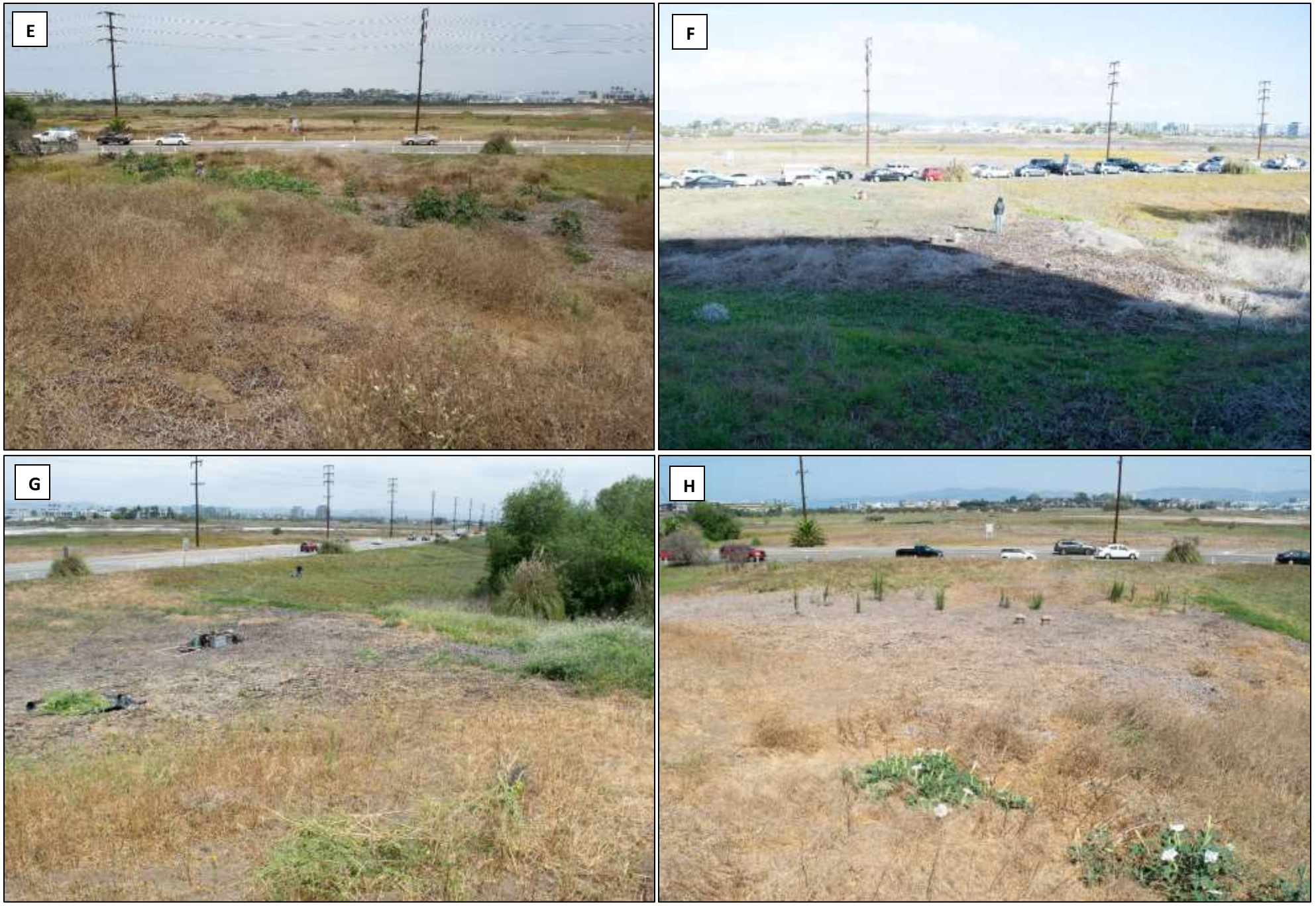


Figure 38. Photo Point 2 at bearing 300° on (E) 12 August 2017; (F) 27 February 2018; (G) 18 May 2018; (H) 31 July 2018.

Figure 39. Photo Point 2 at bearing 300° on (I) 20 September 2018; (J) 21 February 2018; (K) 30 April 2019; (L) 24 July 2019.

Figure 40. Photo Point 3 at bearing 270° on (A) 29 November 2016; (B) 25 April 2017; (C) 2 May 2017; (D) 12 July 2017.

Figure 41. Photo Point 3 at bearing 270° on (E) 12 August 2017; (F) 16 November 2017; (G) 18 April 2018; (H) 31 July 2018.

Figure 42. Photo Point 3 at bearing 270° on (I) 20 September 2018; (J) 21 February 2018; (K) 30 April 2019; (L) 24 July 2019.

Figure 43. Photo Point 4a at bearing 173° on (A) 20 September 2018; (B) 21 February 2019; (C) 30 April 2019; (D) 24 July 2019.

Figure 44. Photo Point 4b at bearing 61° on (A) 20 September 2018; (B) 21 February 2019; (C) 30 April 2019; (D) 24 July 2019.

Figure 45. Hillside before and immediately post weeding, seeding, and erosion control mat installation on 8 February 2019.

Figure 46. Hillside before and immediately post weeding, seeding, and erosion control mat installation on 8 February 2019.

Figure 47. Hillside before and after seeding on (A) 28 December 2018 (before); (B) 8 February 2019; (C) 5 June 2019; (D) 19 July 19.

Figure 48. Photo point of pre-restoration square meter area of iceplant with intermixed native salt marsh species (top left), immediately post-restoration after hand-pulling iceplant (top right), post-restoration on 12 July 2017 (bottom left), and 31 July 2018 (bottom right).

Figure 48 (continued). Post-restoration after hand-pulling iceplant on 5 July 2019.

Permitting

TBF, in coordination with the California Department of Fish Wildlife (CDFW), obtained permits to implement the Ballona Wetlands Community Iceplant Removal Project. On 10 March 2016, the California Coastal Commission (CCC) approved Coastal Development Permit (CDP) No. 5-15-1427 for the removal of non-native *Carpobrotus spp*., or iceplant, from the targeted 3-acre area within the Ballona Wetlands Ecological Reserve, south of Culver Boulevard with several conditions. Only a portion of this iceplant removal has occurred as described in this report. Additionally, a CEQA exemption was filed and obtained by CDFW to implement this project.

Special conditions of CDP No. 5-15-1427 included:

1) Timing of operations prohibiting vegetation eradication and removal, hauling, annual maintenance and spot removal from 1 February through 30 August to avoid impact to avian species during breeding season;
2) Submittal of a plan to monitor and remove invasive non-native plants from the project area; and,
3) Disposal of materials outside the coastal zone.

On 14 July 2016, permit conditions were satisfied, and the CDP permit was issued. Shortly after the first report was drafted in December 2016 (not a requirement of the permitting process, but an extra report prepared by TBF), TBF contacted Commission staff in January 2017 seeking a permit amendment to allow tarping and solarization for three months versus two months (to facilitate a higher percentage of iceplant desiccation), and the ability for TBF staff to conduct as-needed smaller spot removal events to pull weeds year-round. In April 2017, TBF (on behalf of CDFW) requested a permit amendment (CDP No. 5-15-1427-A1) to adjust the timing restriction condition of the underlying permit to allow year-round weed pulling to facilitate better management of invasive plant growth in the project area. Objections were made against the requested permit amendment which resulted in the amendment request becoming “material” and needing to go before a public Commission meeting for approval. Monitoring of the site continued; however, the “material” permit amendment process prevented TBF from being able to conduct spot-removal of weedy vegetation that came up following heavy winter rains in Year 1, thus negatively impacting the restoration process.

On 27 June 2017, a revocation request was submitted to the Commission by Ballona Wetlands Land Trust (BWLT). The revocation request (No. 5-15-1427-REV) resulted in an additional agenda item to be presented and reviewed during the 11 August 2017 Commission hearing. On 27 July 2017, TBF participated in a meeting organized by BWLT to discuss the project with a larger group of stakeholders to understand and address ongoing concerns with the project.

At the CCC hearing on 11 August 2017, BWLT withdrew their revocation request No. 5-15-1427-REV, and CCC approved the amendment request by CDFW and TBF (No. 5-15-1427-A1), including an extension of project activities (spot removal by hand-pulling invasives) to be year-round for maintenance, and an extension of potential tarping deployment time, if needed. The permit amendment was issued on 12 September 2017. All reports for this project are made publicly available on TBF’s website: www.santamonicabay.org. The annual reporting time period is August through July of the following year. Coordination and communications are ongoing with CDFW and Commission staff.

Challenges

Restoration activities in a heavily degraded urban environment continued to pose challenges in Year 3. Similar to Year 2, non-native weed maintenance continued to remain an ongoing challenge. Urban wetlands, like many other urban environments, experience significant impacts from non-native vegetation seed dispersal and growth, as well as encroachment from adjacent patches of non-native plants. The restoration site is immediately adjacent to a roadway, so it is possible that road transport and non-native seed dispersal via adjacent mechanisms may need to continue to be controlled until the larger Ballona Wetlands Ecological Reserve restoration project is implemented, in whichever final vision is chosen by the lead agencies (CDFW and the Army Corps of Engineers). Additionally, natural native vegetation recruitment remained patchy and with seasonal variation. Year 3 included the start of revegetation activities such as seed dispersal and salt grass plug installation (see details in subsection above). These methods of revegetation were recommended as preferential by CDFW's Native American consultants. Long-term restoration of the project site will likely require a period of ongoing effort to remove non-native, invasive vegetation (e.g., Table 9), and continued monitoring will inform necessary adaptive management decisions (see subsection below).

One challenge from Year 2 was solved, which was the amendment of the Coastal Commission permit to extend the timing for TBF to lead public restoration events. Additionally, more volunteers participated in Year 3 than in Year 2, providing increased support during community restoration events. This support has been provided in part by schools, individuals, and through Loyola Marymount University's Coastal Research Institute internship students and may be supplemented through more and additional forms of new communication, including alternate online volunteer venues. An example of innovative volunteer recruitment strategies during Year 3 included participating in National Estuaries Week and hosting an official event at the site and leveraging platforms like Patagonia Action Work's Social Amplification program. While not directly a challenge, hosting community restoration events at the site includes logistical issues like the lack of adjacent parking and restroom facilities, as well as ongoing efforts to maintain safety due to the proximity of restoration activities to vehicular traffic on Culver Boulevard.

A notable challenge occurred at the end of Year 3 (end of July 2019), amid the preparation of the Year 3 monitoring report. The project site was dramatically disturbed by a vehicle driving off the adjacent dirt road (Cabora Road) and through the project Sites 3-A, 3-B, 1-A, and 1-B. Revegetation efforts along the hillside (Sites 3-A and 3-B) were visibly impacted, with erosion control mats broken, new seedlings trampled or uprooted, and soil severely disturbed (Figure 49). While tire tracks were observed in the newly restored area of Site 1-B and the saltgrass and other species were flattened, there was minimal soil (ground) disturbance (Figure 50). The long-term impacts of this disturbance will be evaluated by subsequent monitoring, and adaptive management practices are being considered.

These challenges continue to add to the difficulty of restoring an urban wetland in the middle of Los Angeles; however, information provided by this project will serve to inform similar projects throughout the region and the larger BWER restoration planning efforts.

Figure 49. Photographs of vehicle disturbance in project site (Site 3-A and 3-B, hillside) taken on 31 July 2019.

Figure 50. Photographs of vehicle disturbance of Site 1-A (bottom) and 1-B (top) taken on 31 July 2019.

Adaptive Management Strategies

Monitoring combined with adaptive management actions can help address restoration challenges. Since the amendment was approved by the Coastal Commission, weed management within the restrictive permit conditions was subsequently expanded during Year 3. Weed succession refers to the growth of other weed species following the removal of one type of vegetation and is further discussed below after three years of data on plant regrowth. Unfortunately, many non-native species are highly adapted to respond quickly and grow much faster than their native competitors. While iceplant removal efforts were largely a success, with only scattered minimal re-growth present in a few areas, many other non-natives (including both perennials and annuals) continued to invade the site. However, the high level of invasion that was seen in Year 1 of a few key species shifted in Year 2 and was less present. Similarly to Year 2, Year 3 saw varied invasion based on Site, with some areas more resistant than others. A strong continued maintenance regime is recommended. Community restoration events will continue to be held that strategically target non-native vegetation growth on-site using species-specific removal strategies as described further below. Volunteer participants during Year 4 restoration events will be given a thorough briefing on non-native plants being targeted during the event and will be guided by TBF staff on removal techniques.

Table 6 provides a list of invasive species, with subsequent descriptions by species of the adaptive management efforts undertaken in Year 3, anecdotal results based on recurrence, and recommendations by species for Year 4. TBF will continue focus on removing the dominant invaders in Year 4 as part of ongoing long-term maintenance of the site. Perhaps equally as important is consideration of additional revegetation options, as discussed in the Revegetation section, above.

Ongoing Maintenance

Year 3 maintenance required less effort than the first implementation year, which allowed for an expansion of the project footprint. Trends indicated fewer perennials such as iceplant (only a few small sprouts reoccurring within the project area in Year 3) and castor bean (again, only a couple of sprouts after removal of sprouts and seed heads in fall 2017). The primary target species for Year 3 included a variety of annuals such as bromes, Geraldton carnation weed, and sweetclover (Table 6). For additional details by species, see individual subsections below and Table 6.

Year 4 restoration activities will focus on strategically controlling non-native vegetation within the previous restoration footprint; additional native vegetation seeding, saltgrass plugs, and willow stakes; and continued hand restoration maintenance of weeds into the larger project area (still within the same permitted 3-acre area). This new hand restoration will allow for the perimeter control of several key invaders and may help reduce the impact of some of the non-native invaders into the restoration project footprint. Removal of non-natives will continue to be targeted by flowering period for each individual species for maximum effectiveness (prior to seeding; Table 7). The following subsections provide details for the dominant vegetation invaders present within the restoration project area and suggested control methods. Table 6 and Table 7 summarize maintenance information by species. All removed non-native plant material will be disposed of offsite.

Table 9. Summary of weed maintenance adaptive management strategies by species (non-natives).

Scientific Name	Common Name	Growth Type	Year 3 Summary	Recommendations for Year 4
Bromus spp.	Brome grasses	Annual	Present throughout; maintained through seed clipping and pulling	Weed-wacker before seeding or hand removal by roots before seeding
Carpobrotus spp.	Iceplant	Perennial	Very little regrowth in Year 3; hand removed individual sprouts	Hand removal by roots
Euphorbia terracina	Geraldton carnation weed	Perennial	Boundary of spread maintained in Year 3, continued removing by hand	Hand removal by roots
Glebionis coronarium	Crown daisy	Annual	Present in Year 3 within site; present around periphery; Targeted in Site 3-A and 3-B (hillside) in Year 3	Hand removal by roots or weed-wrench before seeding; expand perimeter maintenance
Lysimachia arvensis	Scarlet pimpernel	Annual	Very little presence in Year 2; Scattered individuals on portion of Site 3-B in Year 3; hand removed	Hand removal by roots or weed-wrench before seeding
Melilotus indicus	Sweetclover	Annual	Dense patches in Site 2-A; overall less invasive than Year 2; hand removed	Weed-wacker (or clipping) before seeding or hand removal by roots before seeding
Oxalis pes-caprae	Bermuda buttercup	Perennial	Low presence in Year 3; hand removed	Hand removal by roots or weed-wrench before seeding; make sure to remove bulbs
Raphanus sativus	Wild radish	Annual	Present in Year 3, especially around periphery and Site 3-A and Site 3-B; hand removed and cut flowering tops	Weed-wacker (or clipping) before seeding or hand removal by roots before seeding
Ricinus communis	Castor bean	Perennial	Very little regrowth after initial seed clipping and sprout pulling in fall 2017; pulled sprouts in Year 3	Bag seeds; hand removal by roots or weed-wrench before seeding; expand perimeter maintenance
Sonchus oleraceus	Common sowthistle	Annual	Present in low amounts throughout; hand removed	Hand removal by roots or weed-wrench before seeding
Atriplex semibaccata	Australian saltbush	Perennial	Present in low amounts at Site 2-A; hand removed	Hand removal by roots
Cortaderia selloana	Pampas grass	Perennial	Not targeted during Year 1 and Year 2; opportunistically cut flower heads, trimmed back large plants on targeted individuals, removed new (small) plants in Year 3	Clipping and bagging of seed heads from plants within project area; manual removal of plants when feasible

Table 10. Summary flowering period for invasive vegetation by month and species.

	Bloom Period											
Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brome grasses												
Iceplant												
Geraldton carnation weed												
Crown daisy												
Scarlet pimpernel												
Sweetclover												
Bermuda buttercup												
Wild radish												
Castor bean												
Common sowthistle												
Pampas grass												
Australian saltbush												

Perennial Non-native Species

Carpobrotus spp.

Iceplant was not present in significant amounts in Year 3, and the couple of individual plants that re-sprouted were easily removed. For future years, all iceplant sprouts present in the project area can be removed by hand and disposed of offsite. For additional details about iceplant, see the rest of this report and other information on the project webpage.

Euphorbia terracina

Geraldton carnation weed (*Euphorbia terracina*) was present in higher amounts during Year 2 than Year 1, and it continued to encroach from the perimeter, especially at Site 1-A and Site 3-B. During Year 3, the spread of Geraldton carnation weed seemed to be contained within Site 1-A and continued to be removed by hand during restoration events. Canadian horseweed was observed to dominate an area where Geraldton carnation weed was present during Year 1 and Year 2. Geraldton carnation weed is a perennial (or biennial) herb that is not native to California and has the potential to spread rapidly (Cal-IPC). Like many other members of the spurge family, it produces toxic sap and has allelopathic properties that reduce germination of native plants (Cal-IPC). Although chemical methods have shown success in controlling this plant, this project is limited to manual removal methods only; therefore, this invasive plant species will continue to be removed by hand, bagging plants which have gone to seed, and carefully minimizing soil disturbance around the area (Dorsey et al. 2010). Geraldton carnation weed seeds can exist in the seed bank for three to five years, so continued maintenance of removing this invasive before it goes to seed will be necessary to establish control (Randall and Brooks 2000). Additional recommendations for this species include expanding the perimeter maintenance activities.

Oxalis pes-caprae

During Year 3, there was minimal presence of Bermuda buttercup (*Oxalis pes-caprae*) compared to the higher densities in Year 2. Additionally, Bermuda buttercup grew earlier and was able to be targeted by

ongoing community restoration events in the winter. The buttercup is a low-growing perennial herb (family Oxalidaceae) found along the coast of California (Cal-IPC). This buttercup does not produce seeds, but it has been shown to be difficult to control because of its ability to form many persistent bulbs and is often described as an "agricultural weed" (Cal-IPC). A loose basal rosette of leaves up to about 14 inches (35 cm) tall grows from the bulb and flowers bloom from November through April (UCIPM). While herbicides are commonly used to control this species (Stringer and Heath 2011), it can be removed by hand.

Cortaderia selloana

Pampas grass (*Cortaderia selloana*) is a large perennial grass found sporadically around the periphery of the project site. A few large stands exist within the permitted project site (not within the Year 1 footprint), and while Year 1 and Year 2 restoration activities targeted primarily iceplant followed by non-native annuals, Year 3 activities included clipping the seed heads from targeted pampas grass plants located in the extended project footprint and removing juvenile plants completely. Each flower (plume) from the pampas grass plant can produce up to 100,000 seeds that are widely dispersed by wind; thus, management of the spread of seeds within the project footprint will benefit not only the site but other portions of the Reserve.

Ricinus communis

Castor bean (*Ricinus communis*) did not appear to have large amounts of re-growth after efforts were made in fall 2017 to bag and remove all seed heads and to pull sprouts (approximately 400). Only a couple of individual sprouts were seen in spring 2018. During Year 3, small numbers of sprouts were pulled in Sites 3-A, 3-B, and 1-A. The sprouts likely originated from large individuals bordering the project site. Castor bean is a perennial shrub, sometimes tree-like, that can grow three to 15 feet tall. Castor bean grows quickly in mild climates and has escaped cultivation to become a noxious weed in southern and central California (Bossard et al. 2000). Castor bean displaces native plant species by growing rapidly and shading out native seeds and seedlings. Additionally, the seeds of castor bean are highly toxic to humans and wildlife such as rabbits, cats, dogs, and gophers (Robbins et al. 1941). As this plant spreads via seeds, seed heads from individual plants should be bagged prior to pulling plants by hand and removing the bulk of the root system. A weed wrench can be used to remove larger castor bean plants. Additional recommendations include expanding the perimeter maintenance activities.

Atriplex semibaccata

Australian saltbush (*Atriplex semibaccata*) is a spreading, shrubby perennial and is invasive in coastal grasslands and scrub, and the higher ground of salt marshes. It is a prostrate ground cover plant that has an extensive flowering period. A small area of Australian saltbush was tarped in Year 1, and subsequently manually removed during community restoration events during Year 1 and Year 2 from within the project footprint at Site 2-A. During Year 3, Australian saltbush continued to be pulled from Site 2-A; additionally, small sprouts and a handful of individuals were found on the base of the hillside at Site 3-B. It will continue to be managed during Year 3 restoration activities using hand removal techniques.

Annual Non-native Species

Bromus spp.

Bromus spp. includes a variety of non-native annual brome grasses such as ripgut brome (*Bromus diandrus*), soft brome (*Bromus hordeaceus*), and foxtail brome (*Bromus madritensis*), exhibiting similar graminoid growth patterns and reproducing by seed (Cal-IPC). These species had patchy presence throughout the restoration areas and should continue to be cut or pulled before seeds form. These species are characteristic of disturbed habitats and are common "weedy" grasses. In California, they contribute to altered patterns of wildfire, altered microhabitat characteristics, and altered nutrient cycling and competition for soil nutrients and light (Cal-IPC). Seeds of brome grasses can cling to people and are easily spread. Care should be taken not to transport the seeds from other areas onto the project area. During Year 3, brome grasses continued to be problematic, especially closer to Culver Boulevard. For Year 4, these non-natives should continue to be removed prior to seeding by hand removal. Some recommendations for removal include possibly using a weed-wacker to cut off the tops (flowering heads prior to seeding) of these grasses in areas dominated by these species for maximum cost-effectiveness.

Glebionis coronaria

Crown daisy (*Glebionis coronaria*) was not identified in the restoration areas during Year 2 but has been identified on the periphery adjacent to the Year 1 restoration sites, especially along the base of the bluff. During Year 3, crown daisy was observed and pulled on the hillside of Site 3-A and 3-B, particularly in preparation of seeding efforts. Crown daisy continued to be observed in high densities along the hillside and adjacent to the project site. Crown daisy is a flowering annual, commonly found in coastal California, and can invade a variety of habitats. This common ornamental plant escapes gardens settings and easily invades disturbed areas (Cal-IPC). The seeds of this species sprout quickly after rain and can grow up to five feet tall. Dense stands can crowd out native vegetation and dead plant mass can also prevent native plants from recolonizing if not removed (Tuttle et al. 2011). Crown daisy can be removed by hand or weed wrench. For Year 4, the adjacent crown daisy should be assessed, and additional recommendations for this species include expanding perimeter maintenance activities.

Lysimachia arvensis

Scarlet pimpernel (*Lysimachia arvensis*) is a small annual (can be biennial) non-native broadleaf herb that was present in Site 1-A and 3-B as small scattered individual plants in Year 2. During Year 3, minimal sprouts of scarlet pimpernel were observed in portions of Sites 3-A and 3-B. The species is commonly found in man-made and disturbed habitats and is tolerant of wetland habitats. If consumed, it can be toxic to livestock and humans (UCIPM). Mature plants can grow up to approximately 1.3 feet with upright or prostrate stems. Small salmon-orange colored flowers are produced from March through July (UCIPM), and it reproduces by seed. This species can be removed by hand or weed wrench. Year 4 recommendations include removing reoccurring individual sprouts.

Melilotus indicus

Sweetclover (*Melilotus indicus*) was present in much smaller amounts during Year 2, when compared to the maintenance efforts of Year 1. Sweetclover was problematic in Site 2-A during Year 3, with little invasion in other restoration sites. This non-native annual (can be biennial) herb that blooms from April through October, can grow up to approximately two feet in height, and is fairly tolerant of saline soils

(Calflora). This plant is often poisonous to mammals and can have a persistent seed bank of up to 20 years (Florabase). Plants should be hand removed before seeds are formed. If using a weed-wacker, the plant needs to be cut below the lowest branch axil to prevent resprouting. For Year 4, continued maintenance of any regrowth should occur, and additional recommendations for this species include expanding the perimeter maintenance activities.

Raphanus sativus

Wild radish (*Raphanus sativus*) was present in Year 2 in smaller amounts than Year 1 but was a significant presence around the periphery of the restoration area. During Year 3, wild radish continued to be a common invader in the restoration site. Radish was less dense in areas with established native cover (e.g., saltgrass and Canadian horseweed) and denser in areas with little to no native cover. Radish is an herbaceous annual that frequently invades disturbed areas, including roadsides, and can also be found in wetland areas (Holloran et al. 2004). Wild radish can grow up to three feet or taller and reproduces only by seed. Seeds can remain viable for long periods of time and can germinate in spring on fall depending on weather. Wild radish plants with seeds present will be bagged and removed from the site. Removal can occur manually by hand or weed wrench. Plants should be hand removed before seeds are formed. Additional recommendations for this species during Year 4 include controlling wild radish within the restoration site and expanding perimeter maintenance activities.

Sonchus oleraceus

Common sowthistle (*Sonchus oleraceus*) was present in small amounts in various places throughout the restoration area in Year 3. Sowthistle is a common annual (can be biennial) broadleaf plant that is frequently found in disturbed soils. It has hollow stems, releases a milky sap when cut open, and can reach over four feet in height. The yellow flowers mature into fluffy white seed heads, and this species reproduces by wind-dispersed seed. A single plant can produce up to 8,000 seeds (Florabase). Seed is able to germinate all year round over a broad range of temperatures and light availability (Cal-IPC). This species has been known to be resistant to herbicides and manual removal techniques are recommended. Populations can be removed by hand or by weed wrench. Cutting is often ineffective, as flowers can continue to be produced from cut stems. Recommendations for Year 4 include continued hand removal and maintenance.

Conclusions

Iceplant is a ground-hugging succulent that can grow deep, nearly impenetrable mats several feet thick which dominate resources along a range of soil moisture and nutrient conditions. Iceplant provides little protection or useable habitat for native birds and wildlife. Additionally, its shallow, fibrous root network consumes large quantities of available water year-round, further impeding the growth of native species with the largest impact occurring during times of drought. Most significantly, the highly competitive characteristics of iceplant for available nutrients, water, light, and space allows it to suppress the growth of native seedlings and often results in the growth of large, monospecific stands providing minimal habitat value. Iceplant also alters soil conditions, making the influx of native vegetation species difficult.

The importance of iceplant removal at a site like the Ballona Reserve should not be understated. It is an invasive species that has increased in area on the Reserve by approximately 20% over the last several decades, covering approximately 30 acres of the Reserve (prior to implementation of this project). While this project was focused on a relatively small area, it serves to inform future hand-restoration efforts both at the Reserve and throughout southern California. Both restoration methods (i.e. tarping and hand-pulling iceplant) were successful at removing iceplant and engaging the local community and school groups to varying degrees. Additional efforts to continue to engage the public are made available through the project webpage, periodic newsletters, and engagement through social media. Allowing students and the community to actively participate in improving the health of the Reserve will encourage stronger stakeholder involvement in the larger restoration process for the whole Reserve and broaden the hands-on educational opportunities for Los Angeles.

While the initial results of the tarping and hand-pull restoration efforts successfully removed iceplant with very little regrowth exhibited, Year 3 saw the continued need for maintenance of non-native vegetation. However, some areas of the project are doing very well with regards to native plant cover expansion (e.g., Site 1-B). Many of the annual non-native species died out in the late spring / early summer months, and as expected, ongoing and long-term monitoring and maintenance will be needed due to the high level of degradation of the Reserve and the lack of tidal influence to the salt marsh, which would encourage more native vegetation growth. Continued adaptive management will allow for non-native vegetation removal in future years, as restoration efforts continue, as well as informing a long-term understanding of invasive plant succession within the restoration area. Saltgrass and alkali weed are definitively expanding within the restoration area. As saltgrass is the preferred habitat for rare species such as the wandering skipper, the iceplant removal efforts are likely to help support this species and others in future years. During Years 2 and 3, anecdotal notes included a higher presence of wandering skipper in the restoration area than prior to restoration (D. Cooper, pers. obs.).

While the initial efforts specifically targeted to iceplant removal were successful, with minimal re-growth of iceplant, additional restoration events are needed to continue to remove other non-native invaders in the future. Additional recommendations include further expanding the perimeter to restrict encroachment of non-natives into the project area. Lastly, additional efforts to monitor and implement additional revegetation efforts will be necessary in Year 4 and beyond.

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