Ballona Wetlands Restoration: Community Iceplant Removal Project

Year 1 Annual Report

July 2017

Prepared for the California Coastal Commission and the California Department of Fish and Wildlife

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Ballona Wetlands Restoration: Community Iceplant Removal Project

Annual Report (Year 1)

July 2017

Coastal Development Permit No. 5-15-1427

Prepared by: The Bay Foundation

Prepared for:

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California Department of Fish and Wildlife

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Acknowledgements

We would like to thank the Southern California Wetlands Recovery Project for funding the first phase of this project through the Community Wetland Restoration Grant Program (Grant #2015-001). We are grateful for the help of the many volunteers who participated in this restoration project, and appreciate all of their efforts and donated time. We also want to acknowledge and thank our partners, Friends of Ballona Wetlands, CDFW, and Loyola Marymount University. Additionally, we are especially grateful to the staff of E. Read and Associates for donating so much of their time to help the project succeed. We would not have been able to complete this project without them.

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Project 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 first 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 July 2017.

The project focused on the removal of *Carpobrotus spp*., or iceplant, from a targeted area within Area B of the Reserve. 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, and has allowed for community engagement in hands-on restoration efforts. Pre- and post-restoration monitoring will evaluate the success 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.

During Year 1, TBF and community volunteers concentrated restoration efforts on removing invasive iceplant from the project site. Over 15 tons of iceplant (more than 200 cubic yards) were removed from the restoration area to a green waste dumpster for composting offsite. Initial iceplant removal efforts were followed by heavy winter rains. Many non-native species are highly adapted to respond quickly and grow much faster than their native competitors. Due to the high level of degradation of the Reserve, and the significant presence of non-native vegetation immediately adjacent to the project site, non-native vegetation growth occurred in some areas after the initial iceplant removal. Nativity of vegetation cover was highly variable and patchy, with both native and non-native vegetation growth in the project area. Non-native vegetation cover was predominantly annual grasses and herbaceous species, with very little iceplant regrowth. Native vegetation growth was predominantly saltgrass and alkali weed. Long-term restoration of the project site will likely require a period of ongoing efforts to remove non-native, invasive vegetation, and continued monitoring will inform necessary adaptive management decisions. Supplemental planting or seeding of native vegetation will continue to be considered as part of the project's Monitoring and Implementation Plan.

Restoration Activities

Restoration events began on 1 September 2016, in accordance with Coastal Commission permit conditions (Permit No. 5-15-1427). Desiccating iceplant through solarization requires installing tarps over iceplant monocultures during the hot summer and early fall months; therefore, TBF prioritized installing tarps as part of initial restoration efforts. 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. Table 1 provides summary details of all restoration events held from 1 September through 31 May 2017 and includes statistics on the number of volunteers, number of hours, restoration activities, and site details. 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 throughout the duration of the project. Figures 1 and 2 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 3). Acreages are summarized in Table 2. Hand restoration efforts alone resulted in a restoration area of 0.39 acres (1,585 m^2), and the total tarped restoration area was 0.36 acres (1,460 m^2) for a total project footprint of 0.75 acres. Additionally, some of the tarped area also had to be hand-restored through additional restoration events in an area of 0.13 acres or 510 m^2. Collectively, restoration efforts comprised a total area of 0.88 acres (3,555 m^2), which included the portion of Site 1 that was subsequently hand-restored after tarps were removed and some of the iceplant remained. The total aerial extent ("footprint") of the restoration area covers 0.75 acres (3,035 m^2) within the 3-acre permitted proposed restoration area.

Overall, restoration events were highly successful, with enthusiastic groups of engaged community members, local residents, and student participants. In total, 181 volunteers contributed 525 hours of service across 12 restoration events. Several large school groups (N=60, 36) participated in the restoration, especially during the November events (Figures 1 and 2). Additional volunteer hours were contributed by several students and interns helping with scientific monitoring. 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.

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 newsletter notices, a public project webpage, social media, word-of-mouth, and directly reaching out to schools and community members. All restoration events were open to sign-ups from the public and everyone who offered help was met with a positive response. 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 1. Photograph of 18 November 2016 restoration even at Site 1 with students and volunteers.

Figure 2. Photograph of restoration event on 10 November 2016.

Table 1. Summary of restoration event statistics through 31 May 2017.

Event Date / Time	Site	# Volunteers	# Volunteer Hours	Restoration Method
1 Sept – AM	1	9	27	Tarping + Hand-restored
1 Sept – PM	1	9	27	Tarping + Hand-restored
6 Sept – AM	2	11	25.5	Tarping + Hand-restored
6 Sept – PM	2	13	39	Tarping + Hand-restored
8 Sept – AM	3	9	19.5	Tarping + Hand-restored
8 Sept – PM	1 & 3	8	24	Hand-restored
13 Sept – AM	1 & 2	9	16.5	Hand-restored
16 Sept – AM	1 & 2	5	15	Hand-restored
20 Oct – AM	1	10	22.5	Hand-restored
10 Nov – AM	1	2	6	Hand-restored
15 Nov – AM	1 & 2	60	240	Hand-restored
18 Nov – AM	1	36	63	Hand-restored
Subtotal	**----**	**181**	**525**	**----**

Table 2. Summary of restoration areas and acreages through 31 May 2017.

Restoration Method	Area (m^2)	Area (Acres)
Hand-Restored	1,585	0.39
Tarp Cover	1,460	0.36
Tarp Cover + Hand-Restored	510	0.13
Total Area Restored	**3,555**	**0.88**
Total Project "Footprint" (aerial extent)	**3,035**	**0.75**

Figure 3. Map of hand-restored and tarped restoration activity locations at the Ballona Reserve.

Scientific Monitoring

A rigorous scientific monitoring plan will allow for adaptive management of restoration activities. Table 3 summarizes the biological monitoring sampling design. It lists five major parameters, the primary protocol(s) which will be implemented for each parameter, and the frequency of implementation. Event statistics (e.g. volunteer hours) are reported above. Vegetation planting has not yet occurred for this project, as one year of post-restoration monitoring to determine what vegetation species recruited to the restoration area was part of the initial implementation plan. Planting or seeding may be supplemented in future years. 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 November 2016, May 2017, and July 2017. Additionally, site checks were conducted bi-weekly during project implementation.

Table 3. 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

A summary of the pre- and post-restoration monitoring methods and results is included below. Note that species lists are not meant to be exhaustive, they are just identifications of the variety of flora and fauna that were seen 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.

Overall Summary of Vegetation Results

Overall results indicated a reduction in non-native vegetation cover of greater than 60% in most areas. However, this was due primarily to the initial removal of 100% of the iceplant cover and 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 off.

Some expansion or new growth of native vegetation occurred, in some areas several times greater than pre-restoration cover. Adaptive management recommendation actions to improve the condition of the project area are included in a subsequent chapter of this report to address the non-native vegetation invasion. The following Figures 4-7 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 4. New native saltgrass intermixed with desiccated iceplant in tarped restoration area (12 July 2017).

Figure 5. Mixed native and non-native vegetation assemblages (new growth) in tarped iceplant restoration area (2 May 2017).

Figure 6. Mixed native and non-native vegetation assemblages with two (new growth) iceplant plants (yellow circles) (2 May 2017).

Figure 7. Predominantly non-native vegetation assemblage (new growth), made up of sweetclover and wild radish (2 May 2017).

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. Post-restoration field surveys were conducted in November 2016, immediately following restoration efforts, and again in May 2017.

Vegetation Cover Survey Results

Site 1 transect results indicated a reduction in non-native vegetation cover from 100%, pre-restoration, to 0% during the November 2016 survey, to less than 20% non-native cover, post-restoration in May 2017 (Figure 8, top left). This indicates a reduction of over 80% non-native cover. Conversely, an

increase in native cover [saltgrass (*Distichlis spicata*)] from 0% to 1% was also quantified. The significant reduction in non-native cover was primarily due to the successful removal of iceplant from the project area. The less than 20% non-native cover was primarily new, annual "weedy" vegetation species, including: sweetclover (*Melilotus indicus*), non-native brome grasses, wild radish (*Raphanus sativus*), and Bermuda buttercup (*Oxalis pes-caprae*), though other non-native species were present [e.g. sprouts of castor bean (*Ricinus communis*)]. Much of 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 9 illustrate the vegetation transition over time from a monoculture of iceplant (Figure 9, top), to dead iceplant immediately post-restoration (Figure 9, middle), to a mix of a variety of native and non-native vegetation species (Figure 9, bottom).

Similarly, Site 2 transect results indicated a shift from 86% non-native cover to less than 25% non-native cover, a reduction of over 60%. Conversely, the native cover more than tripled from 2% to 7%, post-restoration (Figure 8, top right), primarily due to expansion of saltgrass within the restoration area and some small patches of alkali weed (*Cressa truxillensis*). Additionally, there were patches of native vegetation (again, primarily saltgrass) of up to 25% in some of the Site 2 restoration areas (Figure 10). The non-native vegetation cover was primarily sweetclover, with patches of wild radish and brome grasses mixed throughout the area.

Control results (transects surveyed outside of the restoration area and not altered during restorations) indicated stability in the predominantly native areas, with native cover ranging from 96.8% to 100% across the survey months (Figure 8, bottom left). Conversely, control results in the predominantly non-native areas indicated a dramatic rise in non-native cover (from 63.3% to 93%) and a decrease in native cover from 36.5% to 7% (Figure 8, bottom right). These control transects are indicative of the overall trend of increasing 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 the project area had high non-native cover (e.g. Figure 11 taken immediately across Culver Boulevard from the project site).

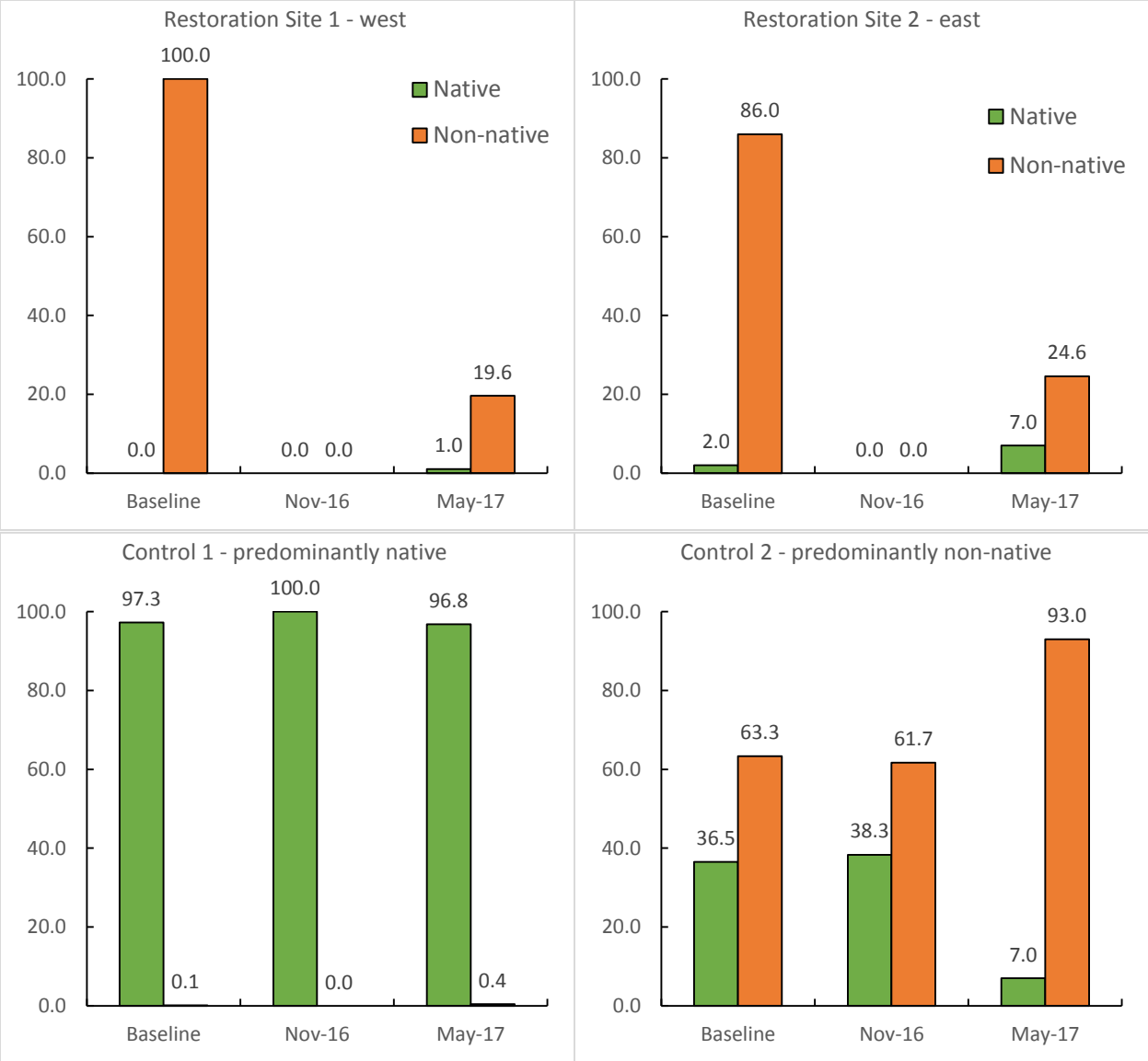

Figure 8. Vegetation data cover results from Site 1 (top), Site 2 (middle), and the control area (outside the restoration footprint; bottom).

Figure 9. Transect 5 before restoration (top), immediately post-restoration (middle), and post-restoration on 1 May 2017 (bottom).

Figure 10. Photograph of mixed nativity vegetation growth in Site 2.

Figure 11. Photograph of non-native vegetation growth outside of project site across Culver Boulevard.

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 in May 2017.

Vegetation Mapping Survey Results

Figure 12a is a map displaying dominant vegetation type within 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.

Figure 12b is a map displaying dominant vegetation type within GIS polygons classified as native, non-native, or mixed nativity. 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. Sites 1 and 2 both had some areas with new iceplant growth: 35 small individual plants sprouted in Site 1, and 5 small individual plants sprouted in Site 2. Desiccated iceplant "mulch" areas where no native or non-native vegetation re-growth has 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.

Mapping results established similar trends as the cover assessment results, in that there was some native vegetation expansion and an overall reduction in non-native vegetation as compared to pre-restoration cover; however, some areas had significant non-native vegetation regrowth into the project area, including many "weedy" invader species common in the other degraded areas of the Reserve, including immediately adjacent to the restoration project area.

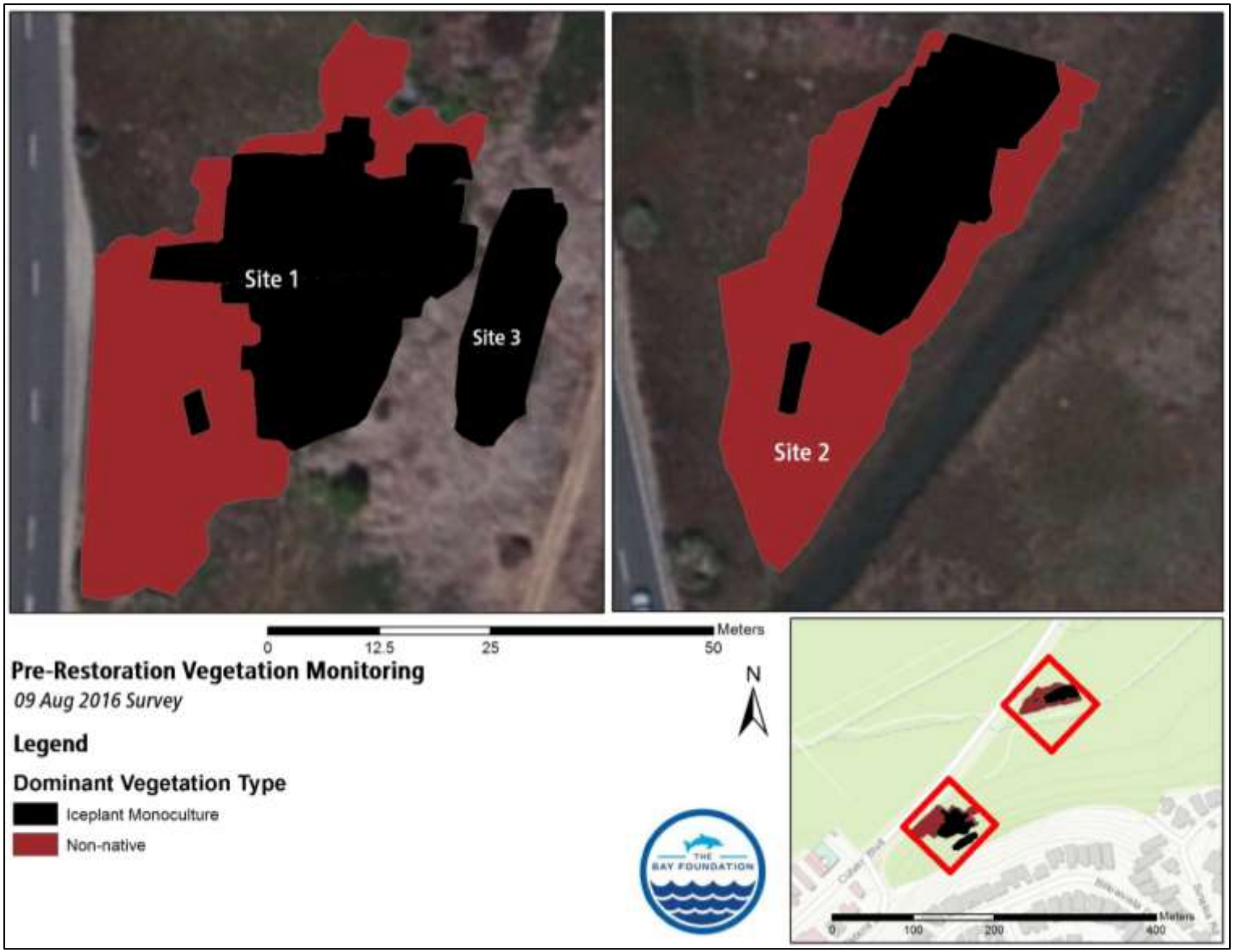

Figure 12a. Map displaying dominant vegetation type within GIS polygons during the 9 August 2016 baseline survey.

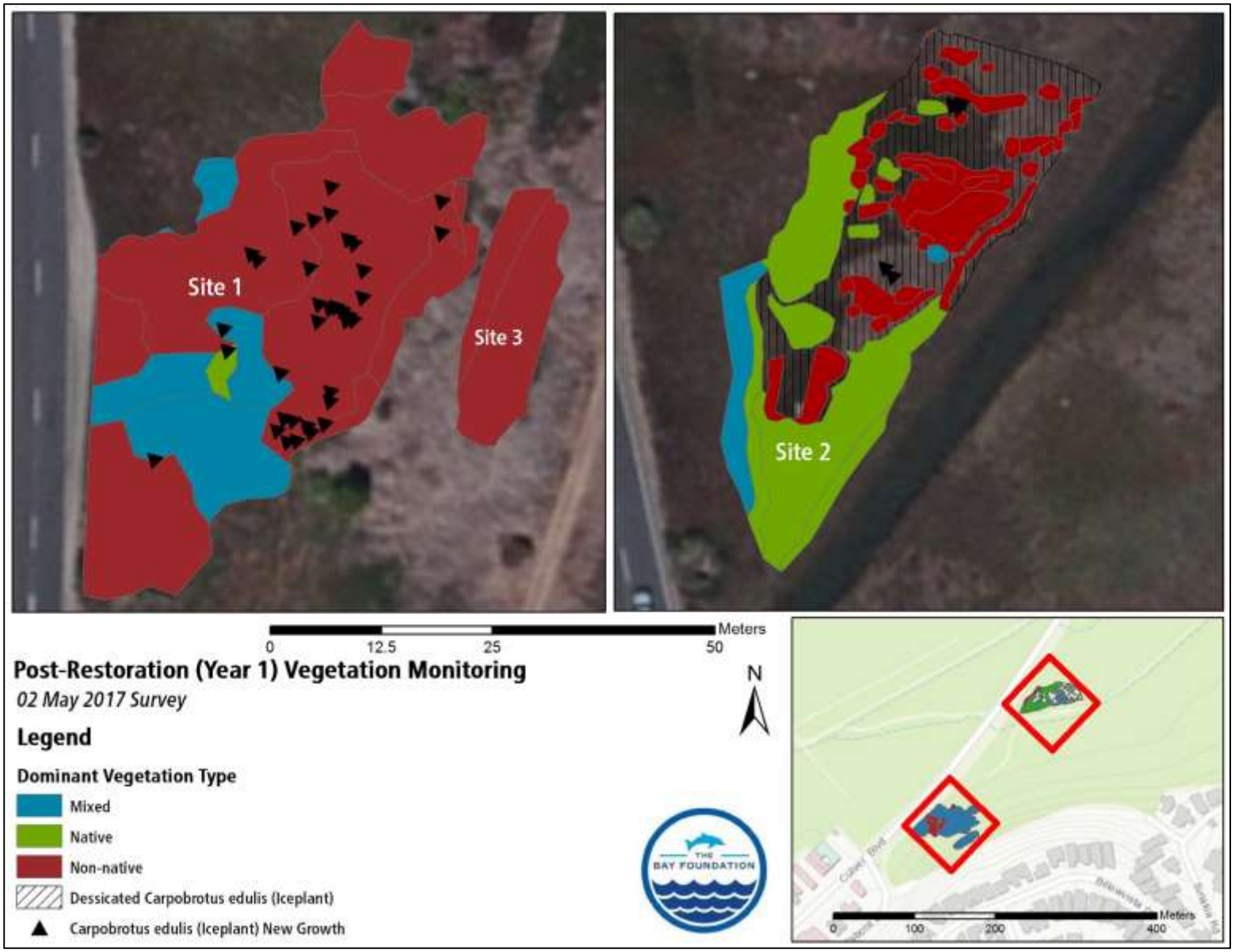

Figure 12b. Map displaying dominant vegetation type within GIS polygons during the 2 May 2017 survey.

Avifauna and Other Wildlife

No wildlife were 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, and 1 May 2017. Observational data were also collected on mammal and herpetofauna presence during the implementation of other survey protocols and during restoration events.

Avifauna and Wildlife Survey Results

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 4 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 restoration area by this species during the project was very unlikely to occur.

Table 4 displays bird presence survey results. Many of the birds were identified immediately adjacent to the project area, rather than within the restoration footprint (e.g. "Cooper" column of Table 4). This trend was exhibited during both the pre- and post-restoration surveys. One killdeer was seen within the project area on desiccated iceplant (Figure 13). 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 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.

No wildlife mortality was observed under the tarps. 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 so as to avoid disturbance during events.

During restoration events and post-monitoring surveys, a number of wildlife were seen and recorded such a number of butterflies and moths, with some occasionally photographed such as the marine blue butterfly (Figure 13). Western fence lizards and the Pacific tree frog were often observed (Figure 14). California ground squirrel burrows were also present throughout the restoration and adjacent areas, while cottontail rabbits were frequently seen along the adjacent bluffs. Table 5 displays wildlife presents results.

Table 4. Bird species identified in and around the restoration project area.

Common Name	Pre-restoration (and during) *	Post-restoration *	Cooper Ecological (5/1/17) **
Allen's hummingbird			X
Black phoebe	X		
Bushtit			X
California towhee			X
Common raven			X
Common yellowthroat			X
Cooper's hawk			
Great egret			
House finch			X
House wren			X
Killdeer		X	
Marsh wren			
Mourning dove			X
Osprey			
Pigeon			
Red tailed hawk			
Red shouldered hawk			
Savannah sparrow			
Scrub jay			
Song sparrow			X
Yellow warbler			X
Warbling vireo			X
Wilson's warbler			X

** Note: Pre-restoration (and during) survey efforts and post-restoration survey efforts are not equivalent. Additionally, those columns are specifically for species identified within the project footprint.*

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

Figure 13. Killdeer in tarped iceplant restoration area (inside yellow circle) (credit: R. Abbott, 25 April 2017).

Table 5. 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	Post-restoration
Cottontail rabbits		
CA ground squirrel	X	
Western harvest mouse		X
South Coast marsh vole		
Western fence lizard	X	
Alligator lizard	X	
Gopher snake	X	
Pacific tree frog	X	X
Wandering skipper	X	
Monarch butterfly		
Marine blue butterfly		X
Cabbage butterfly	X	X
Grey hairstreak		
Common buckeye		
Unk. black moth		X
Unk. brown moth		X

Figure 14. Marine blue butterfly in tarped iceplant restoration area (credit: R. Abbott, 12 July 2017).

Figure 15. Pacific tree frog in tarped iceplant restoration area (credit: R. Abbott, 27 April 2017).

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. Figure 16 shows an example close up of a hand restoration site where iceplant was carefully removed around native saltgrass and alkali weed. Note the expansion of several of the patches of native alkali weed and saltgrass and the dead non-native mixes grasses throughout the photograph (bottom). Figures 17 through 19 document various points within the project area to provide visual examples of the post-restoration vegetation assemblages. Although both sets of photos are from a similar perspective, the Site 1 photo series (Figure 17) is more narrowly focused; while the Site 1 and 3 series (Figure 19) is zoomed out to capture both areas simultaneously.

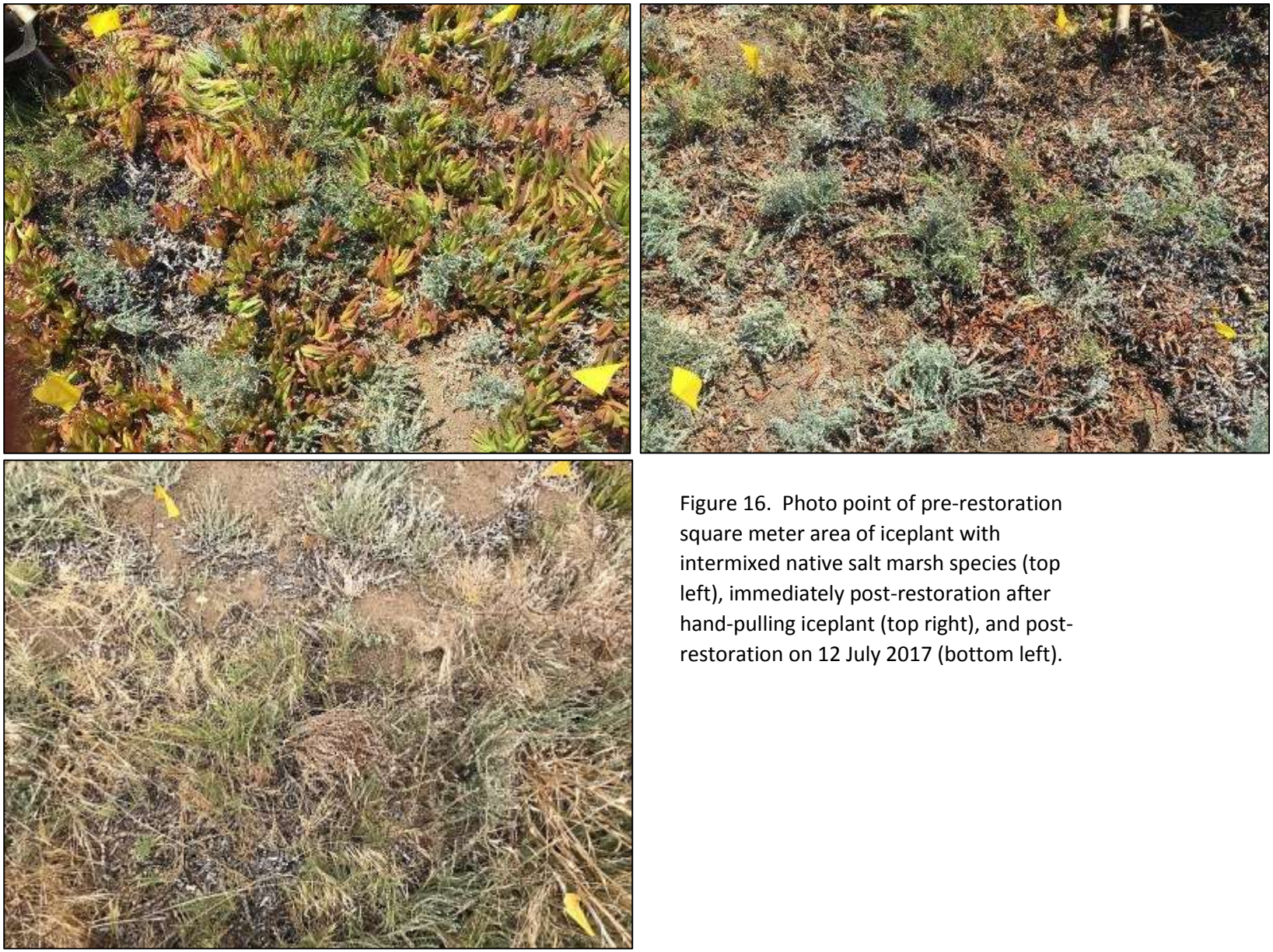

Figure 16. Photo point of pre-restoration square meter area of iceplant with intermixed native salt marsh species (top left), immediately post-restoration after hand-pulling iceplant (top right), and post-restoration on 12 July 2017 (bottom left).

Site 1 Photographs

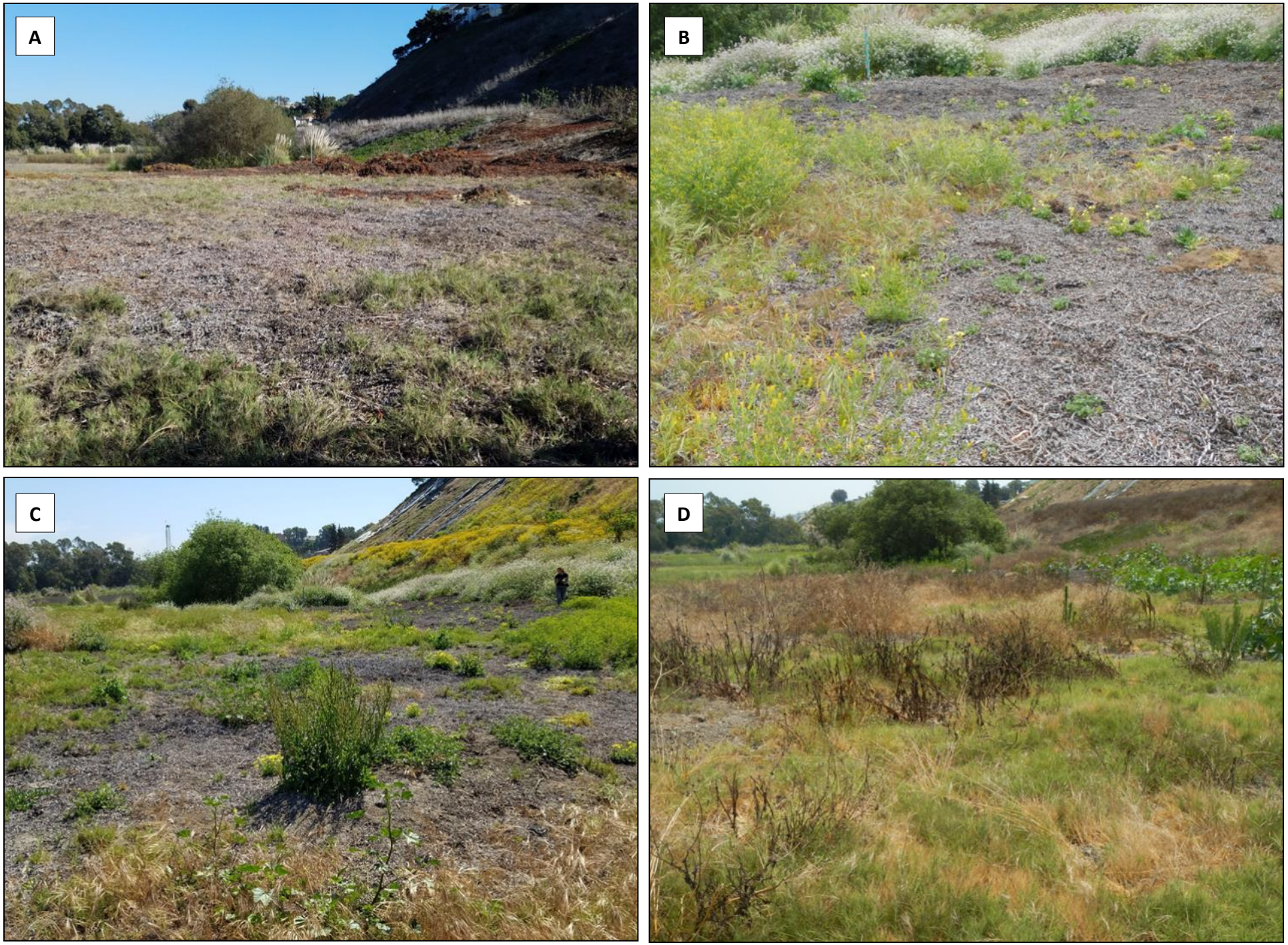

Figure 17. Photographs of Site 1 and 3 on (A) 29 November 2016; (B) 25 April 2017; (C) 2 May 2017; (D) 12 July 2017.

Site 1 Photographs

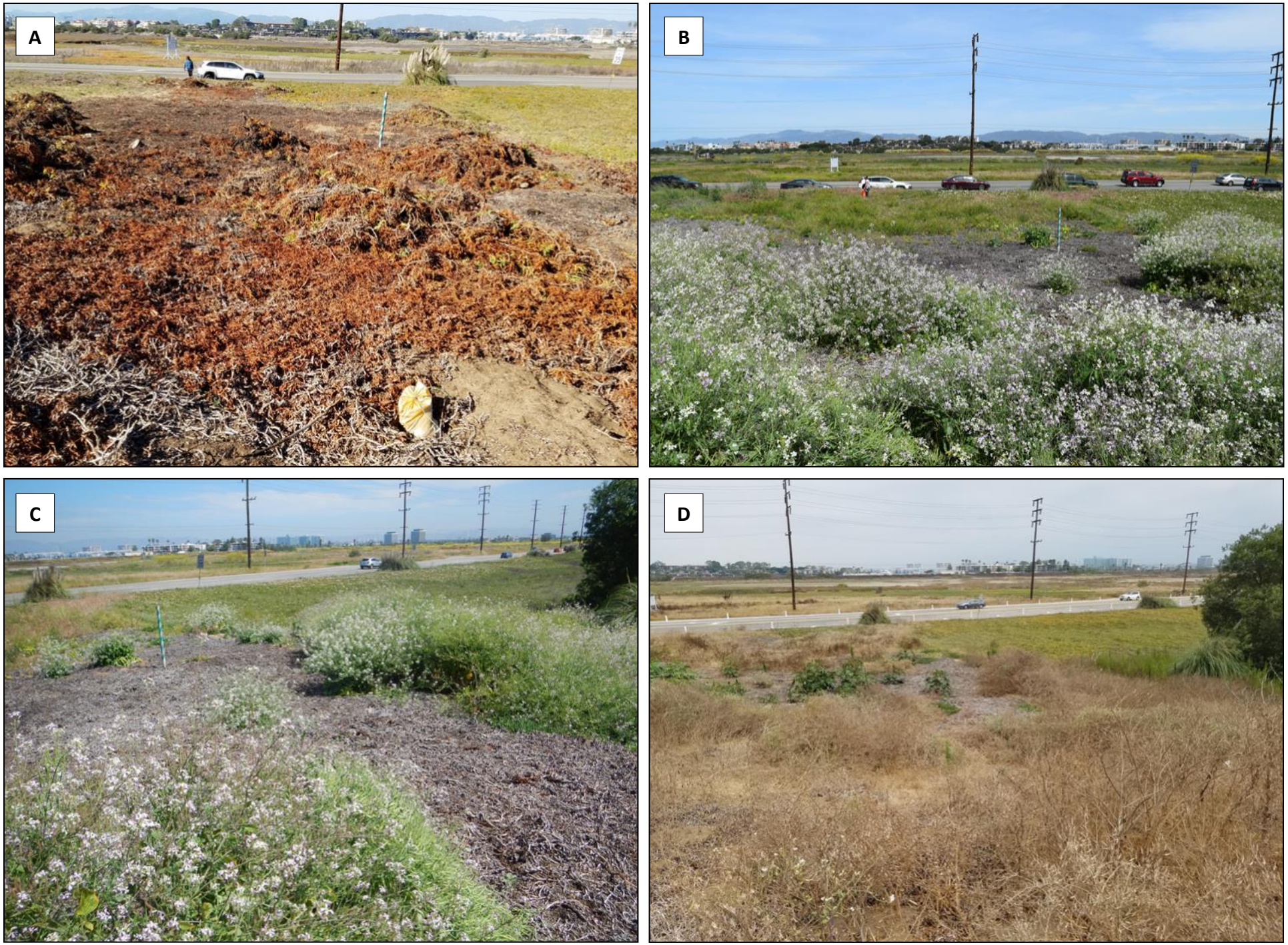

Figure 18. Photographs of Site 1 and 3 on (A) 29 November 2016; (B) 25 April 2017; (C) 2 May 2017; (D) 12 July 2017.

Site 2 Photographs

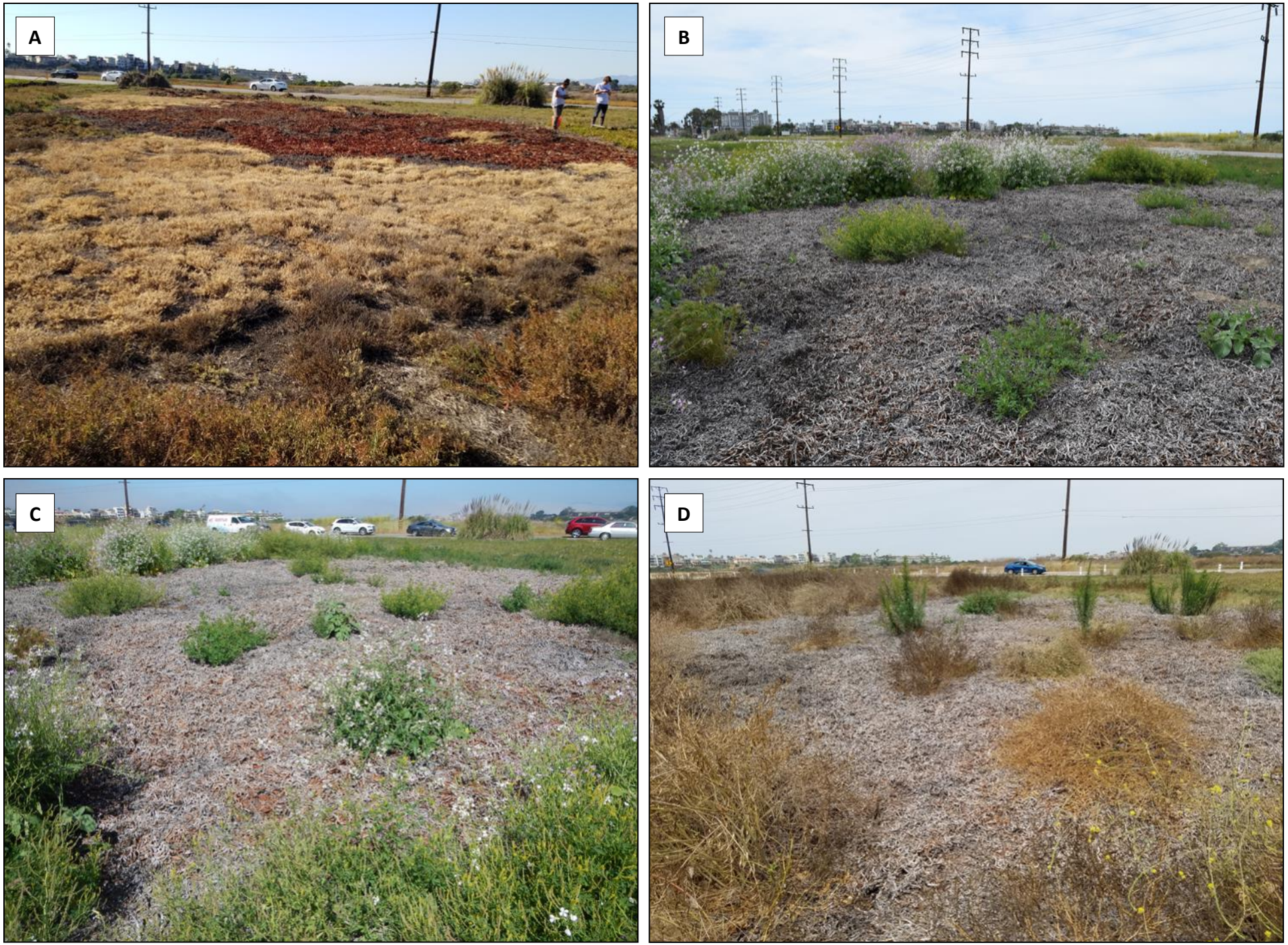

Figure 19. Photographs of Site 2 on (A) 29 November 2016; (B) 25 April 2017; (C) 2 May 2017; (D) 12 July 2017.

Permitting

TBF, in coordination with the California Department of Fish Wildlife (CDFW), has obtained the necessary permits to implement the Ballona Wetlands Community Iceplant Removal Project. On 10 March 2016, the California Coastal Commission 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) The 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 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 3 months versus 2 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 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. In an attempt to resolve objections made from Ballona Wetlands Land Trust (BWLT), TBF's Executive Director and Watershed Programs Manager met with Mr. Walter Lamb, representing BWLT, on 9 May 2017. The earliest local public Commission meeting was scheduled for August 2017. Monitoring of the site has continued; however, the "material" permit amendment process has prevented TBF from being able to conduct spot-removal of weedy vegetation that came up following heavy winter rains, thus negatively impacting the restoration process.

On 27 June 2017, a revocation request was submitted to the Commission by BWLT. The revocation request (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 interested stakeholders in an effort to understand and address ongoing concerns with the project. Coordination and communications are ongoing with CDFW and Commission staff.

All reports for this project are made publically available on TBF's website: www.santamonicabay.org. The annual reporting time period is August through July of the following year.

Challenges

The challenges identified in the first report completed just after the implementation of the iceplant removal was completed (December 2016) were two-fold, including a misunderstanding by the public of the impacts of the tarp restoration method on iceplant and associated wildlife, and the initial lack of 100% success using the tarping method due to too short of a deployment period. Regarding the first challenge, there was unanimous consensus from the scientific community surveyed prior to the implementation of this project that the tarping method was a successful, low-impact, and cost-effective removal method for iceplant that would not harm wildlife. However, the several members of the public did not agree, and thus a full CDP process through the Coastal Commission commenced. Conclusions drawn from the implementation of this project support the scientific evaluations for similar projects throughout southern California; notably, that there was no wildlife mortality underneath the tarps. In fact, western fence lizards, alligator lizards, and Pacific tree frogs were numerous in and around the restoration area. No wildlife mortality was caused by the tarping restoration method.

Regarding the second challenge, the early-onset rains and restrictive timing on the permit conditions forced the tarps to be pulled prior to the full desiccation of the iceplant in several areas. While much of the site still had significant desiccation, an extension of the duration of tarp placement should solve the problem in future years. This challenge was addressed in Year 1 through the addition of several supplemental restoration events to pull the remaining iceplant from the project area that had not fully desiccated, and an application was submitted to the Coastal Commission for an extension of the tarping deployment period via a permit amendment (see Permit section for details).

A new challenge for this reporting period was the heavy onset of rains in the winter of 2016/17 leading to significant growth of annual, "weedy" non-native vegetation species. Over 16 inches accumulated in this reporting year through the end of March 2017, as compared to approximately 7 inches the previous water year (NOAA California Nevada River Forecast Center, accessed July 2017). Due to the high level of degradation of the Reserve, and the significant presence of non-native vegetation immediately adjacent to the project site, non-native vegetation growth occurred in some areas after the initial iceplant removal. Long-term restoration of the project site will likely require a period of ongoing effort to remove non-native, invasive vegetation (e.g. Table 6), and continued monitoring will inform necessary adaptive management decisions (see subsection below). Supplemental planting or seeding of native vegetation will continue to be considered as part of the project's Monitoring and Implementation Plan.

An additional new challenge for this project was that concerns about the permit amendment (expansion of restoration event timing) were expressed by a stakeholder group to the Coastal Commission; therefore, management actions to remove non-native vegetation through restoration events were not able to occur beginning in the spring. The group subsequently filed a revocation request against the permit, requiring a wait of several months until the Commission convened a local hearing in Los Angeles.

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 future efforts both at this site and other wetlands throughout southern California.

Adaptive Management Strategies

Monitoring combined with adaptive management actions can help address restoration challenges, if the permit amendment is approved. Without the amendment, weed management within the restrictive permit conditions would be extraordinarily difficult. Weed succession refers to the growth of other weed species following the removal of one type of vegetation. Following initial efforts to remove iceplant in the project area, California experienced heavy winter rainfall that helped both native and non-native plants to grow. 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 re-growth present in a few areas, many other non-natives (including both perennials and annuals) have now invaded the site. TBF will focus on removing the dominant invaders, listed in Table 6, during Year 2 restoration activities. Community restoration events will be held that strategically target non-native vegetation growth on-site using species-specific removal strategies as described below.

Non-native vegetation removal efforts will be focused on the restoration footprint of Year 1 first, and if time and resources allow, expand out of the Year 1 footprint. Additionally, TBF will not be deploying tarps to solarize iceplant during Year 2 activities. Re-vegetation protocols will continue to be considered as monitoring progresses and after Year 2 restoration activities have been completed. Volunteer participants during Year 2 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.

Ongoing Maintenance

Year 2 restoration activities will focus on strategically controlling non-native vegetation within the Year 1 restoration footprint first, followed by expansion into the larger project area if time and resources allow. Currently, allowed work is limited in scope to outside the flowering and seeding season for many invasive species. A much more effective weed abatement program could begin if the Coastal Commission approves the amendment request.

Perennial non-native invaders including iceplant re-growth, castor bean, Geraldton carnation weed, and Bermuda buttercup should be controlled first, followed by annual non-native invaders including wild radish, crown daisy, common sowthistle, sweetclover, scarlet pimpernel, bromes, and additional non-native species observed (Table 6). Removal of the non-natives should be targeted by flowering period for each individual species for maximum effectiveness (Table 7). The following sections provide details for the dominant vegetation invaders present within the restoration project area and suggested control methods. All control methods proposed on site for Year 2 are manual and will not require the use of herbicides. Table 6 and Table 7 summarize maintenance information by species. All removed non-native plant material will be disposed of offsite.

Table 6. Summary of weed maintenance adaptive management strategies by species (non-natives).

Scientific Name	Common Name	Growth Type	2017 Removal Technique	Future Recommendations
Bromus spp.	Brome grasses	Annual	Hand removal by roots or weed-wrench	Weed-wacker before seeding or hand removal by roots before seeding
Carpobrotus spp.	Iceplant	Perennial	Hand removal by roots	Hand removal by roots; solarization through tarping
Euphorbia terracina	Geraldton carnation weed	Perennial	Bag seeds; Hand removal by roots or weed-wrench	Hand removal by roots or weed-wrench before seeding
Glebionis coronarium	Crown daisy	Annual	Hand removal by roots or weed-wrench	Hand removal by roots or weed-wrench before seeding
Lysimachia arvensis	Scarlet pimpernel	Annual	Hand removal by roots or weed-wrench	Hand removal by roots or weed-wrench before seeding
Melilotus indicus	Sweetclover	Annual	Hand removal by roots or weed-wrench	Weed-wacker (or clipping) before seeding or hand removal by roots before seeding
Oxalis pes-caprae	Bermuda buttercup	Perennial	Hand removal by roots	Hand removal by roots or weed-wrench before seeding
Raphanus sativus	Wild radish	Annual	Bag seeds; Hand removal by roots or weed-wrench	Weed-wacker (or clipping) before seeding or hand removal by roots before seeding
Ricinus communis	Castor bean	Perennial	Bag seeds; Hand removal by roots or weed-wrench	Hand removal by roots or weed-wrench before seeding
Sonchus oleraceus	Common sowthistle	Annual	Hand removal by roots or weed-wrench	Hand removal by roots or weed-wrench before seeding

Table 7. 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												

Perennial Non-native Species

Carpobrotus spp.

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*) is present in an area within Site 1 and 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). The present Geraldton carnation weed is not dispersed throughout the project area, but rather confined to a patch. 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 be removed by hand, bagging those 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).

Oxalis pes-caprae

Bermuda buttercup (*Oxalis pes-caprae*) 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.

Ricinus communis

Castor bean (*Ricinus communis*) 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). Castor bean has been documented sprouting within Site 1 and Site 3 of the project site and will be removed using manual methods. 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.

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 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. Bromes were found intermixed in iceplant removal areas in spring and were dead by mid-summer. These non-natives should be removed prior to seeding by hand removal. Some recommendations for removal include using a weed-wacker to cut off the tops (flowering heads and seeds) of these grasses in areas dominated by these species for maximum cost-effectiveness.

Glebionis coronaria

Crown daisy (*Glebionis coronaria*) 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 if not removed can also prevent native plants from recolonizing (Tuttle et al. 2011). Crown daisy can be removed by hand or weed wrench.

Lysimachia arvensis

Scarlet pimpernel (*Lysimachia arvensis*) is a small annual (can be biennial) non-native broadleaf herb that is present in Site 1 and 3 in minimal scattered patches. If consumed, it can be toxic to livestock and humans (UCIPM). The species is commonly found in man-made and disturbed habitats and is tolerant of wetland habitats. 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.

Melilotus indicus

Sweetclover (*Melilotus indicus*) is a 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.

Raphanus sativus

Wild radish (*Raphanus sativus*) 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 3 feet or taller and reproduce only by seed. Seeds can remain viable for long periods of time and can germinate in spring on fall depending on weather. Wild radish is present in all restoration sites and has likely gone to seed by the time TBF is allowed to conduct post-restoration maintenance. 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.

Sonchus oleraceus

Common sowthistle (*Sonchus oleraceus*) 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 4 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.

Re-vegetation of the Project Area

The first step of re-vegetation allows for a passive evaluation of natural native vegetation recruitment based on the existing seed bank. This scientific evaluation may occur for a period of 1-3 years after iceplant removal, depending on funding, vegetation recruitment, and preferences of CDFW as the land managers.

Subsequently, active re-vegetation of the restoration area may occur in two ways through an iterative adaptive management and monitoring process. Both hand-seeding and container planting may occur, with the specific protocols to be implemented depending on recruitment success. At the request of CDFW, re-vegetation protocols that involve no soil disturbance have been prioritized.

If subsequent post-restoration monitoring shows poor native plant recruitment or minimal species richness (e.g. only one species recruiting), then hand-seeding to supplement the native plant recruitment may be considered. Broadcast dispersing of native vegetation seeds and cuttings by hand in the restoration area would occur as part of this protocol. No soil disturbance would occur. If recruitment of native vegetation occurs using this method, no further actions are required other than post-restoration monitoring.

Targeted infill plantings with native species in the restored areas may be conducted, based on the success of the natural recruitment protocol and hand-seeding protocol implementation. Small, native (1 gallon or smaller) container stock may be considered if the previous re-vegetation protocols are insufficient to achieve native vegetation recruitment. The plant palette reflects hardy, salt-tolerant species which can also withstand seasonal reduced hydrology. Vegetation planted on the site will consist of native plants present in the Reserve. The plant palette will be developed in greater detail, along with a final planting plan, after the first growing season to adaptively manage the restoration area and allow for maximum potential natural native plant recruitment to take place. 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:

> **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*.

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 (before the 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. In fact, several groups of students are already interested in participating in Year 2 events, pending Coastal Commission approval.

However, while the initial results of the tarping and hand-pull restoration efforts successfully removed iceplant; based on the challenges described above, there has been an influx of additional non-native species. The non-native cover of vegetation increased in areas outside of the project area as well, thus suggesting that the surrounding area suffered from non-native vegetation invasion as well as the project area. Many of the annual non-native species died out over 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. Adaptive management will allow for non-native vegetation removal in future years, as restoration efforts continue, and potentially the supplemental addition of native vegetation species, if needed. Saltgrass appears to be expanding within the restoration area, in some places more than doubling its previous cover 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.

While the initial efforts specifically at iceplant removal were successful, with minimal re-growth of iceplant, additional restoration events are needed to continue to remove the few iceplant sprouts and other non-native invaders in the future. Widening the permitted window for restoration activities through the permit amendment will help facilitate these additional events and additional opportunities for the community and students.

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