



# Zedler Marsh Enhancement Project *(amended)*

Recipient: Los Cerritos Wetland Trust  
Project Period: 08/01/2019 – 10/28/2022  
Award Amount: \$96,965  
Matching Contributions: \$228,638.31  
Project Number: #8006.19.066151

## Summary of Accomplishments

Initial baseline monitoring for the Zedler Marsh Enhancement Project (Project) took place in September and October of 2019. Data were collected, entered, and analyzed for percent cover of native species, non-native species, and unvegetated ground. Soil sampling was performed on a semi-annual basis, with samples collected in winter and summer. Soil samples were analyzed for both percent moisture and salinity levels. After baseline monitoring was completed, vegetation monitoring was carried out in both salt marsh and mulefat scrub plant communities on a quarterly basis for the duration of the project. Prior to plant installment, the salt marsh and mulefat scrub restoration sites were prepared by weeding, tilling, and addition of nutrients in certain areas. A total of 25 community-based restoration events were conducted for the Project, including installation of plants within Zedler Marsh's salt marsh and mulefat plant communities.

After completing the enhancement and preliminary monitoring period during the first two years of the project, restoration efforts were focused on continuing site maintenance by providing consistent weeding and irrigation efforts, along with supplemental plantings. As a result of restorative efforts, biological monitors observed an increase in native vegetative cover as compared to the baseline surveys. Subsequently, the native cover has remained stable at approximately 50%, with some fluctuations seasonally and annually. Substantial increases in soil moisture and decreases in soil salinity for both the salt marsh and mulefat scrub habitats were also observed over time. In addition to vegetation and soil surveys, Belding's Savannah Sparrow (BSS, *Passerculus sandwichensis beldingii*) and Least Bell's Vireo (LBV, *Vireo bellii pusillus*) surveys were conducted biweekly during the breeding season of each year to monitor change in populations as restoration activities were conducted. During this three-year period, the number of observed BSS breeding territories increased from six to nine. No discernable LBV breeding territories were identified throughout the project's timeline; however, a single LBV was observed in April 2020, which may indicate improving habitat conditions. Site conditions have improved overall since the initiation of the project and are on a strong trajectory of improved habitat. These changes bode well for future plant establishment and habitat enhancements relating to BSS and LBV habitat.

## Project Activities & Outcomes

Project activities and outcomes were set forth by establishing three separate goals. Goal 1 was to enhance 0.5 acres of coastal salt marsh habitat in Zedler Marsh at Los Cerritos Wetlands. Expected outcomes of Goal 1

were to vegetate any bare areas of Zedler Marsh with salt marsh vegetation used by BSS for breeding activities through non-native removal, irrigation installation, native plant propagation and installation, and buffering existing tidal marsh areas from urban impacts. As part of this goal, two special status plant species were to be included in the revegetation efforts. Goal 2 was to restore up to 4 acres of mulefat scrub habitat adjacent to Zedler Marsh. Expected outcomes for Goal 2 were to vegetate Zedler Marsh with mulefat scrub vegetation used by LBV for nesting activities, Design and implement a LBV monitoring program to produce the first formal documentation of the species at Zedler Marsh, and to include at least 2 special status plant species in the revegetation efforts. Finally, Goal 3 was to involve community-based restoration programs in the project. Expected outcomes for Goal 3 included engaging with 500 volunteers in up to 20 monthly community-based habitat restoration events at Zedler Marsh and to host up to 5 service-learning field trips in which local K-University students would learn about Los Cerritos Wetlands while simultaneously engaging in restoration activities. Quantitative outcomes will be the installation of 3,000 total native plants, establishment of 2 special status plant species within Zedler Marsh, and removal of hundreds of pounds of nonnative plant material. A longer-term outcome will be that BSS and LBV populations in Los Cerritos Wetlands will increase.

### **Goal 1: Enhance 0.5 acres of coastal salt marsh habitat in Zedler Marsh at Los Cerritos Wetlands**

To help meet the three outcomes and meet the goal of restoring 0.5 acres of salt marsh, throughout the length of the project Tidal Influence installed 1,987 salt marsh plants of various species including common pickleweed (*Salicornia pacifica*) and Parish's glasswort (*Arthrocnemum subterminale*). These species were selected as part of the plant palette due to their use as breeding habitat for BSS. The plant palette also included special status plant species estuary seablite (*Suaeda esteroa*) and woolly seablite (*Suaeda taxifolia*) and were installed throughout the areas. Plants for this project were all sourced from within the Los Cerritos Wetlands from seed, cutting, or propagule. Prior to installation the soil conditions were aerated by tilling and mixed with gypsum to reduce soil salinities. Following planting this area of the salt marsh received weekly supplemental irrigation through a temporary dripline that was installed to provide additional freshwater input for the recently planted vegetation during the establishment periods. This irrigation was useful during the relatively dry wet season we experienced these past years. Overall, the work has maintained an increased native vegetation coverage when compared to the project's first year. In addition to plant installation and irrigation, regular vegetative maintenance was conducted by Tidal Influence staff by removing trash and non-native plants. In conjunction with monitoring to assess habitat improvements, a BSS's monitoring program was adapted to support vegetative monitoring data. Surveys were conducted every year during breeding season to monitor BSS breeding and territorial behavior. Through the duration of the project Tidal Influence staff observed a change from 6 breeding territories in 2019 to a total of 9 breeding territories at Zedler Marsh in 2022. This is consistent with the 9 breeding territories identified within Zedler Marsh in 2020 and 2021 and overall is an increase of 3 breeding pairs since 2019. This stabilization in breeding territories is likely due, in part, to the successful establishment of new salt marsh habitat.

### **Goal 2: Restore up to 4 acres of mulefat scrub habitat adjacent to Zedler Marsh**

To help meet the three outcomes that satisfy the goal of restoring 4-acres of mulefat scrub habitat throughout the length of the project, Tidal Influence staff installed a total of 2,023 plants within the mulefat habitat that surrounds Zedler Marsh. The plant palette included species regularly used as LBV nesting habitat such as Arroyo willow (*Salix lasiolepis*) and mulefat (*Baccharis salicifolia*). Among the native plants in the plant palette were special status plants such as woolly seablite (*Suaeda taxifolia*) and California boxthorn (*Lycium*

*californicum*). In some areas of the mulefat scrub the soil was aerated via tilling prior to planting. Mulch was also added in planted areas to facilitate plant growth. Following planting, mulefat scrub habitat was maintained through irrigation installation, weekly watering, and non-native removal, as well as additional mulching efforts. A monitoring program was developed to survey the state and federally endangered LBV at Zedler Marsh. During our surveys for the 2022 breeding season, we conducted bi-weekly surveys at Zedler Marsh, beginning in February 2022 through August 2022. During this period, we did not observe the lone LBV individual that was observed sporadically throughout the last few years, however the previous sightings show that continued growth and increased density of mulefat scrub vegetation may provide enhanced LBV habitat in the future.

### **Goal 3: Involve community-based restoration programs in the project**

Since work on this project began, Tidal Influence has hosted 25 community-based habitat restoration events at Zedler Marsh, engaging a total of 1,098 community members. With restrictions being lifted on public gatherings in Los Angeles County, Tidal Influence will be able to continue hosting programs throughout 2022. In addition to regular monthly programming, Tidal Influence hosted numerous special volunteer events including Belmont Heights' Make a Difference Day, a special Earth Day restoration event, and a group volunteer event for Southern California Edison employees among others. During these events volunteers assisted in the installation of both salt marsh and mulefat scrub plants, irrigation installation, and removal of non-native vegetation. Zedler Marsh was also host to a number of environmental education programs hosting students from Heroes elementary, CSU Long Beach, Cal Poly Pomona as well as participating in the City of Long Beach's BeSAFE program. Through 25 months of community-based restoration programming, Tidal Influence and volunteers were able to remove 4,236 pounds of non-native vegetation, trash, and marine debris from Zedler Marsh, and installed a total of 4,010 plants.

### **Vegetation Coverage**

Permanent vegetation monitoring transects were established in two different plant communities: southern coastal salt marsh and mulefat scrub. Vegetation surveys were performed to determine percent cover. For the salt marsh, three transects were surveyed, and eight random quadrats were assigned along each transect, for a total of 24 quadrats. For the mulefat scrub, a total of 26 random quadrats across 10 transects were surveyed. For this reporting period, vegetation monitoring was performed on 9<sup>th</sup> November 2021, 9<sup>th</sup> February 2022, and 15<sup>th</sup> July 2022. While vegetation monitoring was completed throughout the year, a comparison between the summer seasons from each year were selected to allow plant species to reach maximum foliar growth. Within the area dominated by the southern coastal salt marsh vegetation community, native plant coverage was at 47.0% which is a 5.9% decrease from 52.9% cover this time last year. The species that were most prevalent included common pickleweed (*Salicornia pacifica*) at 22.0%, alkali heath (*Frankenia salina*) at 8.9%, and fleshy jaumea (*Jaumea carnosa*) at 3.7% cover. These species were also dominant last year. Unvegetated ground cover made up the remainder of the area at 53.0%, a 5.9% increase since 2021.

Table 1. Percent Cover for the salt marsh vegetation community (2019-2022).

Monitoring Date	Native Vegetation % Cover	Non-native Vegetation % Cover	Unvegetated Ground % Cover
September 13 <sup>th</sup> , 2019	44.4	0.0	55.6
August 25 <sup>th</sup> , 2020	45.8	0.0	54.2
August 13 <sup>th</sup> , 2021	52.9	0.0	47.1
November 9 <sup>th</sup> , 2021	53.7	0.0	46.3
February 9 <sup>th</sup> , 2022	43.8	0.5	55.8
July 15 <sup>th</sup> , 2022	47.0	0.0	53.0

The decreases in native coverage this year compared to 2021 may be a result of multiple factors, most notably a reduction in planting and soil amendment efforts within the salt marsh. This combined with the harsh soil salinities and ongoing drought conditions are likely contributing factors that affected growth and establishment. This is further supported by the monitoring data in 2020 and 2021, years in which active site improvements were made, showing a notable improvement to native vegetation (7.1% increase) and unvegetated ground cover (7.1% decrease). Though native vegetative coverage decreased from 2021, coverage is still higher than the initial value reported in September 2019 by 2.6% and overall has remained stable since restoration efforts began. Coverage values also vary widely as a result of quadrat randomization as well as seasonal and annual fluctuations. Unvegetated ground cover also decreased by 2.6% since monitoring began in September 2019. Finally, while there has not been substantial change in the salt marsh non-native vegetation, it is notable that over the three-year period since monitoring and maintenance began non-native vegetation coverage has remained consistently below 1%. This is likely due to the combination of high soil salinities preventing establishment within the salt marsh and the consistent upkeep the site has received by Tidal Influence staff and community volunteers.

Soil conditions have limited the opportunity for vegetative enhancement of the salt marsh habitat within Zedler Marsh; however, restoration efforts in combination with continuous site maintenance has resulted in improvements to native plant cover, reductions in unvegetated cover, and kept the presence of non-native plant species consistently low. Based on the improvements we've seen to Zedler Marsh over the 3-year restoration period, we believe Zedler Marsh can be further improved as BSS habitat if provided additional soil amendments in combination with regular maintenance and plant care.

Table 2. Percent coverage for the mulefat scrub vegetation community (2019-2022).

Monitoring Date	Native Vegetation Percent Coverage	Non-native Vegetation Percent Coverage	Unvegetated Ground Percent Coverage
October 17 <sup>th</sup> , 2019	40.6	2.7	56.7
August 25 <sup>th</sup> , 2020	52.2	4.5	42.8
August 13 <sup>th</sup> , 2021	50.8	2.0	47.2
November 9 <sup>th</sup> , 2021	34.3	0.8	64.9
February 9 <sup>th</sup> , 2022	38.8	7.2	54.2
July 15 <sup>th</sup> , 2022	50.8	0.7	48.5

Native vegetation within the mulefat scrub covered 50.8% of the total area surveyed in July 2022 remaining consistent with the 50.8% cover achieved in August 2021. The most prevalent species found in this area was coastal goldenbush (*Isocoma menziesii*) at 8.4%, salt grass (*Distichlis spicata*) at 7.8%, and coastal sage brush (*Artemisia californica*) at 6.6% cover. Non-native vegetation coverage was 0.7%, 1.3% lower than what was observed in August 2021. The only non-native species found were fivehook bassia (*Bassia hyssopifolia*) at 0.7% and rabbitsfoot grass (*Polypogon monspeliensis*) at 0.03%. The unvegetated ground made up the remainder of 2022 coverage at 48.5%, a 1.3% increase from August 2021.

Although there were no major improvements in native vegetative coverage in mulefat habitat this year, native coverage overall appears to be stable at just over 50% during the same time period this year compared to both 2020 and 2021. In comparison to the initial native vegetation coverage of 40.6% reported in October 2019, the 50.8% cover in 2022 shows an increase of 10.2% cover. A similar stability trend occurred in the non-native vegetative metric with coverage remaining consistently below 5%. Overall unvegetated cover has decreased 8.2% below unvegetated cover observed in October 2019.

Several factors likely contributed to the steady improvement and stabilization of the restoration areas, including diligent care for the native vegetation through consistent irrigation, installation of new plantings and soil improvement techniques such as mulching to improve water retention, improve soil structure, increase organic content, and providing a topsoil layer. During this performance period Tidal Influence staff and volunteers controlled non-native vegetation through hand removal. Hand removal was supplemented by the addition of mulch to suppress and obstruct non-native seeds by preventing establishment.

### Soil Surveys

Soil surveys involved sampling a total of 24 locations along the same transects used for the vegetation monitoring. Soil pastes were created and used to determine salinity and moisture levels. Most soils in the salt marsh this year continued to be hypersaline with an average salinity of 50 parts per thousand (ppt); however, this value is 28 ppt lower than 78.3 ppt observed in August 2021 and significantly lower than the >100 ppt reported in 2019. Average salt marsh moisture observed this year was 14.4%, a 12.9% increase from the value observed last year and 9.3% higher than the soil moisture reported in 2019. Overall salinity and moisture levels for the salt marsh restoration site have been improved since monitoring began. The change in salinity

and moisture levels may be due to previous soil amendment efforts such as soil aeration via tilling, addition of salt amending nutrients such as gypsum, as well as the installation and regular use of a freshwater irrigation system.

While salt marsh soil salinity levels have decreased, they have remained at a level that is likely to hinder plant growth. If the hypersaline conditions persist, plant establishment will continue to be hindered unless additional soil amendments are considered. However, despite the challenging soil conditions, the hard work put in by Tidal Influence staff and volunteers has led to the successful stabilization of, and overall improvement of the salt marsh habitat.

Average mulefat scrub salinity from samples taken in July 2022 were 16.1 ppt. This is a 7.1 ppt increase from the 8.9 ppt obtained in August 2021. Although the salinity throughout the mulefat scrub did increase from August 2021 to July 2022, overall salinity has significantly reduced from 28.8 ppt, near ocean water levels, reported in October 2019. Average mulefat scrub moisture in July 2022 was 2.1%, this is a 1.6% increase from values observed in August 2021 and 2019. The increase in moisture may be attributed to the extensive mulching performed throughout the site, increasing water retention as well as improving vegetative coverage by providing additional shading from summer heat.

While the mulefat scrub soil salinity has decreased they remain at high enough levels to hinder mulefat scrub growth. However, the consistent care the site has received from our team and volunteers including watering, irrigation installation, tilling, and mulching throughout the three years of the project have led to overall soil condition improvements since the project began in 2019. If site care and amendments are to be continued it is possible that conditions may further benefit the mulefat scrub habitat within Zedler Marsh.

Table 3. Results of soil samples (2019-2022)

Monitoring Date	Salt Marsh Average Moisture %	Salt Marsh Average Salinity (ppt)	Mulefat Average Moisture	Mulefat Average Salinity (ppt)
October 11 <sup>th</sup> , 2019	5.1	>100	0.5	28.8
August 25 <sup>th</sup> , 2020	3.7	72.5	1.2	24.6
August 13 <sup>th</sup> , 2021	1.5	78.3	0.5	8.9
March 1 <sup>st</sup> , 2022	15.1	74.3	7.9	15.0
July 15 <sup>th</sup> , 2022	14.4	50.0	2.1	16.1

## Lessons Learned

Across the three years of restoration, many important observations were made regarding site conditions, the state of the vegetative plant life, and their response to monitoring and maintenance activities. Through these observations, many lessons were learned that will prove vital to the continued restoration and improvement of the salt marsh and mulefat habitats at Zedler Marsh. One of the more important lessons learned is on the critical role soil condition plays when restoring salt marsh and mulefat plant communities. The soil salinity level in both habitats on site were higher than normal for vigorous plant establishment and growth. The salt

marsh habitat soil salinity initially measured in at over 100 ppt in 2019, and the mulefat habitat initially measured in at 29 ppt, which is near ocean water salinity (30-35 ppt). While salt marsh and mulefat scrub plants can tolerate certain salinity levels and stressors, the salinity levels observed within each of the restoration types were higher than what can naturally be tolerated by these species. However, through restoration efforts the data has shown that when soil amendments are applied in combination with proper care and maintenance, favorable conditions for the restoration sites can be achieved.

If future restoration efforts are conducted, it is recommended that more intensive care and soil augmentations be applied to promote native vegetative success. These augmentations should include tilling of compacted soils, addition of soil amendments such as gypsum to reduce soil salinities, continued plant installation and replacement plantings, and increased mulching to improve water retention and organic content. These augmentations would all be in addition to regular supplemental irrigation and non-native plant control. Along with these augmentations and regular maintenance, a more comprehensive soil monitoring program including collecting a small number of samples that would be sent off for agronomic testing. The results of this testing would allow for a greater understanding of the soils to determine what amendments may be needed and what adaptive management actions would allow the habitat to thrive. Additionally, we recommend greater mulch integration through tilling into soils in areas within the mulefat scrub habitat that continue to have high unvegetated ground coverage.

These recommendations may help steer the restoration sites towards more successful establishment of native vegetation and provide a more robust habitat for BSS and LBV in the future. While the active restoration, maintenance, and monitoring on behalf of NFWF has come to an end, Tidal Influence staff is dedicated to involving community volunteers in the continued restoration of Zedler Marsh and will continue regular maintenance of the site to sustain vegetative coverage and preserve current and future suitable BSS and LBV habitat.

## Dissemination

The restorative methods used, and lessons learned from this project are often disseminated to the public via educational programs such habitat restoration events, environmental education field trips, service learning, internship opportunities, land tours, and bird walks among other means. These events often include conducting restoration programs as well as an educational tour through the wetlands describing the history and importance of the restoration sites. News from this project along, with notices of these events and opportunities may be shared during partner meetings then disseminated publicly via publicly posted event data flyers, social media post updates, school visits, as well as e-mail blasts and newsletters from the Los Cerritos Wetlands Land Trust and Los Cerritos Wetlands Authority and partners such as the Aquarium of the Pacific. In addition, Zedler Marsh is now publicly accessible on weekends during which the public may explore the site, interact with restoration experts, and read interpretive signage outlining restorative techniques used. Notices for community-based restoration events continue to be posted to an information bulletin board on site.

## Project Photos



*Figure 1: 2022 Earth Day Restoration Event Group Photo (left), Cal Poly Pomona habitat restoration field trip (right)*



*Figure 2: Irrigation installation in restoration area*



*Figure 3: Mulch being spread in mulefat scrub restoration area*



*Figure 4: Salt marsh quadrat monitoring*



*Figure 5. Volunteers conducting non-native removal (left), volunteers planting mule fat restoration area*



Figure 6. Salt Marsh restoration area and soil sample locations



Figure 7. Mulefat scrub restoration area and soil sample locations