

California Department of Fish and Wildlife
Office of Spill Prevention and Response
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Final Report

Grantee:

California Department of Parks and Recreation
P.O. Box 942896
Sacramento, CA 94296-0001

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List of Maps, Tables and Appendices:

Map 1: Morro Strand State Beach - 2013 Dominant Non-native Species

Map 2: Morro Strand State Beach - 2016 Dominant Non-native Species and Restoration Sites

Map 3: Morro Strand State Beach - Representative Photo Points

Map 4: Morro Strand State Beach - Photo Point Locations

Map 5: Morro Strand State Beach - *Erigeron blochmaniae* - Blochman's Leafy Daisy

Table 1: Cumulative percent cover of live and treated European beachgrass on Hwy. 41 to Azure Street corridor transect.

Table 2: Average percent cover of live European beachgrass per focused quadrat sampling point over three years.

Appendix 1: Summary of activities performed each quarter of the grant period separated into reported categories.

Appendix 2: Photo points of North Kiosk Restoration Site

Appendix 3: Photo points of Morro Strand State Beach Habitat Conversion

Appendix 4: Percent cover of live European beachgrass per focused quadrat sampling point over three years.

Background

Located adjacent to California marine waters, Morro Strand State Beach (MSSB) is home to many native coastal flora and fauna species, including the federally threatened Western snowy plover (*Charadrius nivosus*), the endangered Morro shoulderband snail (*Helminthoglypta walkeriana*), and CNPS listed Blochman's leafy daisy (*Erigeron blochmaniae*). MSSB is included

in designated critical habitat for Western snowy plover, which has maintained a nesting and winter population there for years. The 193 acres of sandy beach and coastal dune habitats of MSSB South Parcel (Map 1) represent an increasingly shrinking habitat statewide and thus is a priority for California State Parks to protect and preserve.

Morro Strand State Beach was planted in the early 1900's with European beachgrass (*Ammophila arenaria*) and iceplant (*Carpobrotus spp.*) to stabilize the dunes, in the 1940's it was heavily used for military training, and in the 1960's was dedicated as a State Park. Fifteen years ago California State Parks (State Parks) began the removal of dominant non-native species with hopes to one day convert the park back to a high quality ecosystem that supports extant populations of native flora and fauna. Efforts persisted over the years beginning with the foredunes and slowly working in from the edges of the park. Progress was inconsistent due to sporadic funding and variable staffing and contractor efforts leaving populations of non-native European beachgrass and iceplant in the center of the park, and tucked inconspicuously in with native species. Though the acreage was small, the sparse and discrete distribution of non-natives made treatment a challenge. Over a three year period with the grant funding of \$150,000 provided by the California Department of Fish and Wildlife – Office of Spill Prevention and Response this long-term dune restoration project was finally completed.

Introduction

Funded as a three year dune restoration project from July 2013 until June 2016, the goal was to remove the remaining populations of European beachgrass and iceplant to promote native species recruitment and move MSSB to a 'sustainable status' requiring limited and affordable annual maintenance by Parks staff provided in the annual budget. The specific goal and objectives for the project are as follows:

Goal

Restore coastal dune habitats throughout Morro Strand State Beach to a sustainable level of a high quality ecosystem that supports extant populations of CNPS, state, or federally-listed flora and fauna species.

Objectives

- 1) Over a three year period control 99% of all live European beachgrass (~3 acres) and iceplant (~3 acres) from the south parcel of Morro Strand State Beach.

- 2) Increase recruitment of native species by at least 10% cover in dead European beachgrass dominated areas over a three year period.
- 3) No more than 1% cover of iceplant and European beachgrass resprouts over the 90 acre treatment area after three years of treatment.

This grant gave State Parks the extra funds to complete the long-term dune restoration at Morro Strand State Beach. The main accomplishment was eliminating invasive European beachgrass and iceplant throughout the entire site but other benefits included: park protection, setting future management priorities, and increased public education. A summary of activities performed each quarter of the grant period separated into reported categories - herbicide treatment, native plant propagation and restoration, volunteers, monitoring, mapping, and other is shown in Appendix 1. Results from all these activities far exceeded the expectations for this grant and has positioned the park for a successful annual maintenance program to assure invasive non-native species are kept at a controlled level.

Herbicide treatment

Seven herbicide treatments were performed by Providence Horticulture the contractor hired to herbicide treat all live European beachgrass and iceplant throughout the 90 acres of dune habitat. Herbicide application initially targeted the densely populated ~three acres of European beachgrass and ~three acres of iceplant but as treatments went on more time was spent walking the entire site slowly and methodically, often multiple times, searching for the resprouts and missed plants hiding among the native plants. This was detailed, time consuming work that required backpack sprayers and a trained eye. As the population of the targeted species decreased, staff began prioritizing other invasive non-native species such as Bermuda and Kikuya grass and New Zealand spinach for treatment.

Staff spent over 200 hours marking the site and directing priorities for the contractor. The extra effort to locate hidden resprouts and mark other invasive non-native species for the contractor proved to be extremely effective and worthwhile. Between contractor herbicide applications, staff also spent time treating outlier non-native plants such as Russian thistle, veldt grass and devil's thorn and treated weeds in and around restoration sites to limit the competition to the newly planted native species.

At the end of the grant period staff spent approximately 16 labor hours walking through the entire site removing all flagging. During this effort only four live European beachgrass resprouts over the entire 90 acres was seen far exceeding the project objective of 1% non-native cover.

Native plant propagation and restoration

Over the course of the grant period approximately 4800 native plants were propagated, grown and planted, 200 pounds of seed collected, and approximately two acres planted. Since rainfall over this period was low, we planted less than expected and because State Parks does not supplement water and only plants during the rainy season we ended up holding over plants the first two years, and overall, grew and out-planted fewer plants.

Much of the 90 acres of MSSB dune habitat is what we call a '1 step' restoration meaning if you remove the invasive non-native species competition the native species will re-colonize and thrive without assistance. This only occurs if there are native seeds in the soil and the historic disturbance of the site is minimal. This is the case for most of MSSB so only a few areas, the most highly visible areas for park visitors were selected for planting. Two of these were adjacent to the campground and one was next to Morro Bay high school (see Map 2). A huge benefit of this grant funding was to be able to increase the areas of restoration where we otherwise would not have. The area north of the campground kiosk was one such area. Once a large weedy hillside is now covered with native plants thanks to many volunteers who cared for the plants in the greenhouse and then out-planted them (see photos in Appendix 2). The conversion of this area not only increased dune habitat but also improves the visitor's experience entering the campground and, with the symbolic fence, discourages visitor's creating unofficial trails to the beach through the dunes.

Hundreds of hours by staff and volunteers were spent over the course of the grant propagating, transplanting, weeding, and generally keeping the native plants healthy and growing in the greenhouse to then be out-planted in restoration sites. Given our previous experience of growing dune plants we limited our seed collecting and propagation to our known eight successful restoration species making our efforts efficient. Also, during this grant period we experimented with, and concluded that, seed collection for direct sowing is a very efficient restoration method, saving an enormous amount of time in the greenhouse and out-planting. However we also learned that prior treatment of the area is necessary if the site has weeds because the native seed will not be able to germinate and survive among the competitive weed seed. Together lessons learned about native plant propagation and restoration has allowed for more effective results.

Volunteers

Over 250 people volunteered for some aspect of the dune restoration during this grant period. This equated to over 1,200 volunteers hours. Groups ranged from school groups, community groups, PG&E employees, youth authority, scout groups and interested neighbors. Volunteers participated in a variety of restoration activities: they cleared the dead European beachgrass from the dunes to expose the sand to light and heat to promote native seed germination; collected seed of targeted restoration species; in the greenhouse they sowed flats, transplanted seedlings from flats to 4" pots, weeded to keep the plants healthy; and they out-planted the native plants in the field at particular restoration sites.

There were three neighbor long-term volunteers that participated on a somewhat quarterly basis controlling particular weeds along the east boundary of the park. Sometimes they put together small work parties or just pulled weeds for a few hours. They are great ambassadors for the larger dune restoration project as they talk with the many walkers that pass by the site. Together they dedicated approximately 60 volunteers hours annually to MSSB restoration.

Monitoring

Monitoring was conducted to evaluate effectiveness of herbicide treatment and recruitment of native species using photo points, vegetation transect and quadrats, and marked individual plants and populations. All of these efforts showed the elimination of European beachgrass and iceplant at the end of the grant period.

Photo points proved to be the most helpful monitoring method and were also a great way to 'show' the story to volunteers and the public. They show the conversion from a monoculture of European beachgrass or iceplant to a landscape dominated by a diverse native species palette (see all photo points in Appendix 3). Photo points in Appendix 3 show the habitat before and after at each point with arrows or outlines marking European beachgrass or iceplant. The time span between photos differs between photo points. Some are from the beginning of our restoration efforts in 2001 showing substantial habitat conversion and others are during the grant period to demonstrate specifically the changes over that time (e.g., photo points 16, 18, 20b, 21, 31, 32, 33a&b, 35, 41, 42, 43). Photo point 32 is a good example of the activities performed during the grant: 2012 - before photo, live iceplant; 2014 - after herbicide treatment, dead iceplant; 2015 planted, small 4" natives; and 2016, growing natives. Another example of how the grant funded efforts completed the restoration is in photo point 21. Here a dense monoculture of European beachgrass was treated before the grant period but individual

plants remained as of 2013. The grant funds assured final treatment and eliminated the European beachgrass in 2016 and prevented re-colonization.

Some photo points show the progression of treatment and/or habitat change over time. For example, photo point 1 shows the domination of iceplant in 2001, European beachgrass in 2007, and finally all natives in 2016. Photo point 28 shows a treatment conversion from a European dominated hill in 2001 but also shows a non-native *Melilotus spp.* dominated swale in 2013 that in 2016 is converted to native rushes without any intervention. It became evident through the photos that once the native species re-established the site then little change was detected the following years indicating stability of the site. For an example of this see photo point 37, basically from 2013 the site is stable. Photo points proved to be the most efficient and useful monitoring method. It showed and represented a much larger area than the quadrat sampling, was more confidently repeated, and proved good for presentations and education about habitat change through time.

Transect sampling along most of the site (Hwy. 41 to Azure Street corridor) was conducted in 2008, 2009, 2013 and 2016. In 2008 a transect was established on a compass bearing with 98 1m x 1m quadrat samples every 15 meters. Although the quadrat sampling proved to be only a crude estimate of the percent cover of live European beachgrass and iceplant throughout the site it still demonstrated the success of the treatment. Table 1 shows the cumulative percent cover (added percent cover of all 98 quadrats) of both live and treated European beachgrass (treated but not yet dead which has a higher possibility of resprouts) for all 98 quadrat samples along the transect from Highway 41 to Azure Street corridor over the years. The cumulative percent decreased from 281 in 2007 to 0 in 2016. The number of quadrats with live European beachgrass was 36 in 2007 and 0 in 2016. During the time of the grant (2013-2016) percent cover went from 50 in 2013 to 0 in 2016 and the number of quadrats with live European beachgrass went from 9 to 0, respectively.

Table 1. Cumulative percent cover of live and treated European beachgrass on the Hwy. 41 to Azure Street corridor transect.

	Nov-07	Apr-08	Jun-08	Aug-08	May-09	Jul-13	May-16
Live European beachgrass							
Total percentage (added percentage of 98 points) of live European beachgrass	281	186	254	258	273	50	0
Number of quadrats with live European beachgrass	36	33	38	34	23	9	0

Yellow European beachgrass (treated but not yet dead, higher possibility of resprouts)							
Total percentage (added percentage of 98 points) of treated European beachgrass	1341	1034	1002	1073	439	30	0
Number of quadrats with treated European beachgrass	54	44	44	43	33	12	0

Given the transect data did not pick up the density of live European beachgrass in the middle of the site seen on Map 1 staff decided to conduct a focus sampling effort that consisted of 5 points, each with 5 quadrats in a radius from the points to sample the area. Being the last large population of European beachgrass this was a focus of the grant money. Table 2 shows the average percent cover of live European beachgrass per focused quadrat sampling point in the three years of the grant, and similar to the transect data, shows all live European beachgrass eliminated over that period. The full table is shown in Appendix 4.

Table 2. Average percent cover of live European beachgrass per focused quadrat sampling point over three years.

Point	July 2013	June 2014	May 2016
1	87	9.6	0
2	86.6	8.8	0
3	82.8	9.2	0
4	82	7	0
5	84.8	8.4	0

The most efficient way to ‘show’ habitat change at MSSB proved to be with photo points but the way to experience the change is to just walk through the site. At the end of the grant period staff spent 16 hours walking the entire area removing flagging and markers and only four small European beachgrass resprouts were found during that time. Over 90 acres walked with only four small resprouts found, demonstrates a huge success.

Monitoring wildlife for this project was more challenging and less effort was put towards it either because of weather, personnel, or logistic constraints. Monitoring efforts for the

endangered Morro shoulderband snail were limited due to the lack of rainfall during the grant period. Overall there was 23 hours spent monitoring with only four live snails recorded. This is a very low number of live snails compared with wet years in the past, but given that the various efforts over the years were opportunistic and not standardized, they are not comparable. Other species monitoring for red-legged frog and Morro blue butterfly was limited as well. No frogs or butterflies were recorded on site for the approximate 25 hours spent over the three year time period. Some of this might be due to limited rainfall, especially in the case of red-legged frogs, but also limited survey effort for both species. A request to knowledgeable people in the area regarding butterfly observations resulted in no occurrences at MSSB during the grant period. Again, this is likely due to limited effort.

Not a part of this grant but in coordination, symbolic fencing and area closed signs were erected along the two mile stretch of beach for the protection of the Western snowy plover from March 1st to September 30th each year. Overall the nesting success of plovers has decreased over the past 13 years due mostly to increased predation and disturbance but over the grant period, numbers remained similar. Habitat restoration at MSSB has increased available habitat for the Western snowy plover easing at least one of the threats to the species. Importantly with climate change and predicted sea level rise this additional habitat will provide refuge for the plover improving its chance for survival.

Mapping

A map of the existing condition of remaining live European beachgrass and iceplant populations (Map 1) was the basis for other maps created over the grant period. Maps for display, orientation, monitoring, and educational purposes were created.

The before and after maps shown in Map 1 and 2, respectively show the change to the site over the three year grant period. Three acres of European beachgrass and three acres of iceplant in 2013 at the beginning of the grant period are now eliminated to an infinitesimal amount in 2016. The initial map in 2013 was also used to show the contractor and volunteers where the infestations of European beachgrass and iceplant remained. At volunteer events people appreciated the maps to give them a larger perspective of the project and to simply illustrate the change over time. The representative photo point map (Map 3) was also created for volunteers and the public to show examples of the changes in habitat at particular photo points. The photo point location map (Map 4) shows the location of all the photo points.

Additionally, mapping of Blochman's leafy daisy distribution was done each year to measure the increase as a result of removing the competition of non-native European beachgrass and iceplant. Map 5 shows the dramatic increase from only a few very small populations mapped in 2005 to the expanded distribution and densities of 2016.

Other

Funding from this grant not only facilitated the completion of the long-term dune restoration of MSSB it provided for many other benefits for the park including: improved neighbor relations, an official boundary survey, additional restoration areas, improved protective fencing, increased patrols for homeless camps, and generally more staff time on site to better understand the park and plan for its sustainable future.

The project objectives were exceeded and considerably more was accomplished than could be with State Parks regular budget. For example, improved fencing was constructed which not only protected restoration areas by preventing unofficial visitor trails to the beach but also provided an aesthetic intentional boundary. Extra money and staff also allowed State Parks to expand our non-native targets to include species such as kikuya and Bermuda grass, add new restoration areas, and experiment with direct seed sowing. As staff spent more time on site more discoveries of homeless camps were made and by working with the ranger staff we were able to help limit this activity which meant less trampling through restored areas and/or through plover habitat.

Essential to the success of this project was the official boundary survey funded by this grant. In the past, staff subjectively treated iceplant along the boundary behind the homes on Beachcomber Dr. with the neighbor's disapproval. The official survey allowed for informed negotiations with the neighbors regarding the treatment line which was critical for the 'buy-in' of the project. Furthermore, the increased attention of the restoration project at MSSB provided for more public awareness of the project and thus good volunteer and educational opportunities. A presentation board was made and specific interviews for articles were conducted to better illustrate the dune restoration story at MSSB. Staff also participated in presentations on the dune restoration to local community groups as well as other professional meetings such as the Dune Restoration Workshop and USFWS Western snowy plover meeting to further tell of the success.

Conclusion

The goal of this project to restore coastal dune habitats throughout Morro Strand State Beach to a sustainable level of a high quality ecosystem that supports extant populations of CNPS, state, or federally-listed flora and fauna species was accomplished. The explosion of Blochman's leafy daisy populations throughout the site is a wonderful example of project's success. More specifically all the objectives were exceeded with over 99.99% of live European beachgrass and iceplant eliminated and well over 50% native species recruitment throughout the site. Fifteen years ago when walking through the site dominated by shoulder height European beachgrass and carpets of iceplant it was hard to believe it could ever be converted to a native community. Now it is complete.

The acreage of non-native infestation to be treated for this grant was low but it also was the hardest to treat. The remaining populations were in the middle of the park and hidden throughout the site among established native species. Over time if these non-native plants were not eliminated they once again would begin to spread which is why this last phase of the project was so essential. Each year some aspect of the restoration was completed but this grant funding allowed for State Parks to complete the restoration and set the park up for success into the future.

The approach to dune restoration at MSSB, mostly as a result of erratic funding and staffing levels, has been slow and steady, continuing to make incremental progress at converting the habitat. Unlike other dune restoration projects where heavy equipment is brought in and the conversion is done all at once, the slow approach allowed for unassisted native species recruitment which proved to be extremely successful. Over time the dune restoration at MSSB was truly the collaboration of staff, volunteers, and contractors.

Many lessons were learned during this restoration project and still some questions remain. We learned: the benefits of particular herbicides and their uses; the importance of removing dead biomass from the soil; the critical need for follow-up; the most successful species to propagate; the usefulness of direct seed sowing; and the importance of having a defined large project to recruit volunteers. These learnings will help State Parks sustain the healthy ecosystem of MSSB and in implementing future restoration efforts at other parks.

The large remaining question from a land management perspective is when to stop. Now that the most dominate non-native species are gone, the question now becomes do you tackle the 'second tier' non-native species found on the edges that threaten to spread into the park. With a park like MSSB which is completely surrounded by urban development, has 10 bisecting

access corridors, and has over 169,000 visitors annually, the potential for invasive non-native plant and animal influxes are constant. So it is not about being 'weed free', especially for a park like MSSB it is about sustaining the healthy dune ecosystem and not letting the non-native species get to a dominate level. With the major infestations of non-native species eliminated, State Parks feels confident with annual monitoring and maintenance that we will be able to manage the 'second tier' non-natives and sustain a representative dune ecosystem into the future at Morro Strand State Beach.

Acknowledgements

Parks is thankful to have had the opportunity through this funding not only to complete a long-term restoration project but also to be able to expand our efforts beyond what is possible through regular budgeting. We thank the many volunteers who contributed to the success of this project over the years and the various staff who worked countless hours on this project. I personally thank Jeff Ebner, Environmental Services Intern, who conducted all the work to create the many maps for this project. And a huge appreciation goes Bruce Joab of California Fish and Wildlife-OSPR whose continual communication made working on this project efficient and rewarding.

Submitted by:

Jodi Isaacs – Project Manager
Environmental Scientist
California State Parks
San Luis Obispo Coast District

Morro Strand State Beach

2013

Dominant Non-Native Species

Yerba Buena St.

Hatteras St.

Azure St.





The Cloisters

Morro Bay High School

Boardwalk

HWY 41

Pacific Ocean

-  Morro Strand State Beach - South Parcel: 193 Acres
-  *Ammophila arenaria* - Mapped 2013: 3.08 Acres
-  *Carpobrotus Spp.* - Mapped 2013: 2.45 Acres
-  *Carpobrotus Spp.* - Not in project scope - Mapped 2013: 7.21 Acres

0 500 1,000 2,000 Feet
0 0.125 0.25 0.5 Miles



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Prepared by Jeff Ebner
August 22, 2016



1 : 15,000
State Plane Coordinate System
NAD83 California Teale Albers (Meters)
2014 Aerial Imagery (PG&E)

Morro Strand State Beach

2016

Dominant Non-Native Species & Restoration Sites

Yerba Buena St.

Hatteras St.

Azure St.

The Cloisters

Morro Bay High School

Boardwalk

HWY 41

Pacific Ocean



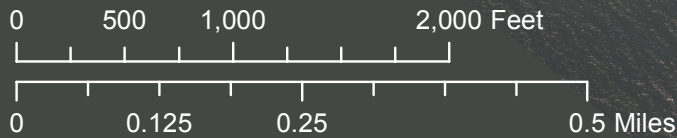
Morro Strand State Beach - South Parcel: 193 Acres



Restoration Sites

Ammophila arenaria - Mapped 2016: Eradicated to Infinitesimal Levels (>.001 Acres)

Carpobrotus Spp. - Mapped 2016: Eradicated to Infinitesimal Levels (>.001 Acres)



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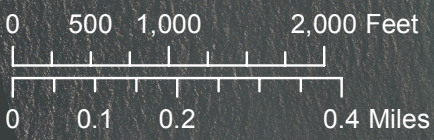
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1 : 15,000
State Plane Coordinate System
NAD83 California Teale Albers (Meters)
2014 Aerial Imagery (PG&E)



Morro Strand State Beach Representative Photo Points



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1 : 15,000
State Plane Coordinate System
NAD83 California Teale Albers (Meters)
2014 Aerial Imagery (PG&E)

Morro Strand State Beach

Photo Point Locations



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1 : 15,000
State Plane Coordinate System
NAD83 California Teale Albers (Meters)
2014 Aerial Imagery (PG&E)

Morro Strand State Beach

Erigeron blochmaniae - Blochman's Leafy Daisy



- Morro Strand State Beach - South Parcel: 193 Acres
- Erigeron blochmaniae* - Mapped 2016: 3.28 Acres
- Erigeron blochmaniae* - Mapped 2005: >.01 Acres

0 500 1,000 2,000 Feet

0 0.125 0.25 0.5 Miles



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1 : 15,000
State Plane Coordinate System
NAD83 California Teale Albers (Meters)
2014 Aerial Imagery (PG&E)

Appendix 2. Photo points of North Kiosk Restoration Site

Photo Point 41 - North Kiosk Restoration Site



2015



2016

Photo Point 42 - North Kiosk Restoration Site



2015



2016

Photo Point 43 - North Kiosk Restoration Site



2015



2016

Appendix 3. Photo points of Morro Strand State Beach Habitat Conversion

Photo Point 1 – Hwy. 41 - Boardwalk



2001



2007



2008



2016

Photo Point 2 – Hwy. 41- Boardwalk



2001



2016

Photo Point 3 - Hwy. 41 - Boardwalk



2010



2016

Photo Point 4 – Hwy. 41 - Boardwalk



2007



2010



2013



2016

Photo Point 5 - Hwy. 41 - Boardwalk



2007



2016

Photo Point 6 - Hwy. 41 - Boardwalk



2007



2016

Photo Point 7 _ Hwy. 41 - Boardwalk



2001



2016

Photo Point 8 - Boardwalk



2001



2005



2016

Photo Point 9 - Boardwalk



2002



2016

Photo Point 10 - Boardwalk



2007



2016

Photo Point 11 - Boardwalk



2001



2016

Photo Point 12 - Boardwalk



2001



2015

Photo Point 14 – Boardwalk - Azure Street



2011



2016

Photo Point 16 – Boardwalk – Azure Street



2013



2016

Photo Point 17 – Boardwalk - Azure Street



2006



2016

Photo Point 18a – Boardwalk – Azure Street



2013



2016

Photo Point 18b – Boardwalk – Azure Street



2013



2016

Photo Point 19 – Boardwalk - Azure Street



2006



2016

Photo Point 20a – Boardwalk - Azure Street



2007



2015

Photo Point 20b – Boardwalk - Azure Street



2013

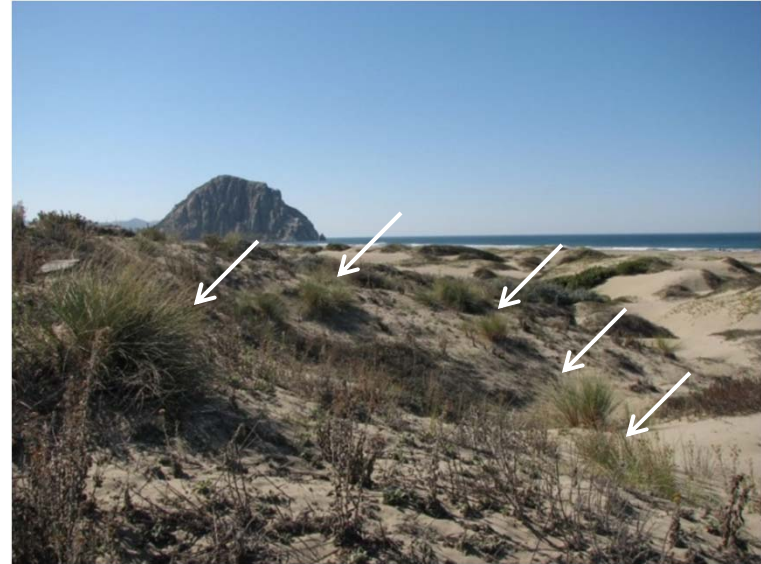


2016

Photo Point 21 – Boardwalk to Azure Street



2010



2013



2016

Photo Point 23 - Azure Street Corridor



2001



2016

Photo Point 27 - Sienna Street Corridor



2001



2016

Photo Point 28 – Sienna - Easter Street



2001



2013

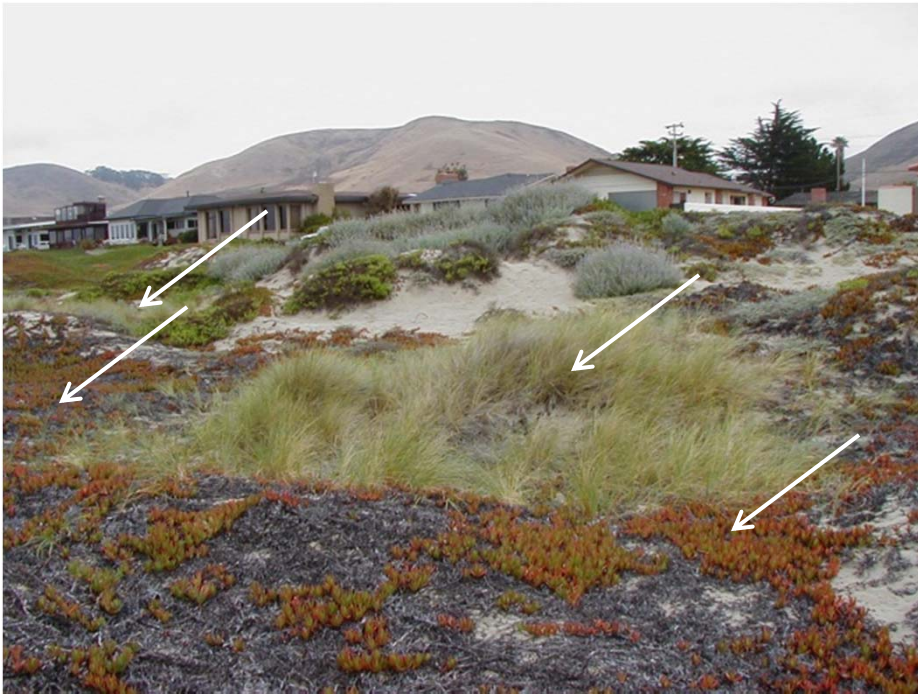


2015



2016

Photo Point 29 – Sienna - Easter Street



2001



2016

Photo Point 30 – Sienna - Easter Street



2001



2013

Photo Point 31 - Campground



2012



2016

Photo Point 32 - Campground



2012



2014



2015



2016

Photo Point 33a&b - Campground



2012



2016



Photo Point 35 - Campground



2013



2016

Photo Point 36 - Kiosk



2005



2016

Photo Point 37 - Kiosk



2008



2010



2011



2013



2015



2016

Photo Point 38 - Kiosk



2010



2016

Photo Point 39 - Kiosk



2007



2016

Photo Point 40 - Kiosk



2007



2016

Appendix 4. Percent cover of live beachgrass per focused quadrat sampling point over three years

Focus quadrat sampling points

		Jul-13	Jun-14	May-16
1	a	85	15	0
	b	95	8	0
	c	90	8	0
	d	75	5	0
	e	90	12	0
Point Average		87	9.6	0
2	a	85	5	0
	b	90	5	0
	c	80	9	0
	d	80	15	0
	e	98	10	0
Point Average		87	8.8	0
3	a	90	10	0
	b	75	7	0
	c	95	5	0
	d	76	8	0
	e	78	7	0
Point Average		82.8	9.2	0
4	a	85	5	0
	b	80	8	0
	c	90	10	0
	d	75	5	0
	e	80	7	0
Point Average		82	7	0
5	a	85	5	0
	b	74	10	0
	c	90	12	0
	d	80	5	0
	e	95	10	0
Point Average		84.8	8.4	0
Overall Average		84.8	8.4	0