Beachgrass Removal at the Samoa Dunes

Restoring a Native Dune Habitat

Phoenix Anthony

Matt Gilster

Kaena Sado

11/26/2012

This report examines an invasive removal project located at Samoa Dunes in Arcata, California. The results of this project are thoroughly discussed and documented in order to aid in future removal projects in dune ecosystems.

Contents

1. Problem Background

1.1 Problem Statement

The Samoa Dunes is an area that has been severely impacted by invasive species including European beach grass, coyote bush and ice plant, which have taken over the dune ecosystem affecting the natural dune cycles and suppressing the native species within.

1.2 Problem background

European beachgrass (*Ammophila arenaria)* is native to Europe and was originally planted along the coast in 1901 to stabilize the slopes ("Invasive Plants", 2012). This rhizomatous grass is characterized by its clumped stems with long pointed leaves that are covered in a waxy coating ("Beachgrass", 2012). Once planted, the grass spreads quickly by subsurface runners, eventually forming a dense stand along the coastline thus changing the dune morphology ("Invasive Plants", 2012). Control of European beachgrass is removal by hands and shovels, and may take up to 4-8 removal efforts before the rhizome dies ("Invasive Plants", 2012). Due to the invasive nature of this plant, the Humboldt Bay dune ecosystem is now dominated by this species along with two other invasives in the area.

Coyote bush (*Baccharis pilularis*) is a native species found here in California. It's a common coastal and chaparral plant of both California and Oregon. This coastal sage scrub is a wiry and woody perennial evergreen that looks like a bush, but can take up many shapes to adapt to wind and salt spray. Coyote bush can provide shelter for wildlife and nectar for bees, butterflies and other insects. It also may serve as a nurse plant for

degraded soil. It is called a pioneer species because it is one of the first shrubs to appear after other plants have been removed by cultivation or fire. Due to this plants hardy nature, it has become an invasive to this specific region.

Ice plant (*Carpobrotus edulis*) is a creeping, mat-forming succulent species found in South Africa. It has naturalized in many other regions throughout the world, and is an invasive species in several parts of the world that share a similar climate for example California, Australia, and the Mediterranean. Ice plants grow year round, with individual shoot segments growing more than three feet per year. Flowering occurs almost year round which causes high seed production to occur. Ice plant were cultivated and used for stabilization and erosion control. The ice plant poses a serious ecological problem, forming vast monospecific zones, lowering biological diversity, and competing directly with several threatened or endangered plant species for nutrients, water, light, and space.

The main concerns with these invasive species are their detrimental effect on the dune ecosystem geomorphology and their competitive growth habits. Beachgrass has no native predators in the area and is not affected by the environment, so it has been able to establish itself as the dominant species in the Samoa Dune area. This species has limited the amount of native vegetation in the area, thus decreasing the biodiversity in the dune ecosystem. The lack of open sand area in the dunes has reduced the amount of nesting habitat for snowy plovers, as well as affecting the arthropods in the area. The dune topography has been altered due to sand deposition that creates steep slopes that are parallel to the ocean, while historically dunes were perpendicular to the coast. This has created a change in the dune cycle and the movement of sand inland.

Humboldt County beaches and dunes are home to two federally listed endangered plant species; Humboldt Bay wallflower and beach layia. The Humboldt Bay wallflower is a subspecies of the Menzies wallflower and is unique to the Humboldt Bay dune system. Beach layia prefers open areas with sparse vegetation, and its decline coincides with the gradual and natural succession of vegetation in the dunes over time. Other species native to the dune areas are wild strawberries (*Fragaria vesca)*, dune goldenrod (*Solidago simplex gillmanii)* and beach buckwheat (*Eriogonum latifolium)*. As well as plant species, the western snowy plover is a small shorebird that is listed as a threatened species. Populations have been monitored since 1988 and since that time, densities have declined. The coastal habitats for these species are subjected to development pressures, encroachment of invasive species, and recreational uses. By conserving and restoring this habitat we could help protect these endangered and native species.

2. Goals and Objectives

2.1 Goals

Our goal is to remove invasive species from the Samoa Dunes and let native plants regenerate for the benefit of the fauna in the area.

2.2 Objectives

- Remove 100% of beachgrass, ice plant and coyote bush in our 50 x 50 meter project area.
- Prevent regeneration of invasive species by removing 100% of re-growth within the first 3 months.

- Construct 2 stretch barrows for the Friends of the Dunes for the purpose of carrying beachgrass.
- Allow 50% of native species to recover in project area during a period of 1 year.

3. Alternatives

3.1 Alternatives/ Weighing Alternatives for our project

1. Acceptance of the new ecosystem composition of beachgrass, coyote bush, and ice plant. This would entail that no project would take place.

The benefits of accepting the new ecosystem would have no cost associated with it. Cons include a reduction of the species that are reliant on native species in the area. The endangered native grasses and flowers will also be eliminated and an extreme loss of biodiversity will take place. This can also cause a negative effect on surrounding ecosystems.

2. Removal of scattered quadrants of beachgrass throughout project area.

Removing only scattered quadrants of beachgrass would save a measurable amount of money and would allow for a greater area to be covered. Cons include a faster re-establishment of invasive species due to a close proximity of seeds from areas that were not removed.

3. Incorporate large machinery in removal rather than hand pulling up species.

Incorporating large machinery would allow for a faster removal rate and would allow for removal of a larger area. The machines may penetrate a deeper level so that more roots are removed and the seed bank eliminated. Cons include a high cost

associated with getting machinery into this area. This may not be feasible because of the location of the project site. The ecosystem might also be damaged by compaction with the use of heavy machinery.

4. Use chemical methods of removal for the project area.

Chemical methods would be less labor intensive than hand removal. Chemical methods have not been thoroughly tested for the removal of beach grass. This may not be a feasible method for this reason. Chemicals may also cause toxicity problems for the re-establishment of native species after the removal of beach grass.

5. Hand removal of a select small area near trail approximately 50 x 50 meter large.

Removal of a small area that can be thoroughly completed in the project time period would be the most feasible option. Native species can be protected by not using chemical methods or heavy machinery. The cost of the project will remain low and hand removal will be very effective at removing the invasive species. The cons would include more manual labor and a reliance on volunteers. This is the option that was chosen by our group and will be thoroughly discussed in further pages.

4. Methods and Implementation Strategies

4.1 Project Site Description

Our project site is located 8 feet from the pathway leading to the beach from the Friends of the Dunes main building. The site is a continuation from a neighboring site that has been recently eradicated of all invasive species. The site is approximately 50 x 50 feet large and contains 85% beachgrass, 5% coyote bush, 5% ice plant and the remaining

5% is native species. There is a large buffer of beachgrass that will remain along the coastline in order to prevent a large amount of movement of sand into the project area.

4.2 Pre- Removal Baseline data collection Methods

Initial Project Site Measurement:

The project site was determined to be 50 x 50 meters large positioned directly next to a previously restored site. The site was measured by selecting the start location with a pin flag and then running a tape measure 50 meters horizontally and vertically from this point. Flags were placed at the four corners of the project site in order to help volunteers with invasive removal.

Vegetation:

In order to perform pre-project vegetation monitoring, a transect was established diagonally from two of the pin flags. Plots 1 x 1 meter large were placed every 10 meters along the transect line for a total of 6 plots. The 1 x 1 meter square plot was centered directly over the tape measure. This would allow for an unbiased sample of the plot. On each of the plots, estimation of vegetation was taken including bare ground (Figure 1). A second method was employed for a thorough understanding of the baseline data in the site. This method randomly sampled 5 different 1 x 1 meter transects throughout the site. The transect square was thrown behind the sampler and a plot was established where the transect square landed. The results of both methods are displayed in Table 1, Table 2, Figure 1 and Figure 2.

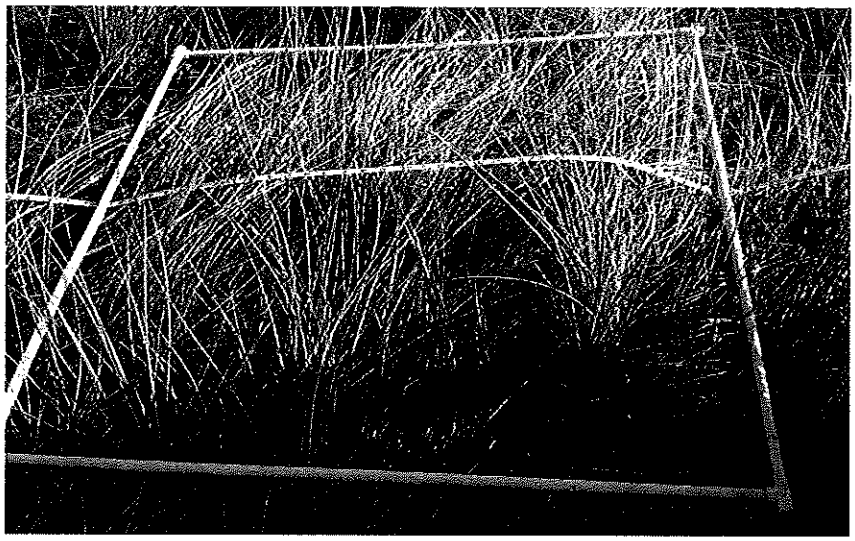


Figure 1: Pre-treatment representative image of 1 x 1 Meter Plot.

Table 1: Vegetation Present in Plots 1-6 using standard sampling method.

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
5% beachgrass	75% beachgrass	60% beachgrass	5% native*	45% beachgrass	25% coyote bush
95% ice plant	10% moss cover	20% moss cover	95% beachgrass	30% moss cover	5% moss cover
	15% ice plant	20% native*		25% native*	70% beachgrass

* Natives include strawberry, beach buckwheat, and dune golden rod.

Table 2: Vegetation Present in Plots 1-6 using random sampling method.

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
50% beachgrass	95% beachgrass	20% moss cover	100% beachgrass	70% beachgrass
20% native strawberry	5% native*	80% coyote bush		30% native*
30% native*				

* Natives include strawberry, beach buckwheat, and dune golden rod.

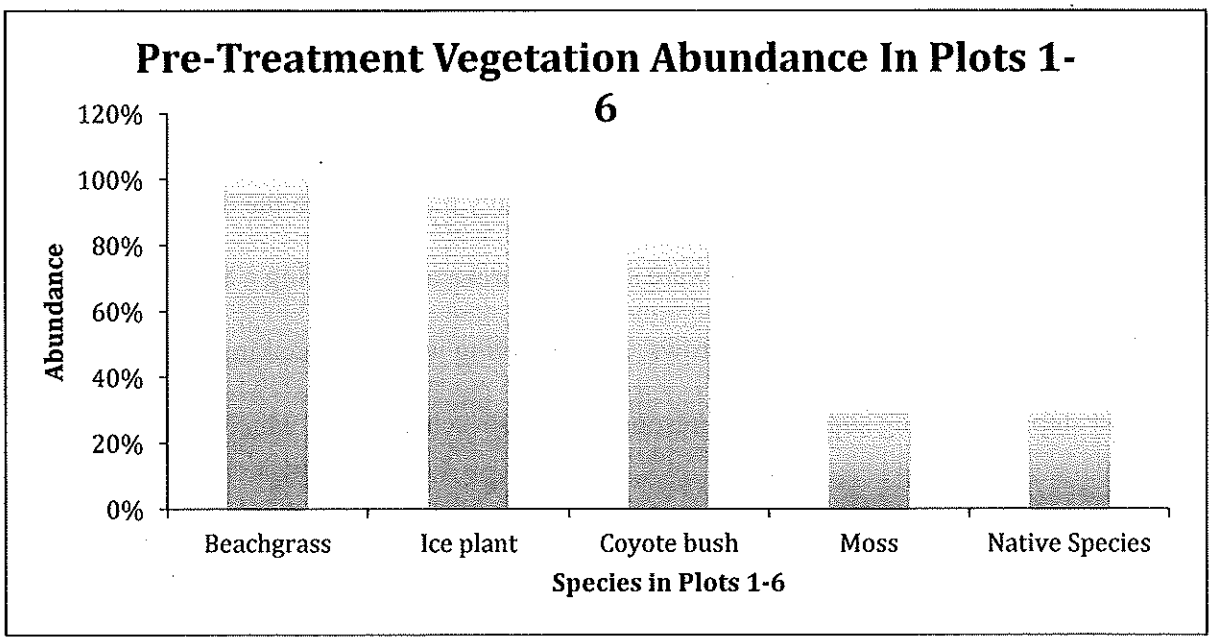


Figure 2: Vegetation Abundance in plots 1-7.

4.3 Project Implementation

Work day: Saturday November 3rd

In order to remove all of the invasive species in the area and let the remaining 5% of native species regenerate, a work day took place to hand pull the invasives. The work day took place on a Saturday November 3rd from 9- 1:00 and was in partnership with the California Coastal Commission. The work day began with hand pulling of the species by use of shovels and putting these species in large piles. Each pile was then loaded into a stretch barrow and taken to the vehicles to be dispensed of. The area was thoroughly cleared of all remains in order to create space for native regeneration. The area will need to be pulled again in the near future 4-8 more times before the beachgrass rhizome dies.

Stretch barrow Construction

Construction of a stretchbarrow took place in order to enhance the efforts of the beach grass removal volunteers by making transportation of beach grass quicker and more efficient. This will eliminate the need for heavy machinery in the dune area. We began by contacting Piersons hardware store in Eureka and acquiring a $200 donation for the construction of two stretch barrows. After meeting with and thanking the donor the next step was buying supplies at Piersons for two stretch barrows, which included:

- Four 2x2 8 feet long, four 2x2 2 feet long
- Canvas
- Hardware
- Lin seed oil and paint thinner
- Two wheels

- Metal rod

After all the supplies were acquired, construction began. The first step was to paint the wood with linseed oil and paint thinner in order to weatherproof the stretch barrow. Next the wood was screwed together in order to create a frame. After the frame was built, a canvas tarp was laid over the top with a one feet deep pocket. One stretch barrow contained a rod and two wheels, while the other would be held by two people for transport. The original plans for the project can been seen in the appendix.

Figure 3: completed Stretchbarrow

5. Results

5.1 Vegetation

Vegetation in each 1 meter by 1 meter plot was characterized and depicted in Table 3.

The following graph represents the abundance of the species present post project.

Table 3. Vegetation Present and Abundance : Post-treatment of Transect plots 1-6

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
20% Native dune golden rod.	**15%** Native dune golden rod.	**0%** Native dune golden rod.	**25%** Native dune golden rod.	**50%** Native dune golden rod.	**70%** Native dune golden rod.
5% Native Strawberry	**0%** Native Strawberry	**10%** Native Strawberry	**10%** Native Strawberry	**0%** Native Strawberry	**0%** Native Strawberry
75% Leaf litter/Expose Sand	**80%** Leaf litter/Expose Sand	**85%** Leaf litter/Expose Sand	**60%** Leaf litter/Expose Sand	**50%** Leaf litter/Expose Sand	**30%** Leaf litter/Expose Sand
0% Rhizomes	**5%** Rhizomes	**5%** Rhizomes	**5%** Rhizomes	**0%** Rhizomes	**0%** Rhizomes

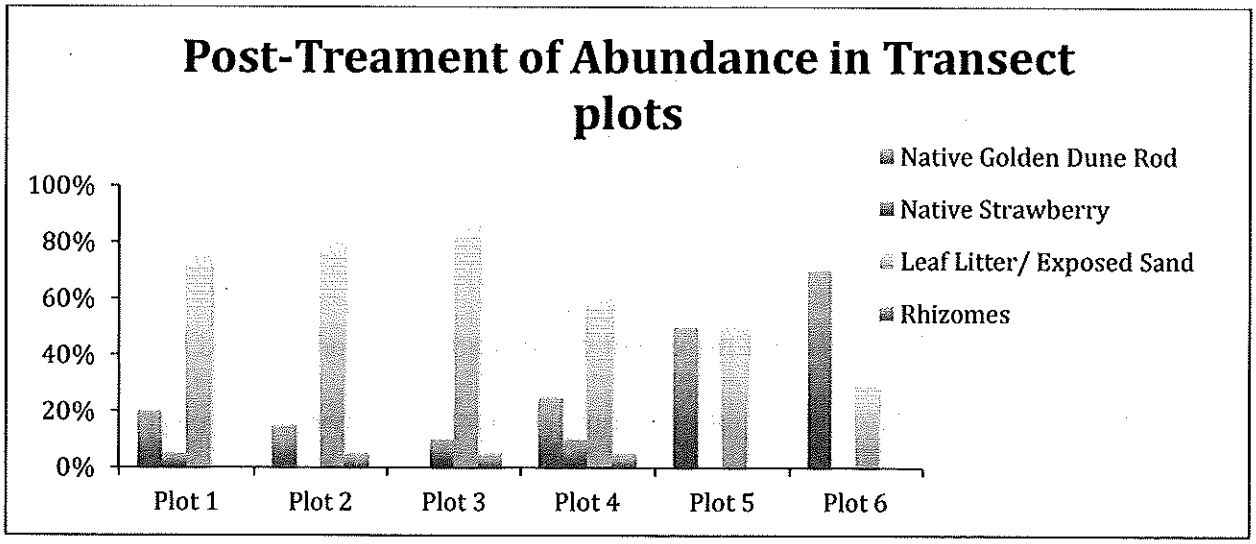


Figure 9: Vegetation abundance of post-transect plots.

Table 4. Vegetation Present and Abundance : Post-treatment of Random plots (1-5)

Plot 1	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
60% Native dune golden rod	**0%** Native dune golden rod	**20%** Native dune golden rod	**5%** Native dune golden rod	**40%** Native dune golden rod
10% Native Strawberry	**10%** Native Strawberry	**0%** Native Strawberry	**0%** Native Strawberry	**20%** Native Strawberry
30% Brush	**90%** Brush	**80%** Brush	**90%** Brush	**35%** Brush
0% Rhizome	**0%** Rhizome	**0%** Rhizome	**5%** Rhizome	**5%** Rhimzome

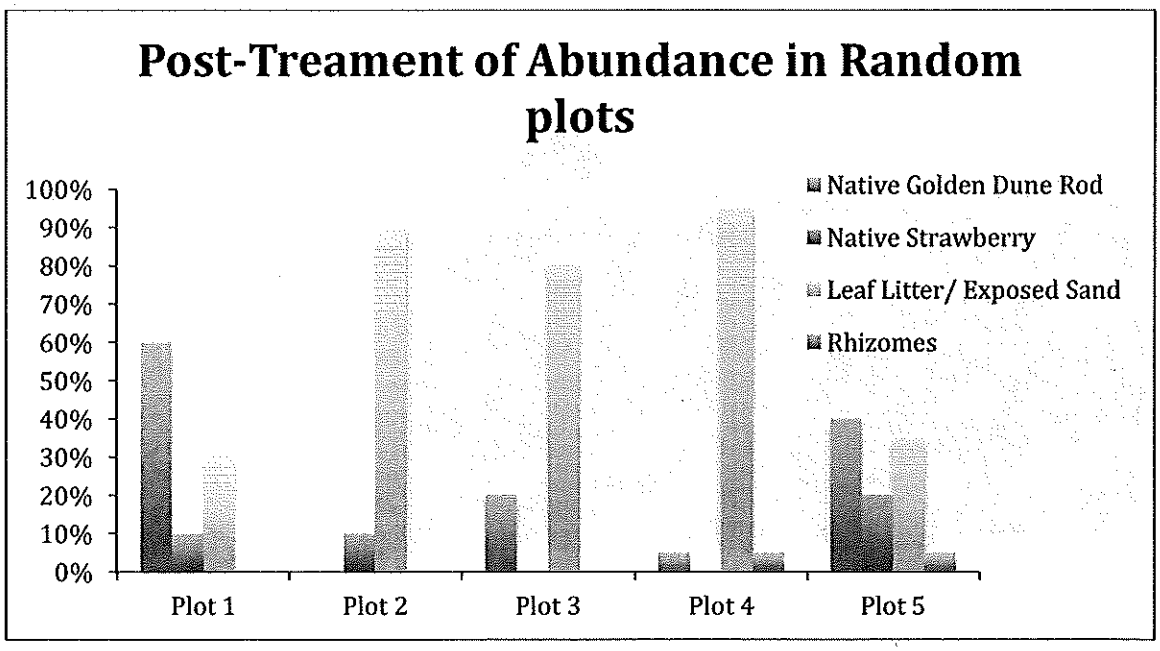


Figure 10: Vegetation abundance of post-treatment of random plots.

5.2 Stretch Barrow

The Stretchbarrow was used to remove the invasive species from the project site to the trucks for off site burning. They could be used by having two people hold each end or attaching a wheel for one person use. They were much more effective than traditional wheelbarrows in the dune environment and expedited the removal process. Our group constructed two stretchbarrows and repaired a broken one creating three effective stretchbarrow tools for our project work day. These tools were then donated to the Friends of the Dunes and have already been used effectively for future restoration projects.

Figure 1: Stretchbarrow in use.

6. Discussion

6.1 Vegetation

Our restoration project sought to eradicate all of the invasive species in a 50 meter by 50 meter project area, and through our work day we accomplished this. The remaining vegetation left in all of our six post-project transects were 100% free of invasive species, except a small amount of beach grass rhizomes. The vegetation that was left standing was native to the dune ecosystem and consisted of native strawberry, beach buckwheat and dune goldenrod. There is ample space surrounding these native species now so that they may expand throughout the area. We hope to see the native plant species flourish in the absence of the beach grass and bring in more native fauna into the area. The project is still not completed as it needs strict monitoring to make sure that the beach grass is pulled at least four more times to completely kill the plant. This project was only a small start to

the large issue with beach grass and its massive expanse in the dune ecosystem. We hope that in the future this project will continue on north and south along the coast through volunteer support. It is important for active restoration to take place in these fragile ecosystems as more and more species become threatened and endangered.

6.2 Stretch Barrow

When removing invasive species all management options need to be considered. There are usually 3 methods for managing invasive species removal mechanical, chemical, and biological (Mattrick). Mechanical control is physically removing the invasive from its environment by cutting or manual pulling. Chemical uses herbicides to kill or inhibit growth. Biological methods introduce predators of the known invasive species to kill or slow population growth. When looking at the Samoa Dunes it was important that we chose a method of removal that was cost efficient and effective without harming the native species of the dunes. We evaluated all three types of species removal. Biologically was much too resource intensive and beyond our means, it may have also damaged surrounding native species. Chemical was also a bit beyond our means, due to permitting as well as native species could be affected. We decided to do mechanical removal because of its low cost and its ability to target specific species.

After deciding on a method, the next step came in implementation of that method. Heavy machinery could not be used because of the location of the project site being far from the main road. This meant that all removed grass would need to be brought by hand to the road which was located a considerable distance over sand dune habitat. When disposing of invasive species there are three methods to choose from burn it, pile it, and

compost it (Mattrick). We considered each and decided on off site burning. The Friends of the Dunes would take the removed beach grass to an offsite facility to burn. It could not be piled because it would re-sprout and the piles of beach grass could not be composted due to re-sprouts. The problem at hand was taking the removed beach grass from the work site to the trucks for transportation to the offsite burning facility. Our answer to this solution was the stretchbarrow.

The stretchbarrow is a modified wheel barrow that was designed by a group of engineering students from Humboldt State University. It was specifically designed to haul plant mass across a dune area. It can be held by 2 people or used by one with the attachment of a wheel. The Friends of the Dunes currently had the original stretchbarrow designed by the engineering students but we required two more for the large amount of grass that our project was going to remove. Both devices would then be donated to the Friends of the Dunes for future invasive removal projects.

The stretchbarrow was perfect for our choice of mechanical invasive species management. It was cheap to produce two of them and they have minimal impact on the surrounding environment. They were easy to use, requiring only two volunteers to each hold a side and large amounts of biomass could be transported across the dune habitat with little to no impact. No permitting or training was required for their use. They were much more effective at removing the invasive species than conventional wheel barrows because of the option to have one or two people using them. This greatly helped improve the speed at which the invasive could be removed from the site and transported to the trucks for off site burning. They can be used for future invasive species removal projects and are easy to maintain.

Before the stretchbarrow design the Friends of the Dunes used normal wheelbarrows and manual labor to remove the beach grass. This was ineffective and resulted in the beach grass just being piled up around the site where it was removed. This caused re-sprouts and over the long term caused the entire project to be ineffective. The stretchbarrow is a solution to this problem and a great example of adaptive management. When it was clear a new method of removal needed to be introduced, the Friends of the Dunes consulted with HSU students and a new method of removal was made. By learning from their mistakes the process of invasive species removal was improved. This site specific technique should be used in more ecological restoration projects and will be used at the Samoa Dunes until the European beachgrass is eradicated.

6.3 Lessons Learned

After organizing and completing a successful work day there were a few elements on putting this event together that lead to unavoidable problems. Complications that appeared were the development of the stretchbarrows, a method for eradicating ice plant, and how to acquire more volunteers. These unavoidable flaws lead to lessons to be learned for future projects.

The stretchbarrows were imperative during the workday but the construction of them yielded many complications. The plans that were given to develop these stretchbarrows weren't as clear as they needed to be. The main problem with this small project was finding the right tool to drill a hole within a bar for the axel. These barrows resulted in missing an axle for the wheel to be placed. But with an incomplete model, this was thought to be better in the long run. Volunteers were able to carry more material and

it became easier for them to travel through the dunes without any complications or obstructions in the way.

Ice plant became an unknown challenge. It forms roots at every node that contacts the ground and creates deep mats of vegetation, which are extremely difficult to remove. Once it is removed, it must be disposed properly or it could grow back quickly and invade large areas, competing with native plants for space and light. The problem that was identified with this task was underestimating the amount of ice plant needing to be removed, time, and the lack of volunteers. It was decided that a more effective method must be researched in order to remove large areas of ice plant. This leads to the last lesson that was learned during our work day.

A detrimental concern from this project was not knowing how many volunteers would attend. It is important to adequately advertise your event with flyers, emails, social media involvement, and/or talking to people to get the word out. We were lucky enough to have volunteers from California Conservation Corps come out to help, and without them this project wouldn't have been fully completed. A lesson from this was to promote more than what was done already.

These weak spots allowed room for developing alternative solutions and ideas for future projects. This gave us time to step back and brainstorm about what could have been achieved if we changed or did things differently. You can never go wrong with improvement especially within the science world.

6.3 Implications of Global Warming and Sea Level Rise

The coastal dune system in Humboldt Bay serves an important role as a buffer for the shoreline. The interaction of the dune system and the beach allows for nutrient and mineral exchange essential for a stable shoreline (Carter, 1991). Due to the relationship of the ocean and the dune system, sea level rise is a topic that has gained much speculation in the last decade. The hypothesis is that increases in radiant energy gases will result in rising temperatures of 1.0 to 1.5 degrees Celsius by 2030 (Carter,1991). This change in temperature will cause ocean levels to rise thus affecting the dune system that blankets the shorelines. Estimates of the amount of sea level rise vary from 1.9 to 6.4 mm per year (Carter, 1991). The effects of the rising sea level will induce an impact on the coastal processes by raising the plane of activity from which the waves are located. The increase in activity of the waves and the shoreline will lead to more erosion, flooding and a larger amount of sediment fluxes. It is thought to be possible that there may be a shifting of the location of the coastal sand sheets over time (Carter, 1991). Though there will be impacts due to rising sea level, it is still under question of exactly what will occur. The nature of the dune system is very dynamic thus making it difficult to pinpoint exactly how it will react to global warming.

7. Monitoring and Evaluation Plan

7.1 Long Term Monitoring Plan

An implementation of a Long Term Monitoring Plan (LMP) for Humboldt Dunes to preserve and restore the natural resources is a long-standing goal for the Humboldt coastal habitats. A major section of this plan is monitoring the newly sprouted seedlings. All re-sprouts must be removed and the area monitored constantly for a few

years to ensure effective removal. It takes about 4-8 times for an area of beach grass to be fully removed. This will include removing any re-sprouts as well as emerging seed bank.

Another important part is informing the public so that park visitors and residents are aware of these invasive species. That will also allow the public to join in the help of restoring the dunes being that this is a labor-intensive job. In order to meet our long term goal, we recommend scheduling eight more volunteer days during the next six months in order to remove all re-growth in our project area. These volunteer days will be labor minimal due to the small amount of effort it takes to pull up beachgrass rhizomes. If this monitoring plan is strictly adhered to, our project will have long-term success and native species will be able to regenerate in the area.

7.2 Assessment of Success

Our projects main goal was to remove 100% of invasive species in the project area in order for native plant establishment. This goal was met, as the project area was eradicated of all invasive species including ice plant, coyote bush and beach grass. We were able to successfully construct two stretch barrows that were used during our work day for hauling beach grass. Though we were able to accomplish these goals, it is essential that the invasive continue to be eradicated to prevent regeneration. This will require continual volunteer support in our project area and strict adherence to our monitoring plan.

Works Cited

"Beach Grass Removal Project." California State Parks, n.d. Web. 04 Dec. 2012. <http://www.parks.ca.gov/?page_id=21575>.

Carter, R.W.G. 1991. Near-Future Sea Level Impacts on Coastal Dune Landscapes. Landscape Ecology. Volume 6: 29-39.

"Dune Geology." *Friends of the Dunes.* N.p., n.d. Web. 04 Dec. 2012. <http://www.friendsofthedunes.org/>.

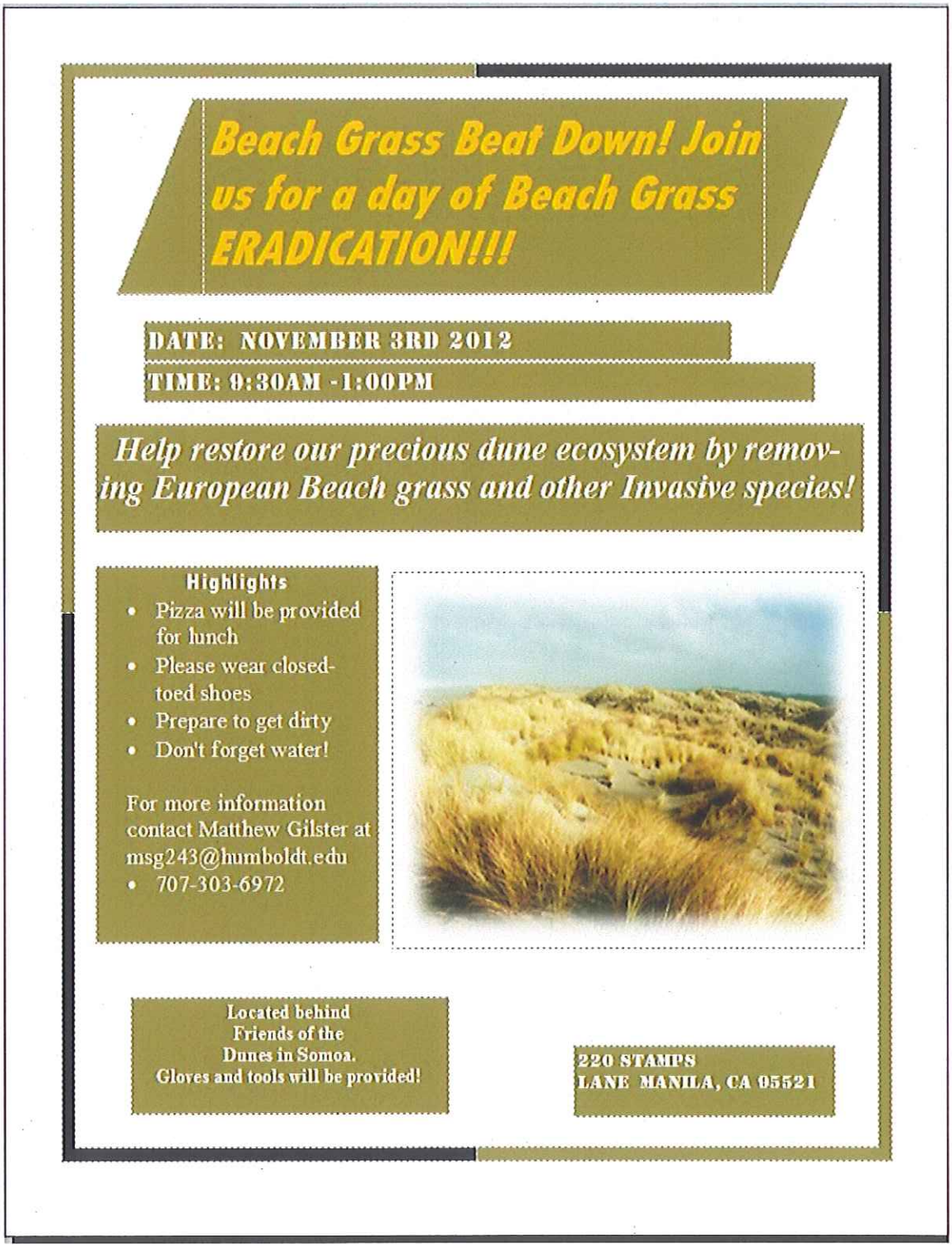
"Invasive Plants of California's Wildland." *California Invasive Plant Council.* N.p., 2012. Web. 3 Dec. 2012. <http://www.cal-ipc.org/ip/management/ipcw/pages/detailreport.cfm@usernumber=5&surveynumber=182.php>.

Mattrick, Christopher. "Managing Invasive Plants." *Conservation Notes of the New " England Wild Flower Society* (n.d.): 20-23. Print.

"Why Is Dune Restoration Important in the. "Coastal Dune Habitat Restoration Project: Why Is Dune Restoration Important?" *National Parks Service.* National Parks Service, 30 Nov. 2012. Web. 04 Dec. 2012. <http://www.nps.gov/pore/parkmgmt/planning_dunerestoration_importance.htm>.

Appendix

Appendix A: Beachgrass work day poster



Pre- Project Transect Pictures Sites 1-6

Site 1.

Site 2.

Site 4.

Site 3.

Site 5.

Site 6.

Post-Project Transect Pictures Sites 1-6

Site 1.

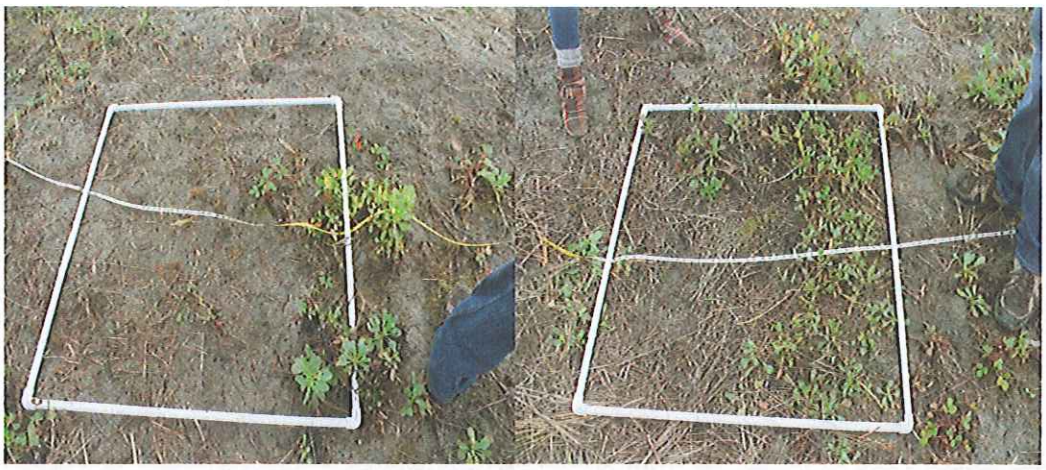
Site 2.

Site 3.

Site 4.

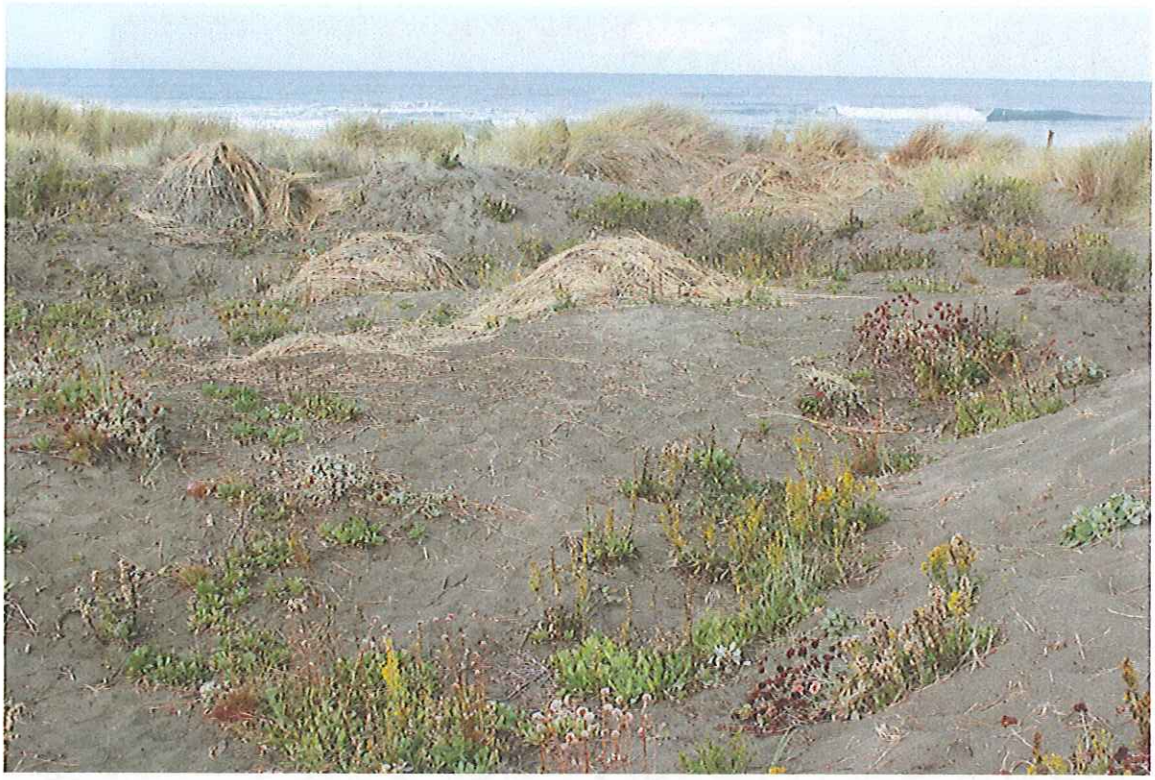
Site 5.

Site 6.



Project Site Prior to Restoration

Project Site Post Restoration



Hour log for entire group as we completed all tasks as a group.

Date	Activity	Hours
9/5/12	Creating objectives	4
9/7/12	Meeting with Friends of the Dunes and creating project ideas. Setting work day for Nov 3rd.	4
9/10/12	Contacting hardware supply stores for donation and creating ideas for the Stretchbarrow	6
9/12/12	Creating poster ideas and design	4
9/17/12	Compiling background data and information on invasive species	5

	removal.	
9/19/12	Thanking donators and Perisons Hardware store and acquiring all supplies for Stretchbarrow projects from Perisons Hardware.	6
9/24/12	Begin construction of Strechbarrow #1 and creation of flyer, advertising for work day.	4
9/26/12	Problem Background and Statement	3
10/1/12	Alternative Solutions and decision making	4
10/3/12	Goals and objectives	4
10/8/12	Strategies for implementation	6
10/10/12	Finish construction of Stretchbarrow #1 and posting flyers	6
10/15/12	Construction of Stretchbarrow #2 begins and follow up meeting with Friends of the Dunes.	7
10/17/12	Weighing alternatives	4
10/22/12	Finish construction of Stretchbarrow #2	5
10/24/12	Monitoring and Evaluation	4

10/29/12	Implementation Strategies	4
10/31/12	Pre-project Monitoring	5
11/3/12	Dune Grass removal work day.	8
11/5/12	Post Project Monitoring	4
11/7/12- 11/14/12	Work on report paper and PowerPoint presentation	10
Total:	107 Hours	