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MOSS LANDING MARINE LABORATORIES

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Monitoring Report: Sand Dune Reconstruction and Restoration,
at the Moss Landing Marine Laboratories
April 25, 1994

Introduction

The Plan for Sand Dune Reconstruction and Restoration (and Biological Assessment) at Moss Landing Marine Laboratories was prepared by ABA Consultants for William Nighswonger of the Office of the Chancellor, California State University. The plan had been requested by the Monterey County Planning Department and the California Coastal Commission and was submitted to the former agency on April 1, 1992. It described reconstruction of dune contours and biological restoration with native dune plants to be carried out over the 8 acre site formerly occupied by the marine labs. The primary effort was to focus on the 2.1 acre area where most of the buildings and structures of the labs had been before their destruction by the Loma Prieta earthquake in October of 1989. The physical dune habitat was to be formed from native sand covering a dune core, a flood control dike, and recontouring the rest of the site which was level.

The plan called for annual reports in letter form which would present data on plant abundance, a short narrative description of changes on the site, progress towards recovery of the plant community, and assessment of progress based on restoration goals and further steps to be taken. This monitoring report addresses those points. In addition it contains a summary of other activities integral in dune restoration - education, public participation, school and conservation organization field trips, as well as the associated activities of restoration, plant collecting, propagation, weed control.

Vegetation restoration over the 2.1 acre area, former site of the labs buildings, was delayed pending the addition of more beach sand. Delays were due to permitting requirements applied to the job of moving sand from the foredune-beach area to the dike and the area behind it, a task presented in the plan. Consequently vegetation restoration efforts were focused on another part of the site. This area is of similar size to the former building site, is immediately adjacent to the south, and extends south to the boardwalk. The area had been heavily trampled by people crossing the dunes from the parking lot to the beach. The intensive disturbance had caused deep ruts and blowouts. About one third of the surface area was of unstable, shifting sands, and was bare of vegetation. Vegetation cover over the other two thirds was virtually all iceplant. European dune grass had established a colony on the seaward edge of the site. The main efforts of dune restoration are currently focused on this area.

Physical

Three primary sources of sand were identified in the plan: wind-blown from the adjacent beach, bulldozed sand from the adjacent beach, sand deposited between the Moss Landing Harbor entrance jetties. Four other possible sources were identified: two of very limited

volume and two of limited practicability. All four were explored and found to be either unfeasible or impossible due to a combination of insufficient volume, expense, or possible pollution.

The first of the three primary sand sources, wind-blown, has been utilized. Drift fences were erected in front of (seaward) and behind the dune core. Sand has accumulated along the foredune drift fence and to the top of the dike in places and about a third of the way up over much of the rest of the dike face along its whole length. The depth of this accumulated sand is as great as 4 feet in places. This is a successful, natural technique for the accumulation of sand. However it is slow. Drift fences erected behind the dune (east side) accumulated minimal sand and were removed after about a year.

The next two primary sources of sand, bulldozing sand from the beach and bringing sand from dredged accumulations in the harbor entrance, were planned to be used from a single, combined operation of beach enrichment. This source would use sand which replenishes the beach annually during spring and summer before it is carried down the Monterey Submarine Canyon during winter storms. Permitting for the activity was drawn out over a year, although appearing to be nearly complete on numerous occasions. However, in March of 1994 the extent of permitting delays was identified to comprise a matter of years, rather than of the days or weeks of the previous year.

Other sources of material for dune contours were identified and utilized. Aromas sands were provided courtesy of the County Department of Public Works. These sands were added along the top of the dike, its landward face and its north edge to augment the contours of the core shape. Lower contours were constructed by forming small mounds with on-site sand dug from pits. The pits were filled with the same silt material used in the main dike, and capped by on-site sands. Aromas sands are planned to be used to further augment contours.

The front and rear face and most of the area behind the dune core were straw-plugged with domestic barley straw in the spring of 1992. The straw helped to stabilize sands on the slope and captured blowing sand. Signs direct foot traffic away from the site and identifies it as a restoration area to be protected. The signs are effective and little erosion or sand disturbance has been caused by trampling.

Straw-plugging was used to stabilize sands on slopes on the current restoration site. However, the prime cause of erosion on these dunes had been trampling by beach visitors. A boardwalk had been placed to allow people to cross the dunes, but much traffic bypassed it and continued the severe trampling. About 1200 linear feet of fence was erected to protect the area. The fence initially formed a barrier to direct most of the foot traffic to the boardwalk and away from the restoration area. The fence was finished in November 1993, completely surrounding the restoration area, and now prevent rather than impedes trespass. Signs were set around the area to identify it as a dune restoration site and to discourage trespass. The fence and signs have been effective at eliminating all or virtually all foot traffic and therefore trampling erosion has been almost completely eliminated.

Two complete series of aerial photographs had been taken January 22, 1992 of the dune system between Moss Landing south jetty and the Salinas River mouth. The photographs were made with 70 mm film from elevations of 3000 feet and 5000 feet. They are archived at the Marine Labs benthic shore facilities. High altitude NASA photographs made during early spring 1994 have been obtained and are also archived there.

Vegetation

Vegetation in front of the dike grows on the native sand brought from the beach by wind and is exclusively sea rocket above the wave wash zone. Farther up the beach beach bur and beach saltbush are dominant, and some yellow verbena, sea rocket and a few American beach grass plants occur. On the dune face native sands extend one third to one half of the way up on average. These are relatively unstable sands, constantly accumulating through wind transport, however they are not trampled and the vegetation is mostly native, nearly free of weeds. Weeds species dominate the non-native soil on the dike, from the western side to the top, and on the east side.

The east portion of the former buildings site, inland from the dike, is nearly completely covered with vegetation. About one third of the vegetation is of native species, primarily beach bur with significant areas covered by salt grass, beach primrose and beach sagewort. The dominant weeds are both annual species, bur clover and Indian melilot. Weed control has been carried out, ice plant has been pulled and most of the annual grasses, mainly ripgut and Mediterranean barley, are pulled before they can set seed. However, weed control was not a priority since all vegetation was to be buried when native sands were introduced, and the weeds which now dominate would be effectively eliminated with a cover of beach sand.

Within the current revegetation/restoration area, most weed control has been directed at iceplant. About 75% of the iceplant there has been killed. Control has been accomplished by spraying with Round-up and hand-pulling. The spraying was carried out through a contract with Thomas Reid Associates, who also killed iceplant over much of the area farther to the south, and some by marine lab workers. Effectiveness of the contract spraying was assessed in a March 1994 inspection and was found to meet or exceed the goal of 80% mortality. Spot spraying and hand pulling will control the patches remaining live iceplant. Hand pulling was accomplished by volunteer groups. The single European dune grass patch within the area is being controlled by physical removal by volunteer groups and should be nearly completely exterminated within the next few months. There is recent evidence that continued physical disturbance to the roots and rhizomes will kill the plants and this is the technique used.

Native species have been planted mainly by outplanting of propagules. That is plants propagated in the greenhouse from seeds or cuttings are grown in containers in the greenhouse until of sufficient size to be transplanted to restoration site. Table 1 presents the results of the monitoring survey (see below) of outplanting success. In addition to outplanting, seeds of mock heather, beach primrose and some beach sagewort were hand broadcast. Also, some natural reseeding has taken place along the north edge of the area,

adjacent to the former building site, where beach sagewort and beach primrose plants are colonizing from previously established plants. Visual inspection of the restoration area provides an overview that is consistent with the quantified data. The area appears disturbed, much bare sand is present and the vegetation is sparse in places, and there are patches of brown iceplant. However, the site appears to be healing: most of the live vegetation is native plants, raw, trampled sand surfaces are not evident, much of the vegetation is small, young, but healthy. Vegetation appears to be covering bare sands, cover appears to be increasing, vegetation appears to be colonizing rather than retreating.

Monitoring

Quantified data were collected from the main revegetation/restoration site. Observations were made on the former building site and semiquantified data collected. These observations are reported above. No quantified data exist to describe the alternate restoration site before revegetation was implemented, however the site had been badly degraded. Iceplant was the vastly predominant plant, covering about two thirds of the area, virtually excluding any other species. The rest of the area was bare sand, disturbed and eroded by constant foot traffic. The following data can be compared with the original condition.

Methods

Monitoring to collect quantitative data was carried out on January 8, February 25 and March 4, 1994 in the fenced area, between the old labs building site and the boardwalk. Here 5 transects 20 m long were established perpendicular to the beach at equal distances from each other. Ten points selected randomly were identified along each transect. At each point a 1 meter square quadrat was placed. Within the quadrat the per cent cover of each species of plant and of bare sand was estimated. Surviving and dead outplants were located by markers (usually the plastic cone the plant was grown in) left adjacent to each plant when it was planted.

Results

Table 1 shows that about 3/4 of about 1000 outplants survived. That is a favorable percentage, particularly considering that much of the material was planted by volunteers with little or no previous experience.

Table 2 shows that one half of the area was bare sand, one third covered by alien plant species and one sixth by native species. These are favorable numbers after a little more than one year of effort. Most of the alien plant cover was being killed or had just been killed when the survey was carried out, and next year the amount of alien species cover will be greatly reduced, possibly completely eliminated. At the same time, the cover by native species will have increased.

Other activities

Greenhouse

The on-site greenhouse was constructed in November of 1992. The greenhouse is used to store propagation materials including deep cells, pots, potting soil, collected seeds; and as a base to process seeds and plant materials. It is used mainly as protection for seed- and cutting-propagated plants being raised for outplanting.

Experiments

Moss Landing Marine Labs students have used the restoration area to carry out class and individual research projects studying ecology and biology of native dune plants.

Plant material

Seeds of native dune plants are collected locally. Seeds must be processed: cleaned, sorted and stored properly. Some species need stratification, or treatment to stimulate sprouting. When ready, seeds are planted in flats or cones to sprout and may then be transferred to a larger container for more growth before being outplanted. Some seeds are used directly for broadcast sowing.

Education

School groups, conservation groups and other volunteer groups including both children and adults contribute their restoration efforts under lab supervisors. A total of 1425 hours of volunteer time has been applied to the restoration project (see Table 3). Volunteer tasks include weed control through hand weeding, straw plugging to stabilize sand, seed collection, greenhouse maintenance, outplanting of plants propagated in the greenhouse, and broadcast seeding. Lessons from tasks performed by volunteers are part of the education gained by the groups. Tasks serve as a vehicle to teach conservation through field observations and personal participation in restoration activities.

Conclusions

The approach to dune restoration applied to the former Marine Labs site is admirable in that there is an emphasis on education of children. A great deal of effort is required to contact schools, and other organizations, deal with logistics of groups and coordinate on-site activities. Volunteer labor may not necessarily be as efficient at restoration tasks as trained workers. However, the lessons in dune ecology gained by hands-on experiences are unique. The value of the experiences both to participants and to the community probably cannot be gained in other ways and are of great importance. This project has been used to perform a much greater service to the community than restoration, important and successful as that has been.

Table 1. Abundance of outplanted native plants sampled in the study area along each plot: survivors by species, sum of total live, sum of total dead, and total percent mortality of plants.

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	total
aster	2	7	0	0		9
beach bur	5	4	2	7	3	21
beach sagewort	121	83	44	51	37	336
buckwheat	9	6	2	0	0	17
gum plant	0	5	2	3	0	10
lizard tail	1	3	1	1	0	6
mock heather	6	3	2	2	0	13
morning glory	1	0	0	0	0	1
poa	1	0	0	1	0	2
poppy	2	0	0	0	0	2
primrose	68	104	59	62	7	300
salt bush	0	1	0	5	2	8
sea thrift	2	2	0	0	0	4
verbena	<u>19</u>	<u>6</u>	<u>0</u>	<u>1</u>	<u>1</u>	<u>27</u>
total live	237	224	112	133	50	756
total dead	73	62	35	13	14	197
per cent dead	24%	22%	24%	9%	22%	26%

Table 2. Estimated total per cent cover by native and alien plant species and bare sand over over the 5 study plots: means (standard deviation), N = 10 observations per plot.

Area	Per Cent Cover		
	Native	Alien	Bare
Plot 1	12 (14)	67 (41)	23 (33)
Plot 2	13 (14)	25 (36)	63 (30)
Plot 3	15 (20)	37 (44)	48 (34)
Plot 4	25 (24)	13 (31)	62 (63)
Plot 5	19 (26)	29 (37)	53 (35)
Average	16.8%	34%	49.8%

Table 3. Volunteer groups participating in Moss Landing Marine Labs dune restoration program, January 1993 through March 1994.

Date	Group	number of participants		
		Children	Adults	Hours
<u>1993</u>				
January 23	Moss Landing neighbors	10	3	1
February 5	Dean Cutter School	30	10	3.5
February 15	Moss Landing neighbors	-	3	1
March 12	Echo Valley School, grade 4	27	4	3
March 13	North County High	25	1	4
March 13	Easter Seal	5	1	3
March 20	Girl Scouts	10	3	2
March 26	Fremont School	32	5	4
March 27	Boy Scouts	11	4	3
April 23	Ohlone School grades 3 & 8	26	4	2
April 23	Notre Dame	34	6	3
April 25	Boy Scouts	36	3	4
May 1	Dean Cutter teachers	-	31	3
May 15	Girl Scouts	9	3	2
May 21	Elkhorn School grade 3	30	6	3
Jun 27	Moss Landing neighbors	6	4	2
July 7	Moss Landing neighbors	1	1	2
October 23	Girl Scouts	12	3	2
<u>1994</u>				
January 22	Fresno Inner city	16	4	3
February 12	Return of Natives	-	3	3.5
March 19	Fresno Boy Scouts	25	4	4
March 26	Sierra Club	2	10	3