

# **Creamery Meadow Post-Restoration Vegetation Inventory**

Prepared for California Department of Parks and Recreation

Prepared By: Karen Shihadeh<sup>1</sup>

Field work completed by: David Founds

28 March 2008



**Ventana Wildlife Society**  
***Conserving Native Wildlife and Their Habitats***

19045 Portola Dr., Ste. F-1  
Salinas, CA 93908

<sup>1</sup>karensihadeh@ventanaws.org; (831) 455-9514

# TABLE OF CONTENTS

<b>ABSTRACT</b> .....	<b>2</b>
<b>INTRODUCTION</b> .....	<b>3</b>
<i>Table 1. The Big Sur River Riparian Restoration Project planting schematic for Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.</i> .....	3
<i>Figure 1. Creamery Meadow project area located in Andrew Molera State Park along the Big Sur River, Monterey County, Ca.</i> .....	4
<i>Figure 2. Three depositional terraces exist within Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.</i> .....	5
<i>Figure 3. Planting phases of the Big Sur River Riparian Restoration Project, Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.</i> .....	6
PROJECT OBJECTIVE .....	6
<b>METHODS</b> .....	<b>6</b>
STUDY AREA .....	6
POST-RESTORATION VEGETATION CATALOGING .....	7
DATA PRESENTATION AND ANALYSIS.....	7
<b>RESULTS</b> .....	<b>7</b>
<i>Table 2. Results of 9 year post-restoration inventory (numbers and biomass) of the Big Sur River Riparian Restoration Project, Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.</i> .....	8
<i>Table 3. Existing trees and their biomass within the phases of the Big Sur River Riparian Restoration Project, Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.</i> .....	9
<i>Table 4. Percent biomass of planted trees from the Big Sur River Riparian Restoration Project, Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.</i> .....	9
<b>DISCUSSION AND RECOMMENDATIONS</b> .....	<b>9</b>
<b>LITERATURE CITED</b> .....	<b>10</b>

## ABSTRACT

The Big Sur River Riparian Restoration Project was initiated by Ventana Wildlife Society in the spring of 1995 and continued through 4 planting phases until April 1998. In 2007, VWS was contracted to conduct a project inventory to document post-restoration plant survivorship. Percent survivorship was evaluated for the entire site and restoration aboveground biomass was ascertained by measuring tree diameter at breast height. The majority of remaining restored plants were found within Phases I and II while relatively few living plants were found in Phase III and Phase IV. A total of 768 plants were documented. The total number of trees originally planted was approximately 3764. The total trees remaining in 2007 was 700. This equals a tree survivorship of 18.6% nine (9) years (1998-2007) post-restoration. Considering only trees, restoration was responsible for 31% of the total aboveground biomass in Creamery Meadow. This equates to substantially more habitat for a variety of wildlife including migratory birds. This study allows resource managers at Andrew Molera Stat Park to better and more cost-effectively strategize site maintenance.

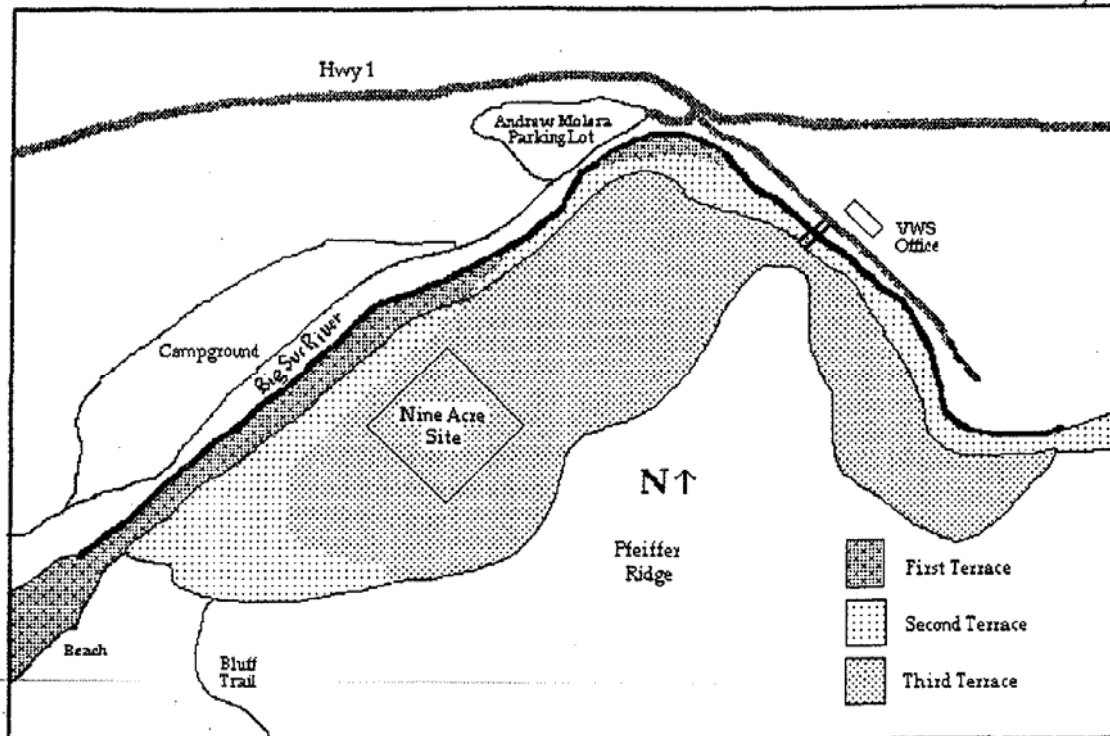
## INTRODUCTION

The Big Sur River Riparian Restoration Project was initiated by Ventana Wildlife Society (then Ventana Wilderness Sanctuary) in the spring of 1995 and continued through 4 planting phases until site maintenance was turned over to California State Parks in April of 1998 (Table 1). Restoration concentrated on the nearly 90-acre area of Andrew Molera State Park known as Creamery Meadow (Figure 1). Geomorphic analysis revealed four major soil types within Creamery Meadow: Tujunga Fine Sand, Fluvents, Pacheco Clay Loam and Gorgonio Sandy Loam as defined by the Soil Conservation Service (1978) underlain by cobble that increased in depth with distance from the river. Watershed Science (1994) categorized the Creamery Meadow as having a two-tiered remnant terrace and an active floodplain. The remnant terrace based on soil distribution and type likely once supported riparian forest. The terrace is a geomorphic feature distinguished from a floodplain in that it is no longer actively being deposited; rather, the Creamery Meadow terrace was deposited as a result of ancient higher sea level (Watershed Science 1994). The two upper terraces, the second 5 feet lower than the first, apparent in the Creamery Meadow suggest at least two events of sea level lowering. The nature of the alluvial fill found in both terraces also suggests that Creamery Meadow is not currently an active floodplain (Watershed Science 1994, Figure 2).

**Table 1. The Big Sur River Riparian Restoration Project planting schematic for Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.**

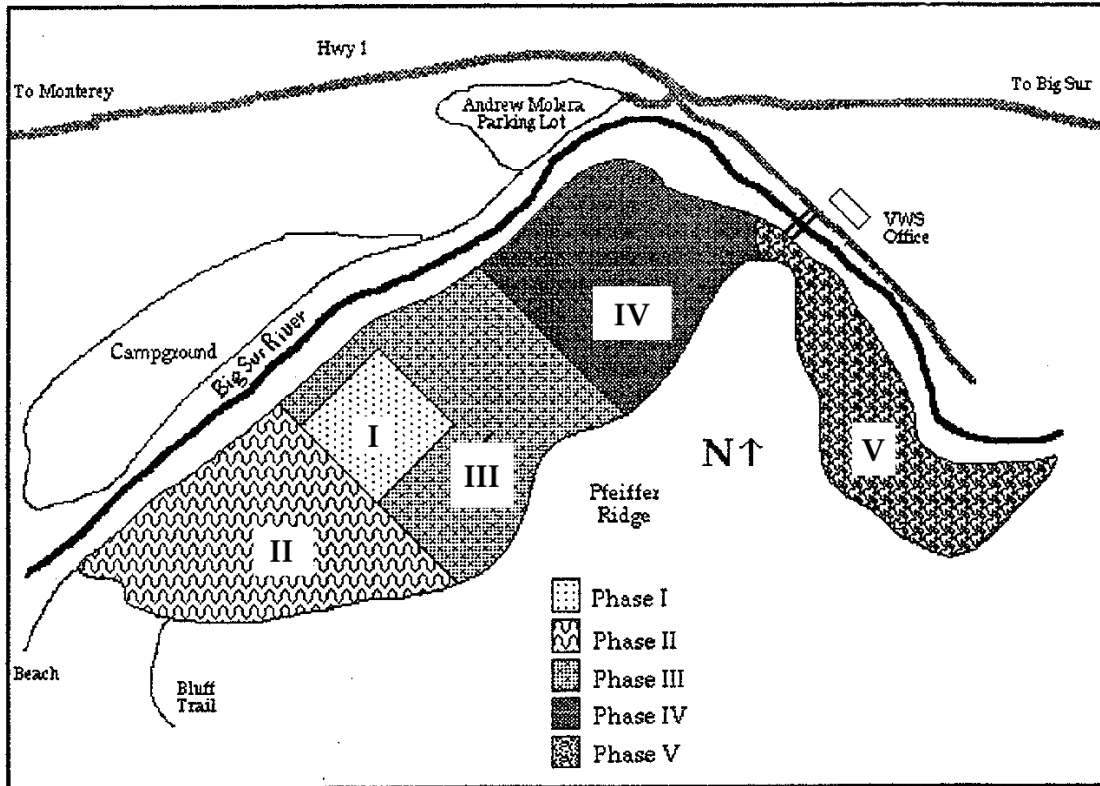
<b>Phase</b>	<b>Planting Completion Date</b>	<b>Acres</b>	<b>Proposed # Plants</b>	<b>Trees</b>	<b>Shrubs</b>	<b>Yrs VWS Irrigated</b>
I	Jun-95	9	900	630	270	3
II	Mar-96	20	1460	1095	365	2
III	Apr-97	20	2140	1636	504	1
IV	Apr-98	20	877	614	263	0
<b>Total</b>			<b>5377</b>	<b>3975</b>	<b>1402</b>	





**Figure 2. Three depositional terraces exist within Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.**

Both soils and existing vegetation, such as cottonwood and willows on the lower terrace and in the active floodplain, suggest Creamery Meadow likely supported a thriving riparian forest. This, along with a management goals of enhancing wildlife habitat, creating greater structural diversity, increasing diversity of vegetation, increasing biologic diversity, restoration of a California ecosystem in limitation (riparian), aesthetics, low cost implementation, and compliance with the General Plan provided justification for the project. The first planting phase was initiated in 1994 and completed in June 1995 on 9 acres in the center of Creamery Meadow. Approximately 900 trees and shrubs were planted. Phase II completed in March 1996 consisted of 1460 plants covering 20 acres at the southwest end of Creamery Meadow. In Phase III, VWS installed about 2140 plants over 20 acres in the center of Creamery Meadow and surrounding Phase I. The final phase, Phase IV, completed in April 1998, covered 20 acres at the northeast end of Creamery Meadow. In this phase 877 plants were installed. A last phase, Phase V was planned for the area outside of the Meadow proper, between the Big Sur River and the River Trail, but was not installed due to lack of continued funding (Figure 3). Phases I-III also were revisited in subsequent years with replacement plantings to fill in where plants were lost to maintain total phase numbers. Thus, the total planting for all 4 phases was approximately 5700 trees and shrubs, planted at an approximate 70:30 ratio. From 1994 to April 1998, VWS was responsible for all maintenance and irrigation. In May 1998, this responsibility was passed on to California Department of Parks and Recreation.



**Figure 3. Planting phases of the Big Sur River Riparian Restoration Project, Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.**

### *Project Objective*

In the fall of 2007, VWS was contracted to conduct a project inventory to document post-restoration plant survivorship. This study allows resource managers at Andrew Molera Stat Park to better and more cost-effectively strategize site maintenance and to plan for restoration augmentation if necessary, to fill-in areas where survivorship was low.

## **METHODS**

### *Study Area*

The portion of the Andrew Molera State Park known as the Creamery Meadow comprises approximately 90-acres of upland, patchily distributed riparian habitat which in areas is overgrown with predominately non-native annual vegetation including poison hemlock, black mustard and wild radish, but also includes native shrubs of bush lupine and coyote brush.

Restoration was implemented at the site in 1994 and continued through April 1998. Original implementation plans included Arroyo Willow (*Salix lasiolepis*), Black Cottonwood (*Populus trichocarpa*), Coast Live Oak (*Quercus agrifolia*), Western Sycamore (*Platanus racemosa*), Big Leaf Maple (*Acer macrophyllum*), Redwood (*Sequoia sempervirens*), California Bay (*Umbellularia californica*), California Buckeye

(*Aesculus californica*), Blue Elderberry (*Sambucus mexicana*), Toyon (*Heteromeles arbutifolia*), Coffeeberry (*Rhamnus californica*), Blackberry (*Rubus ursinus*), Snowberry (*Symphoricarpos albus*), Dogwood (*Cornus sericea*), and California Honeysuckle (*Lonicera hispidula*).

### *Post-restoration vegetation cataloging*

Using restoration design maps and aerial photography, vegetation installed in the 1994-8 Big Sur River Riparian Restoration Project was relocated, tagged and cataloged. Information recorded included species and diameter at breast height in cm. Cataloging took place from October 2007 through January 2008. Trees and shrubs were marked with a unique identification tag to streamline future evaluation. Blackberry, snowberry, and honeysuckle were not included in the inventory.

### *Data presentation and analysis*

Survivorship was tabulated for the project by dividing the total number of surviving individuals by the total individuals planted. Relative species abundance was measured by determining standing biomass of restored tree species and comparing between species. Aboveground biomass was determined using the general allometric regression hardwood and general softwood equations as reported in Jenkins et al. 2004. General equations were used because species specific equations were unavailable for most western species. The aboveground biomass measure is inclusive of the trunk, branches and foliage, but not any underground components, ie., roots. Biomass estimates of restored trees were then compared against existing biomass (or those trees that existed prior to restoration) to determine the increase in riparian habitat in the Creamery Meadow as a result of the Big Sur River Riparian Restoration Project.

## **RESULTS**

A total of 768 plants were documented within the 4 phases of the Big Sur River Riparian Restoration Project planting area: 267 *Quercus agrifolia*, 159 *Populus trichocarpa*, 138 *Salix lasiolepis*, 49 *Sequoia sempervirens*, 46 *Platanus racemosa*, 26 *Sambucus mexicana*, 19 *Aesculus californica*, 13 *Umbellularia californica*, 7 *Heteromeles arbutifolia*, 9 *Acer macrophyllum*, 8 *Cornus sericea*, and 57 *Rhamnus californica* (Table 2). Blackberry (*Rubus ursinus*), Snowberry (*Symphoricarpos albus*), and California Honeysuckle (*Lonicera hispidula*) were not inventoried. Considering the 70:30 planting ratio of trees to shrubs, and disregarding those species considered shrubs in the original scope, Blue Elderberry (*Sambucus mexicana*), Toyon (*Heteromeles arbutifolia*), Coffeeberry (*Rhamnus californica*), and Dogwood (*Cornus sericea*), the total number of trees originally planted was approximately 3764. The total trees remaining in 2007 was 700 (Table 3). This equals a tree survivorship of 18.6% nine (9) years (1998-2007) post-restoration.

The aboveground biomass of riparian trees and shrubs added to Creamery Meadow as a result of the Big Sur River Riparian Restoration Project was 13,551.069 kg. The biomass of restored trees alone was 13,308.91 kg. The aboveground biomass of trees existing in

Creamery Meadow was 29343.2 kg. Considering only trees, restoration was responsible for 31% of the total aboveground biomass to Creamery Meadow (Table 4). Of the restored plants, *Quercus agrifolia* made up the majority of individuals (n= 267) and biomass (3735.78 kg). Of the existing trees, *Populus trichocarpa* made up the majority of the individuals (n=117), while a single, large *Sequoia sempervirens* was responsible for most of the biomass (13,142.4 kg). In fact, the biomass of this single large redwood was equivalent to the total restored biomass. Removal of the redwood from the comparison between restored and existed plants revealed that the restoration project almost doubled the aboveground biomass of Creamery Meadow (Table 4).

The majority of remaining restored plants were found within the areas designated as Phases I and II. Relatively few living plants were found in Phase III and Phase IV.

**Table 2. Results of 9 year post-restoration inventory (numbers and biomass) of the Big Sur River Riparian Restoration Project, Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.**

Species	Common Name	Designation	Count	Aboveground Biomass/90 acres (kg)
<i>Quercus agrifolia</i>	Coast live oak	Tree	267	3735.78
<i>Populus trichocarpa</i>	Black cottonwood	Tree	159	3245.16
<i>Salix lasiolepis</i>	Arroyo willow	Tree	138	3152.92
<i>Sequoia sempervirens</i>	Coast Redwood	Tree	49	2568.76
<i>Platanus racemosa</i>	Western Sycamore	Tree	46	462.27
<i>Sambucus mexicana</i>	Blue elderberry	Shrub	26	188.006
<i>Aesculus californica</i>	California Buckeye	Tree	19	82.1282
<i>Umbellularia californica</i>	California Bay Laurel	Tree	13	32.3733
<i>Heteromeles arbutifolia</i>	Toyon	Shrub	7	30.2857
<i>Acer macrophyllum</i>	Big Leaf Maple	Tree	9	29.5187
<i>Cornus sericea</i>	Western Creek Dogwood	Shrub	8	23.867
<i>Rhamnus californica</i>	Coffeeberry	Shrub	27	-
<b>Total</b>			<b>768</b>	<b>13,551.069</b>
<b>Total trees only</b>			<b>700</b>	<b>13,308.91</b>

**Table 3. Existing trees and their biomass within the phases of the Big Sur River Riparian Restoration Project, Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.**

Species	Common Name	Count	Aboveground Biomass/90 acres (kg)
<i>Sequoia sempervirens</i>	Coast Redwood	1	13,142.4
<i>Platanus racemosa</i>	Western Sycamore	40	8705.65
<i>Populus trichocarpa</i>	Black cottonwood	117	4816.91
<i>Umbellularia californica</i>	California Bay Laurel	4	2238.1
<i>Quercus agrifolia</i>	Coast live oak	5	440.121
<b>Total</b>		<b>167</b>	<b>29,343.2</b>
<b>Total (redwood removed)</b>		<b>166</b>	<b>16,200.78</b>

**Table 4. Percent biomass of planted trees from the Big Sur River Riparian Restoration Project, Creamery Meadow, Andrew Molera State Park, Big Sur, Ca.**

	All Trees	Existing Redwood removed
<b>Total Biomass/90 acres (kg)</b>	42,652.0912	29,509.6912
<b>% Restored</b>	31.20%	45.10%
<b>% Existing</b>	68.80%	54.90%

## DISCUSSION AND RECOMMENDATIONS

Although the overall tree survivorship of the Big Sur River Riparian Restoration Project was very low at less than 20%, it still almost doubled the total riparian tree biomass in Creamery Meadow. This equates to substantially more habitat for a variety of wildlife including migratory birds. Consider also, that restored trees are still young while existing trees are mature. Biomass estimation is a good measure of stand productivity and carbon pool (Jenkins et al. 2004) and it is mature trees that account for the majority of carbon in any one plot (Harmon et al. 2004). In a 500-year-old forest system at Wind River Canopy Crane Research Facility, 99.2% of biomass was attributed to mature trees (Harmon et al. 2004). Thus, we may anticipate that as they age, these restored trees will greatly enhance riparian productivity of Creamery Meadow.

The low project survivorship can likely be attributed to lack of irrigation post-installation. And this still threatens the continued survival of plants. The large die-offs of Phases III and IV likely occurred following installation of Phase IV. This is because irrigation was sporadic at best following Phase IV installation. To maintain a restored site like Creamery Meadow, irrigation must be maintained 3-5 years following installation. Unlike Phases III and IV, Phases I and II fared fairly well. Phase I had three years of

irrigation and maintenance following installation, while Phase II had two years. Together there were 1725 trees planted in Phases I and II. In these phases covering 29 acres, survivorship approached 35%. Yet, this inventory also revealed that many plants while still alive are under severe stress and will not survive without intervention.

In order to maintain the current standing trees in Creamery Meadow, we recommend the following:

- Remove all blue protective tubes that are restricting tree growth or have otherwise collapsed onto vegetation.
- Replace blue tubes with cages to eliminate browsing of smaller saplings.
- Reinstall a drip irrigation system within the 29 acres of Phases I and II for small trees and maintain irrigation for minimum of 3 years.

## LITERATURE CITED

Harmon, M.E., K. Bible, M.G. Ryan, D.C. Shaw, H. Chen, J. Klopatec, and X. Li. 2004. Production, respiration, and overall carbon balance in an old-growth *Pseudotsuga-Tsuga* forest ecosystem. *Ecosystems* 7:498-512.

Jenkins, J.C., D.C. Chojnacky, L. S. Heath, and R.A. Birdsey. 2004. Comprehensive database of diameter-based biomass regressions for North American tree species. USDA Forest Service Northeastern Research Station General Technical Report NE- 319. USDA Forest Service, Newton Square, PA.

Soil Conservation Service (SCS). 1978. Soil Survey of Monterey Ca., CA.

Ventana Wildlife Society (Ventana Wilderness Sanctuary). 1994. The Big Sur River Riparian Restoration Project Andrew Molera State Park- Creamery Meadow. Project implementation plan prepared for California Department of Parks and Recreation. Big Sur, CA.

Watershed Science. 1994. Fluvial Geomorphic and hydrologic characterization of Creamery Meadow including recommendations for reforestation and management. Technical report submitted to Ventana Wildlife Society, Aromas, CA.