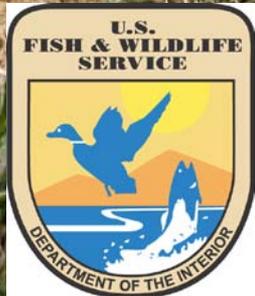


# *Spartina densiflora* Eradication in the San Francisco Estuary

*Drew Kerr, Co-Manager Field Operations*  
*State Coastal Conservancy Invasive Spartina Project*  
[www.spartina.org](http://www.spartina.org)



*Humboldt Bay Spartina densiflora Symposium*  
*Wharfinger Building, Eureka, CA*  
*June 30, 2010*



# **San Francisco Estuary Invasive *Spartina* Project**

**Created in 2000 by the California State Coastal Conservancy and the U.S. Fish and Wildlife Service to coordinate Estuary-wide *Spartina* control efforts**

**Funding from the Conservancy is directed to nine grantees positioned around the Estuary**

**Grantees implement Site-Specific *Spartina* Control Plans produced by the ISP, according to programmatic environmental permitting and documentation (PEIR and USFWS BO)**

**Extensive monitoring and mapping inform Control Program**

**Currently beginning 6<sup>th</sup> season of full-scale implementation of an Estuary-wide *Spartina* control effort**

**Goal at inception of arresting the spread and eventually eradicating (eliminating) non-native *Spartina* from the San Francisco Estuary.**

# What is invasive *Spartina*?

*Spartina* is a cordgrass that grows in salt marshes, mudflats and brackish channels

Four introduced species of *Spartina* invading San Francisco Bay



**Hybrid  
*Spartina alterniflora***



***Spartina densiflora***



***Spartina anglica***



***Spartina patens***



***Spartina foliosa*** – the only native cordgrass species in San Francisco Bay marshes

# ***Why is invasive Spartina a Problem?***

Degrades endangered species habitat

Hybridizes with native Pacific cordgrass

Dominates mudflats and restoration sites

Reduces flood control capacity

Creates mosquito breeding areas



# LANDSCAPE LEVEL CONTROL PROGRAM

168 sites  
within 26 complexes

2005 Baywide infestation  
≈ 2000 acres

2009 Baywide infestation  
≈ 250 acres

2010 Baywide infestation  
<100 acres

Majority of Bay-wide infestation  
is composed of  
hybrid *Spartina alterniflora*

Map from 2008-2010  
Site-Specific *Spartina* Control  
Plans



# ***Conservancy Grant Recipients***

- **San Mateo County Mosquito Abatement District**
- **East Bay Regional Parks District**
- **Friends of Corte Madera Creek Watershed**
- **City of Alameda**
- **City of Palo Alto**
- **City of San Leandro**
- **USFWS, Don Edwards National Wildlife Refuge**
- **Alameda County Public Works**
- **California Wildlife Foundation**
- **California Department of Parks and Recreation**

**These entities use the grant funds to either hire contractors or use their agency staff to implement the site-specific *Spartina* control plans in their area**

# Who is doing the treatment work?

## Ground, Water & Airboat Treatment

- Aquatic Environments, Inc.
  - Clean Lakes, Inc.
  - West Coast Wildlands, Inc.
  - Alameda County Flood Control District
  - San Mateo County Mosquito & Vector Control District
  - East Bay Regional Parks District (EBRPD)
  - Alameda County Department of Agriculture
  - US Fish & Wildlife Service
  - Conservation Corps North Bay
  - Santa Clara Valley Water District
  - National Park Service (Pt. Reyes)
- 



**Hose from truck with extra long wand attached for longer reach**

**Backpack application**



**Argo amphibious tracked vehicle has very low ground pressure. It can go where you can't even walk**

Airboat operations take a power sprayer out to heavily infested areas where Argos can't go, and during tides in which an outboard boat can't operate.



Just a few inches of  
water on an outgoing  
tide = max dry time

Using the airboat to deploy backpack applicators and ISP staff to return to known *Spartina* points scattered over the vast marshes of Don Edwards National Wildlife Refuge



# Helicopter Boom Applications

Over approximately 200 acres in 2009  
Down from 1350 acres in 2006

ISP uses either 5% imazapyr in 15gpa  
or 7.5% in 10gpa (1% Liberate or  
Competitor for surfactant)



# Aerial Applications

Ultra-efficient over uniform cover of the target plant

Need to use an herbicide that works at low volume

Probably the least impactful method of *Spartina* application (pickleweed, the dominant salt marsh plant in SF Bay, is relatively unimpacted by imazapyr, and also thrives from competitive release)

Highly cost effective over big infestations

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Spot treatment presents challenges but can be very effective

- In scattered infestations, the pilot must be engaged in your project to comprehensively search out all the individuals
- Turning the boom on and off to hit small patches can yield unpredictable results
- Low volume/high concentration doesn't always provide adequate coverage on spots or in hard-to-reach areas (down into channels)

# Selecting Optimal *Spartina* Treatment Method

ISP Pilot Projects with manual and mechanical removal

Lessons learned from *Spartina* management in Willapa Bay, WA

- Glyphosate herbicide wasn't working (not in SF Bay either)
- Washington State University research on imazapyr

ISP Pilot Projects with imazapyr (2004) under Experimental Use

ISP commissioned an independent study (Leson & Associates) on the use of imazapyr on *Spartina* in the San Francisco Estuary

<http://www.spartina.org/referencemtrl/SF-Imazapyr-EA.pdf>

California Department of Pesticide Regulation registration of aquatic formulation of Imazapyr (Habitat®) on August 30, 2005

Approval as integral part of USFWS Biological Opinion on ISP's 2005-2007 Site-Specific *Spartina* Control Plans (Sept. 7, 2005)

# What is Imazapyr?

A non-selective, systemic herbicide; works on both monocots (grasses, sedges, etc.) and broad-leaved plants

ISP partners using the aquatic formulation of imazapyr (Habitat® or Polaris™) approved for estuaries

Acetolactate synthase inhibitor (ALS inhibitor);  
Inhibits key enzyme required for biosynthesis of 3 amino acids (the branched-chain aliphatic) needed for growth; **animals don't produce these but rather acquire by consuming plants.**

Surfactant added to lower surface tension of liquid and improve: spreading over the leaf, adherence to the plant, and penetration of the leaf cuticle

ISP uses two surfactants: one is lecithin [soy bean] based (Liberate), and second is a methylated vegetable oil (Competitor)

ISP **does not** use products containing nonylphenol ethoxylate (suspected endocrine disruption in fish) despite their high effectiveness

# Imazapyr Toxicity

US EPA considers imazapyr “practically non-toxic” to wildlife, including mammals, birds, fish, and aquatic invertebrates  
This is the lowest category of toxicity.

Fish  $LC_{50}$ =22,305 mg/L

ISP water quality monitoring – highest sample 0.5mg/L immediately post-treatment; followed by 97-99% reduction in 1<sup>st</sup> week

Low potential to bioaccumulate

Human acute exposure assessments apply to oral (ingestion), dermal, and inhalation; both incidental public contact as well as safety of the applicator working with concentrate

## **Patten (2003) Persistence Field Studies (J. Aquatic Plant Mgnt)**

Imazapyr primarily broken down in water by photolysis  
(half-life=2.5-5.3 days)

Sunlight reduced imazapyr below detection quickly in estuary water  
(within avg. 40 hrs) and from mudflat sediment in 400 hrs.

***Sarcocornia pacifica* (pickleweed) is able to resist impact from imazapyr & also benefits from release from competition with invasive *Spartina***



# *Spartina densiflora* Control Methods

Digging & pulling



Herbicide application



Mechanical mowing

# Constraints on *Spartina densiflora* Control in San Francisco Estuary



- Entry to California clapper rail marshes during breeding season
  - Until 2008, ISP was not permitted entry before Sept 1
  - *S. densiflora* has already set seed by July, AND is less likely to take in the herbicide in Sept. because of senescence
- Not able to mow initially to preserve refugia for rails (even the standing dead mass)

# Manual Treatment of *Spartina densiflora*

*Spartina densiflora* is a bunchgrass that doesn't spread by rhizomes, so individual plants can be dug without exacerbating the infestation.



Photos courtesy of Sandy Guldman,  
Friends of Corte Madera Creek

Removing large, mature *Spartina densiflora* plants from  
channel banks along South Eliseo in Marin County



Photo courtesy of Sandy Guldman,  
Friends of Corte Madera Creek



**Accessing a residential shoreline infestation of *Spartina densiflora* for manual removal by shallow-bottom boat**

Photo courtesy of Sandy Guldman,  
Friends of Corte Madera Creek

In 2008, the Conservation Corps dug out and hauled  
**13 TONS** of *Spartina densiflora* from the Corte Madera  
Creek watershed (Marin County)



Photo courtesy of Sandy Guldman,  
Friends of Corte Madera Creek

# Herbicide Treatment



# Marsh of the Living Dead

Established stands of *S. densiflora* one year post-treatment can display this yellow/green/grey, half-dead appearance

Not healthy enough to translocate herbicide

Managed with mowing to illicit new green growth susceptible to herbicide

One treatment does appear to stop 2 years of seed production, a valuable tool, and kills some of the plants



# The Living Dead - Up Close



# And then there are the Dead



# Mowing Pilot Project 2008 Under Clapper Rail Constraints



# Mowing of previously herbicide-treated *Spartina densiflora* in mid-elevation marsh

- removes dead (or **partially-dead**) above-ground biomass allowing for best assessments of current plant status and development of an adaptive IPM (Integrated Pest Management) treatment strategy

Hummocks accreted by mature *Spartina densiflora* plants



Photo courtesy of Sandy Guldman,  
Friends of Corte Madera Creek

# Mechanical Treatment of *Spartina densiflora*

- *Weakens the reserves of the plants by interrupting the transfer of nutrients back down to perennial roots*



Photo courtesy of Sandy Guldman,  
Friends of Corte Madera Creek

Mowing and bagging 3 mo. post-treatment  
*Spartina densiflora* meadow at Creekside Park

November 2008

Wrack was raked into piles near the truck path. At more remote locations the plants were bagged and heaved across channels



# Post-Mowing Herbicide Application to *Spartina densiflora*

Reduces amount of herbicide required due  
to decrease in above-ground biomass

If herbicide is effective, the marsh plain  
does not need to be destroyed by digging  
all of these plants from this meadow





Lush pickleweed colonizing Creekside Park area from previous slide that was a meadow less than 2 years ago (photo 6/28/10).

Herbicide treatment and mowing to the ground

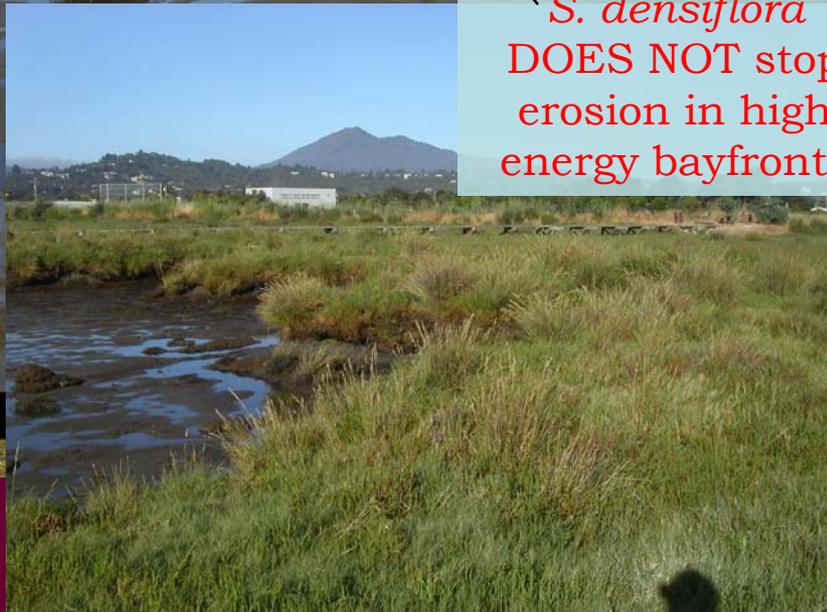
Successful control with imazapyr has resulted in 93% of *S. densiflora* sites shifting to purely manual treatment conducted by a team of ISP biologists in 2010



*S. densiflora* X *foliosa* hybrid



# Pickleweed Park (now known as Tiscornia Marsh) in 2003



# Pickleweed Park/Tiscornia Marsh

## June 6, 2010



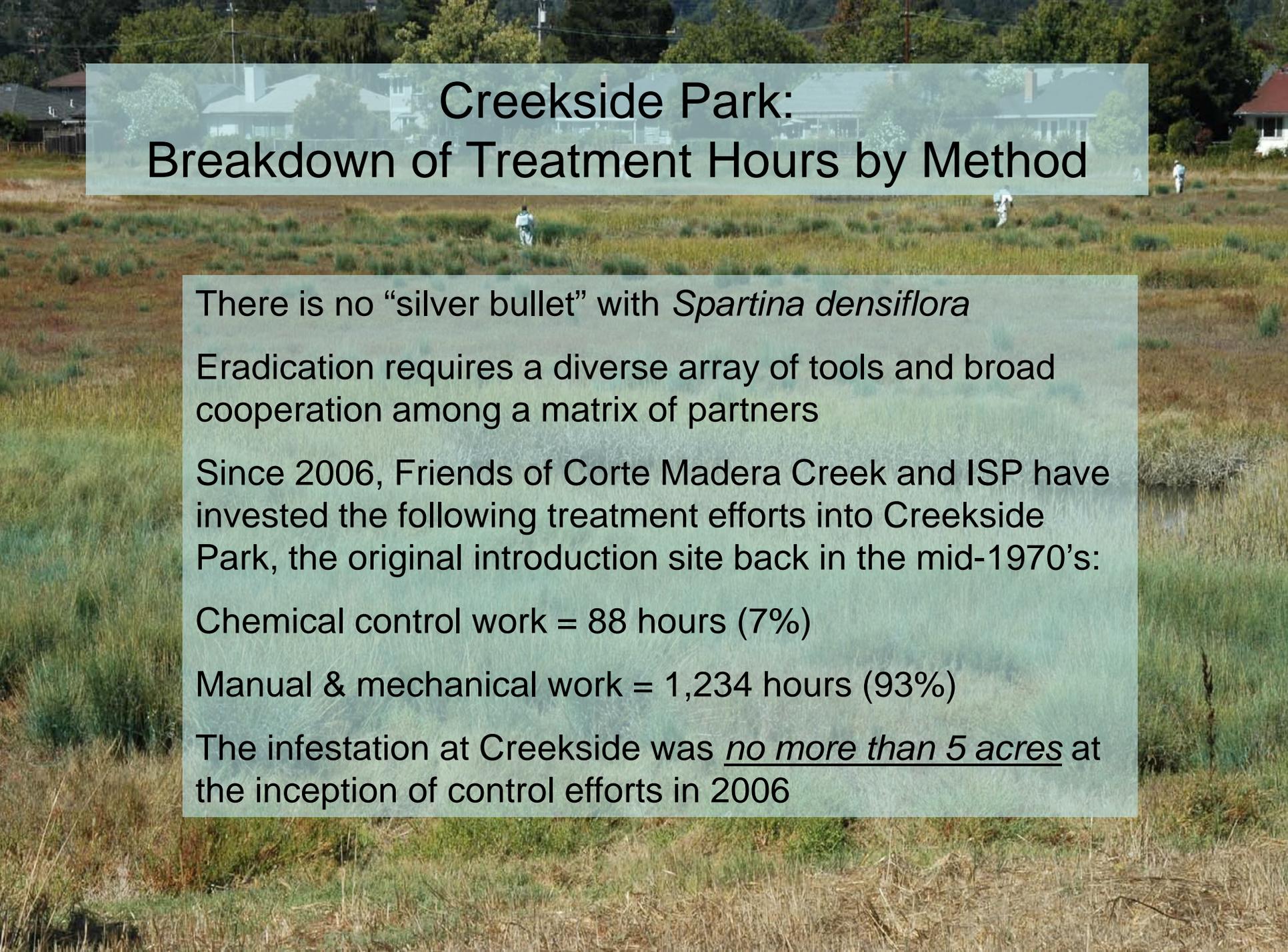
An example of a successfully implemented ISP Site-Specific Control Plan with an adaptive IPM strategy that developed over several years

2004 – Digging with Conservation Corps on large, mature plants

2005-2008 – Imazapyr applications once a year

From 2005-2007, conducted in September because of clapper rail restrictions. This late treatment is much less effective on the senescent plants & viable seed is produced in quantities.

2009 & 2010 – Several hours of manual removal 2X in 2009 (spring/autumn). In 2010, just a single small area with a cluster of 15 small plants



# Creekside Park: Breakdown of Treatment Hours by Method

There is no “silver bullet” with *Spartina densiflora*

Eradication requires a diverse array of tools and broad cooperation among a matrix of partners

Since 2006, Friends of Corte Madera Creek and ISP have invested the following treatment efforts into Creekside Park, the original introduction site back in the mid-1970's:

Chemical control work = 88 hours (7%)

Manual & mechanical work = 1,234 hours (93%)

The infestation at Creekside was no more than 5 acres at the inception of control efforts in 2006

# Marin Outliers Sites: Example of Successful Adaptation of an Integrated Pest Management (IPM) Strategy

- Within the Estuary, there are 15 sites with *Spartina densiflora* outside Corte Madera Creek
- 3 years of combined treatment with herbicide and digging
- 13 out of these 15 sites were reduced enough to warrant limited manual removal by trained biologist staff members in 2009 (2X; spring and autumn).
- All 15 sites were completed in two weeks in 2010, yielding a few bags each
- These sites have progressed beyond chemical treatment in the long-term ISP Site-Specific Control Plans
- Seedlings account for a significant proportion of lingering infestation so seed suppression with imazapyr has been priceless, and earlier entry to the marshes with clapper rails allows for a potential 100% seed/propagule capture

# Can I get a hand?

