Invasive *Spartina* Project at a Turning Point: Eradication on the Horizon, Reconciling Clapper Rail Impacts, and Native Cordgrass Reintroduction

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What is invasive *Spartina*?

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

Four introduced species of *Spartina* in San Francisco Bay:

- Hybrid *Spartina alterniflora*
- *Spartina densiflora*
- *Spartina anglica*
- *Spartina patens*

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

- *Spartina alterniflora* introduced circa 1976
- Spread slowly for years (seeds, propagules, vegetatively)
- Hybridization w/ native *S. foliosa* discovered mid-90’s
- Backcrossing of multiple generations (Introgression of highly fertile hybrid swarm)
- Emergence of novel, ecologically distinctive phenotypes
- Transgressive traits = can exploit all niches
Variety of hybrid forms beginning to dominate the beautiful native *S. foliosa* meadow at Calaveras Marsh (2010)

These invaders were cryptic hybrids just 2 years earlier that did not show these obvious phenotypic traits
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

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

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)

Annual surveys over 35,000 acres inform Control Program

Currently in the 7\textsuperscript{th} season of full-scale implementation of an Estuary-wide *Spartina* control effort
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
Eradication of invasive *Spartina* is a key first step in the South Bay Salt Pond Restoration Project, the most ambitious wetland restoration on the West Coast. A Federal, State & private foundation partnership bought 16,500 acres of salt ponds from Cargill for $100 million in 2003.
Recent Additions:
• 2007 Nordstrom/Shorebird Marsh, Marin
• 2008 Richmond Parkway Marsh, Contra Costa
  KGO Towers Marsh, Alameda
  Triangle Marsh, Marin
• 2009 Baumberg Marshes, Alameda
  Plummer Creek Mitigation Marsh, Alameda
  Color Spot Marsh, Contra Costa
  Outer Bair Island, San Mateo

2011 SF-2

Watch List:
• Island Ponds
• SF-2
• Knapp Tract
Ecosystem Engineer: *Spartina* marsh built in < 20 years by sediment accretion due to hybrid *Spartina* colonization of mudflats.
MLK Mitigation Marsh, constructed in 1998 (photo 2005)
Hybrid *Spartina* invading the open mud of Middle Bair Island Restoration opened autumn 2008

Photo taken from airboat during treatment (Sept. 2010)
REGIONAL CONTROL PROGRAM

170 sites within 24 complexes

2006 Baywide infestation:
Over 800 net acres within 24,000 acres of tidal habitat

2010 Baywide infestation
<100 acres

2011 Baywide infestation
<50 acres

99% of remaining Baywide infestation is composed of hybrid *Spartina alterniflora*
Helicopter Boom Applications

89% reduction in the number of acres treated by helicopter in 2010 compared with 2006

ISP partners now able to minimize aerial applications because of the success of treatment

In most cases, ground-based methods are now more appropriate AND more effective
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.
Audubon Marsh
Don Edwards National Wildlife Refuge
Airboat has been invaluable for treatment on mudflats and to access sites on the proper tidal regime for successful control by maximizing dry time exposure.
Using airboat to refill backpacks at Cooley Landing in East Palo Alto
Backpack applications continue to be a big part of the eradication work, especially as infestations dwindle.
ISP Monitoring Program staff in Mowry Marsh using helicopter monitoring data collected 2 weeks earlier to guide 3 backpack applicators with GPS to the hybrid Spartina needing treatment.
The labor and time-intensive work of treating scattered small infestations in these vast marsh and mudflat systems (above new breach of Mt. Eden Creek)
Colma Creek 2006 (after one year of partial treatment)
Old Alameda Creek 2006 (untreated)
Old Alameda Creek 2009 (after 3 seasons of full treatment)
Progress Towards Eradication of Invasive Spartina

Year

Calculated Net Acres

2004 2005 2006 2007 2008 2009 2010

0 100 200 300 400 500 600 700 800 900

Net Spartina cover
Progress Towards Eradication

Colma Creek/San Bruno Complex
2006 infestation = 54.4 net acres
2010 infestation = 1.6 net acres

Alameda Flood Control Channel
2004 infestation = 135.3 net acres
2010 infestation = 0.9 net acre

West Bay Complex
2004 infestation = 73.7 net acres
2010 infestation = 4.3 net acres

Eden Landing/Whales Tail Complex
2005 infestation = 80.6 net acres
2010 infestation = 0.7 net acre
Prospectus for 2013

PRIOR TO DELAYED 2011 BIOLOGICAL OPINION

- ~90% (153 of 170) sites @ the first year “zero detection”
  - 3 years of zero detection until that infestation would be considered “eradicated” (possibly 2016 for these 153)

- ~10% (17 of 170) sites will require treatment for at least 3 more years
  - Add 3 years of zero detections, and these sites could be at eradication by 2019
Clapper Rails and Hybrid *Spartina*

- Reduced macroinvertebrates
- Displaced native *S. foliosa*
- Dominated native marshes
- Filled in channels

- Created new tidal marsh
- Provided excellent cover

→ Clapper rail populations expanded and grew

Slide courtesy of Jen McBroom (ISP)
• Entry to California clapper rail marshes during breeding season
  • Until 2008, ISP was not permitted entry before Sept 1 (either to inventory sites or to treat them on the ground). Full comprehensive treatment of all Spartina sites was AN IMPOSSIBLE TASK for the first 3 years.
  • Hybrid Spartina alterniflora flowers by July/August, enabling pollination of neighboring S. foliosa and creation of hybrid seed
San Francisco Peninsula
San Leandro Bay
Hayward Shoreline

27 sites total

Slide courtesy of Jen McBroom (ISP)
Three Regions Combined

![Graph showing Spartina Inventory (HA) and Clapper Rail Count from 2004 to 2011. The graph indicates a decrease in Clapper Rail detections over time while the Spartina Inventory remains relatively stable. The data is courtesy of Jen McBroom (ISP).]
**Sarcocornia pacifica** (pickleweed):

- Minimal impact from imazapyr
- Benefits from competitive release from hybrid *Spartina*
- Widespread passive revegetation after *Spartina* treatment
What’s Next…?
Detected clapper rail in 2010 & 2011

Slide courtesy of Jen McBroom (ISP)
ISP Revegetation Work

• Most of the active revegetation efforts have been on hold until ISP gained sufficient control over the hybrid *Spartina*
  – Planting native *S. foliosa* was not an option (with pollen swamping it would become an agent for hybrid seed)
  – Robust hybrid would engulf neighboring plants
  – Plantings could be destroyed during future treatment
  – State budget crisis and bond-funded work stoppage 2009

• Imazapyr has little effect on pickleweed (*Sarcocornia pacifica*) so many sites have experienced *extensive* passive revegetation
ISP Revegetation Work

ISP Draft Revegetation Plan (2011) includes:
- Site selection criteria & ranking system
- Plant palette focused on *S. foliosa*, *Grindelia stricta*, and high marsh ecotone
- Reference sites
- Ground-truthing digitized planting zones
- Monitoring plan
- Success criteria (short, medium & long-term)

Coastal Conservancy has convened a Technical Advisory Committee (TAC – 1st meeting Oct. 2011) to review and provide expert input to enhance the plan.

ISP Revegetation Work

- Winter 2010/2011: ISP began pilot project planting native *Spartina* at two sites [applied research that can inform SBSP]
- Pilot projects 2011-2013 at up to 20 sites
- Reintroduce *S. foliosa* to areas like Eden Landing where:
  - native was assimilated into the hybrid swarm
  - no cordgrass component after successful treatment
- Focus on sites with existing marsh structure as well as freshly opened areas (former salt ponds) within a marsh complex
- Medium-term goal of passive intra-site dispersal
- Also focused on *Grindelia* where under-represented (provides big benefits to clapper rails)
- Partnering with Save the Bay’s volunteer-based planting programs in high marsh ecotone
Monocot propagation beds at The Watershed Nursery
Restoration Mantra: Build it and they will come…

If we can propagate dogs can we also propagate clapper rails?
Alameda Flood Control Channel
Pre-treatment in 2005

Alameda Flood Control Channel
Approaching eradication in 2010
Dense meadow of coalesced clones of hybrid *Spartina* at the mouth of the Alameda Flood Control Channel (2005)

Pond 3 (aka Ecology Marsh): original *S. alterniflora* introduction from the East Coast in 1976
Cargill Mitigation Marsh 2006 (1 year aerial treatment)

The brown *Spartina* was killed or impacted from the first aerial work in 2005
Cargill Mitigation Marsh 2009 (after 4 seasons of aerial treatment)

The green in the marsh is almost exclusively pickleweed

This 50-acre marsh was treated by backpack in just a couple hours in 2010. It was 70% infested in 2005.
Can I get a hand?