Occupancy and Control of Perennial Pepperweed (*Lepidium latifolium*) in Salt Marsh of San Pablo Bay National Wildlife Refuge

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USFWS, Inventory and Monitoring Program

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Partners

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Ingrid Hogle (Invasive Spartina Project)
Shelterbelt Builders

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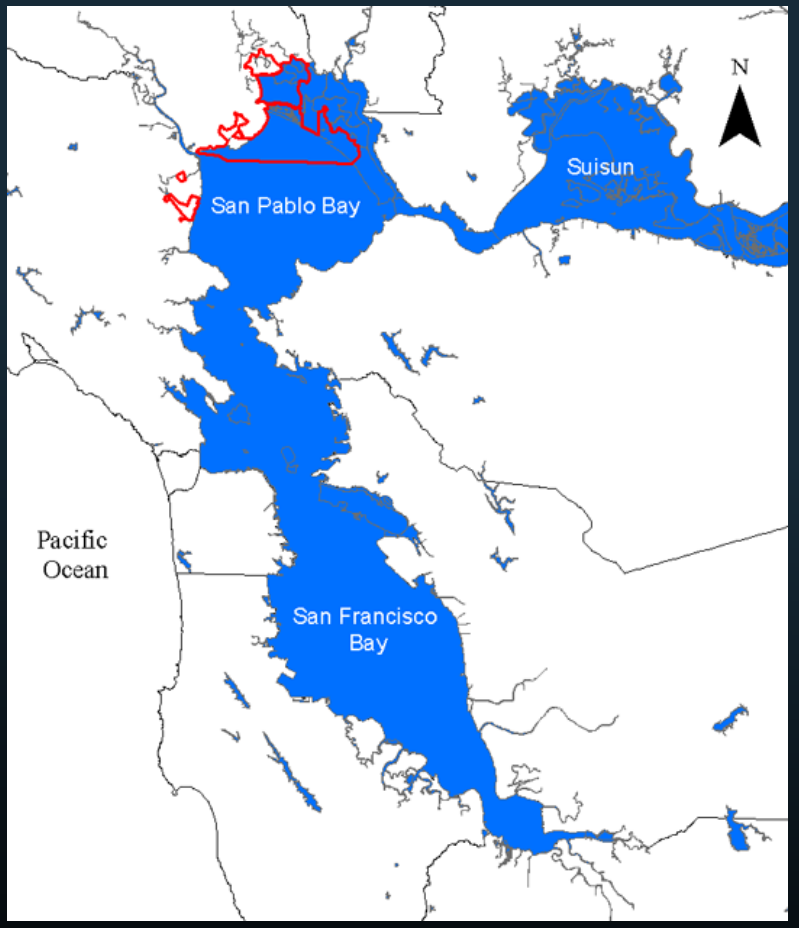
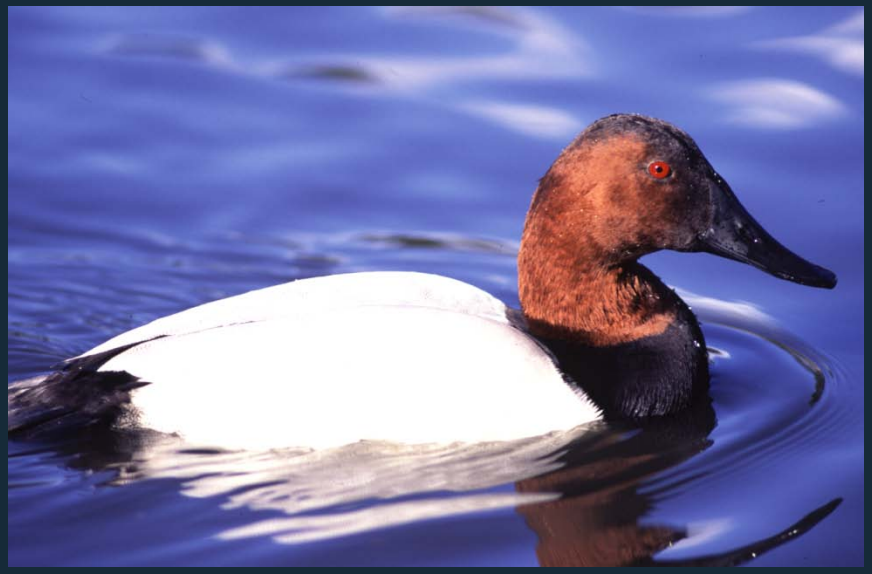
San Pablo Bay National Wildlife Refuge

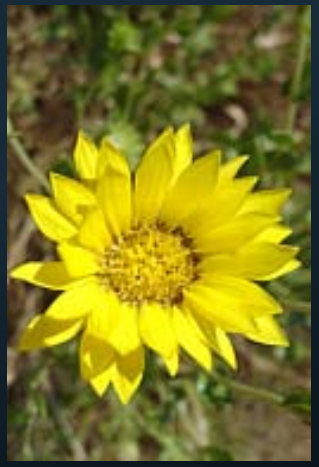
17,500 acres

Estuarine system

- salt marsh
- mudflats
- subtidal







Lepidium latifolium Control Program (2004-present)

Fundamental Goal

Improve structure and function of tidal marsh by reducing stressors such as invasive plants

Lepidium latifolium Management Objectives

Reduce cover of Lepidium latifolium

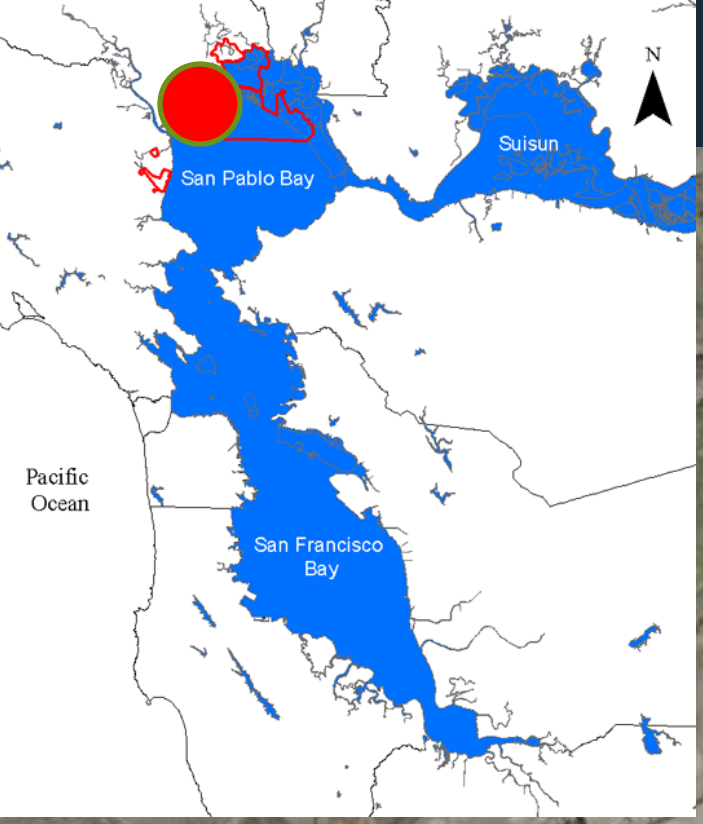
Strategies

Inventory
Develop and Implement Control Plan
Restore native tidal marsh vegetation
Adapt and Learn

Inventory (2,094 acres)

Tidal Marsh
2005-06 and repeated in 2010
Field Based (GPS-Trimble GeoXT)
Patch = Polygon
Inter-patch distance: 10-m
Data:

- date, observer, location
- cover class (<1%, 1-10%, 11-25%, 26-50%, 51-100%)
- phenology, landcover features



San Pablo Bay

Treatment

Annual: 2007-present

Herbicide: Habitat (imazapyr)

Late bud to flower stage

Backpack sprayers
Helicopter application

Cost: approximately $250/acre

Learn and Adapt

What land cover features are associated with *Lepidium latifolium* occurrence?

How effective was *Lepidium latifolium* control when treated with imazapyr?

What land cover features are associated with good and poor *Lepidium latifolium* control when treated with imazapyr

Occupancy pre- and post-treatment: Generalized additive model (R package mgvc) to describe land cover characteristics associated with *L. Lepidium* establishment and effectiveness of control

Variables (raster, 2x2-m pixels)

- *Lepidium latifolium* (response variable)
  - Presence (0/1), Decrease or increase (0 = no decline or increase, 1 = decline)
- Elevation
- Indices: water influence, vegetation

Pre-treatment Inventory Results

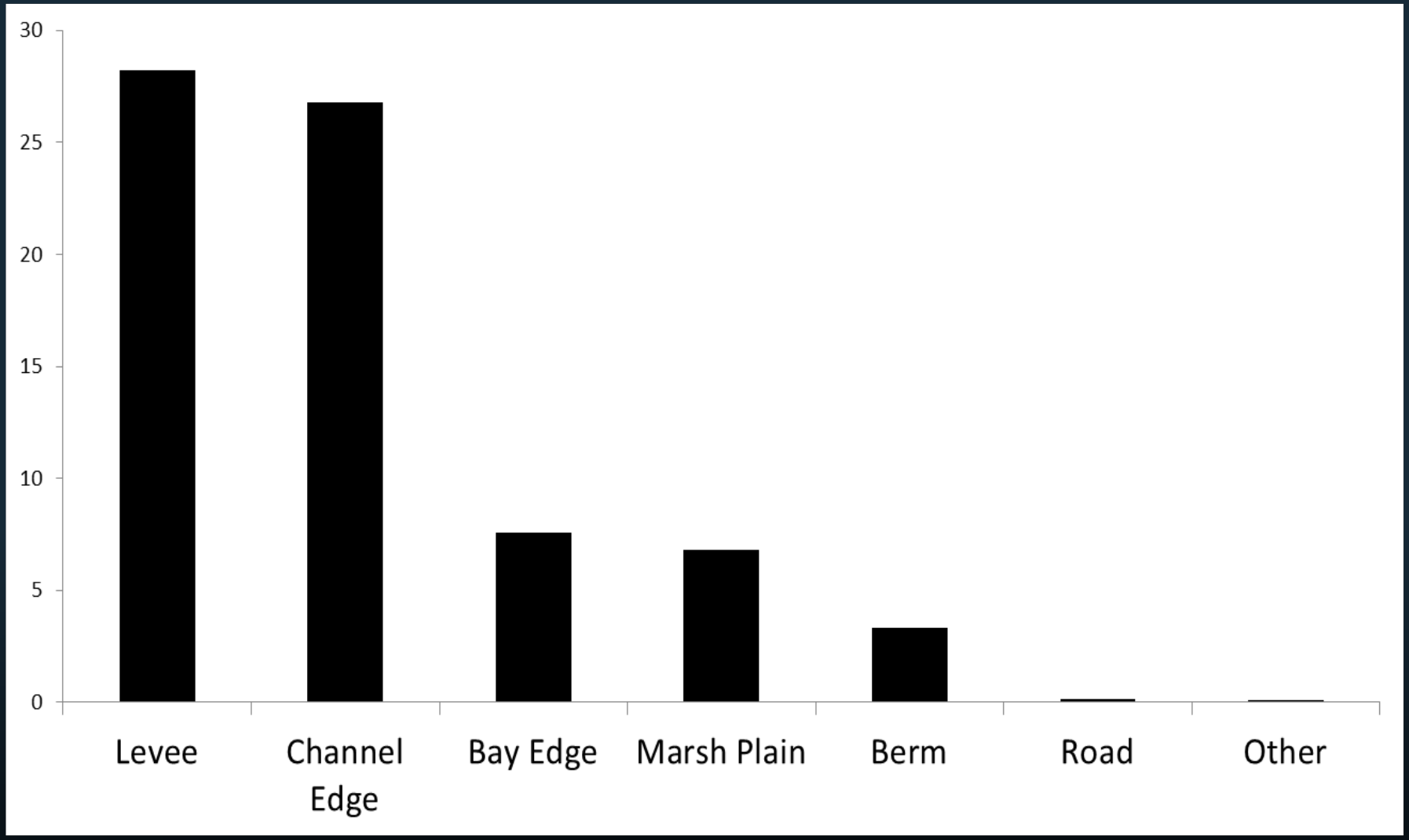
73 gross acres

3% of 2,049 acres infested

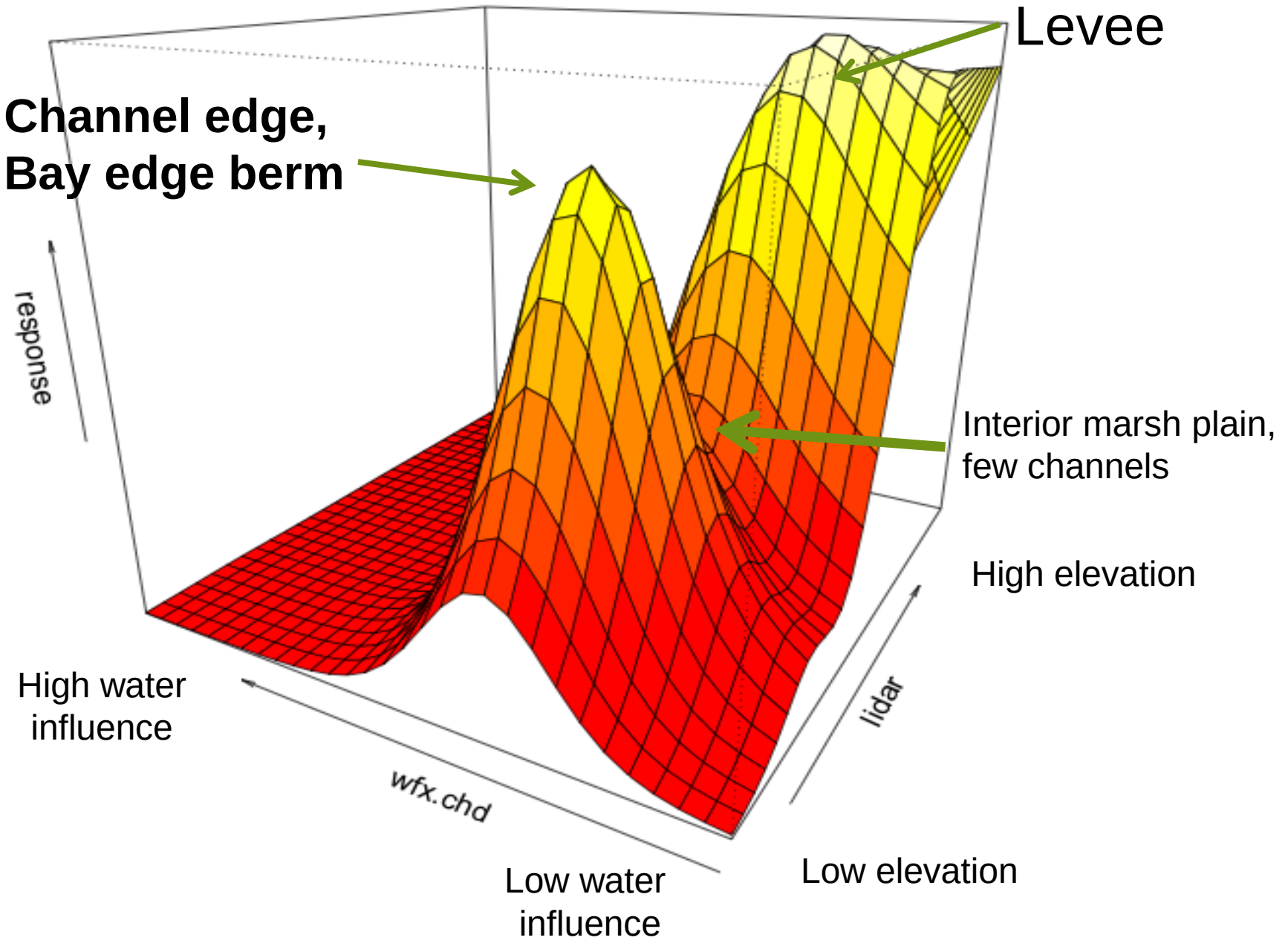
Observed Patterns:

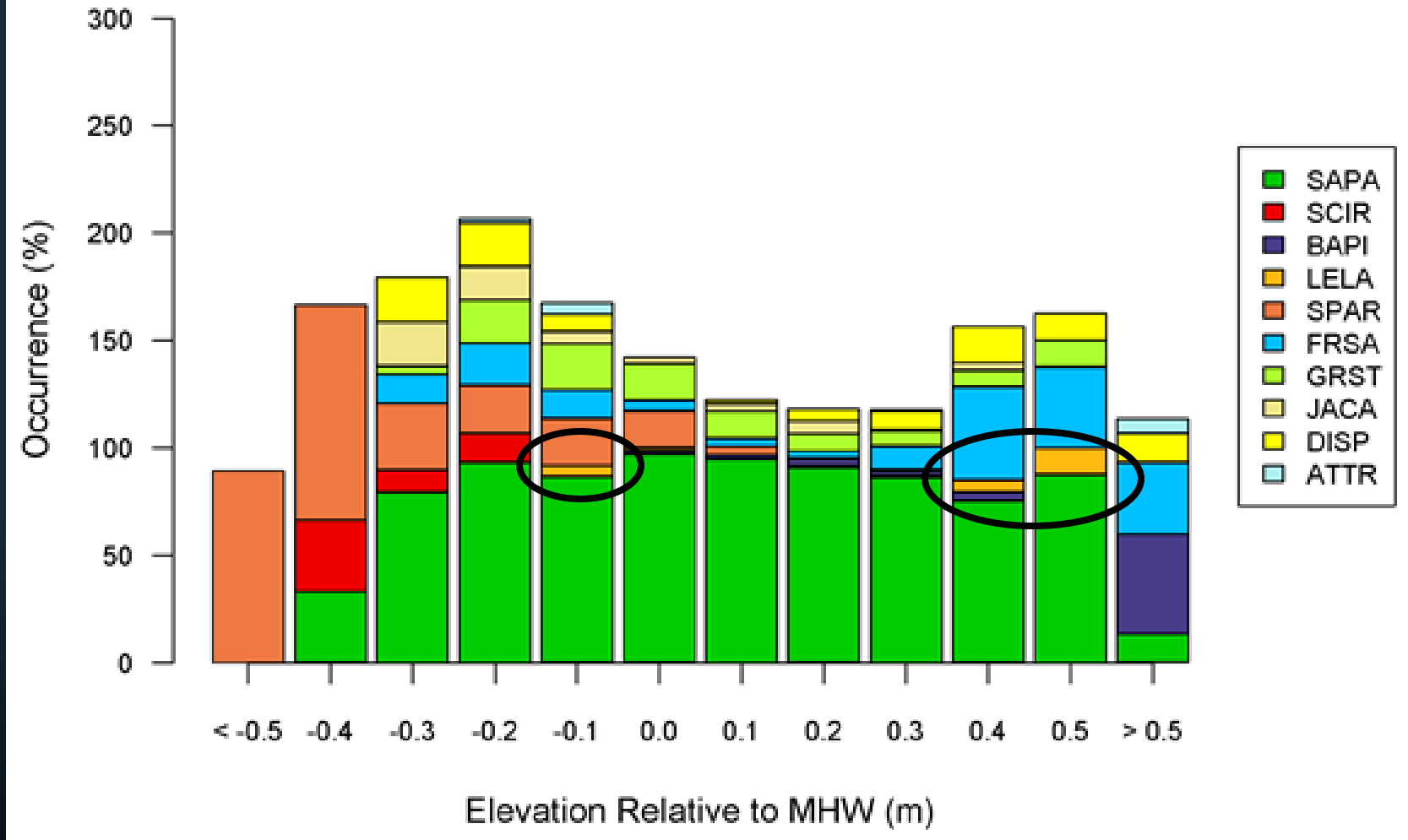
- Areas of tidal disturbance (levees, bay edge, channels)
- Restoration sites
- Fewer patches in interior marsh plain

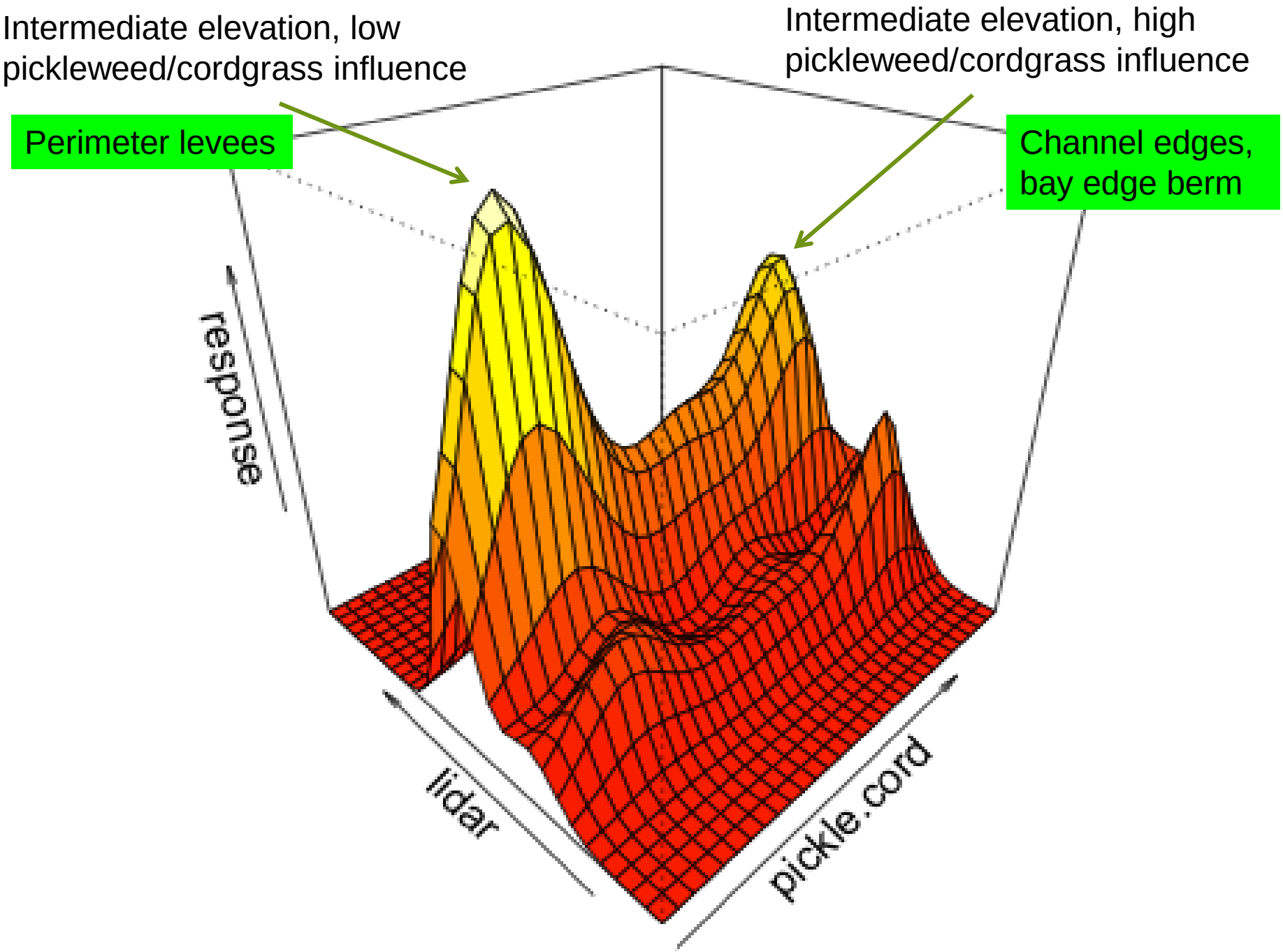
Acres of *Lepidium latifolium* by Landscape Feature



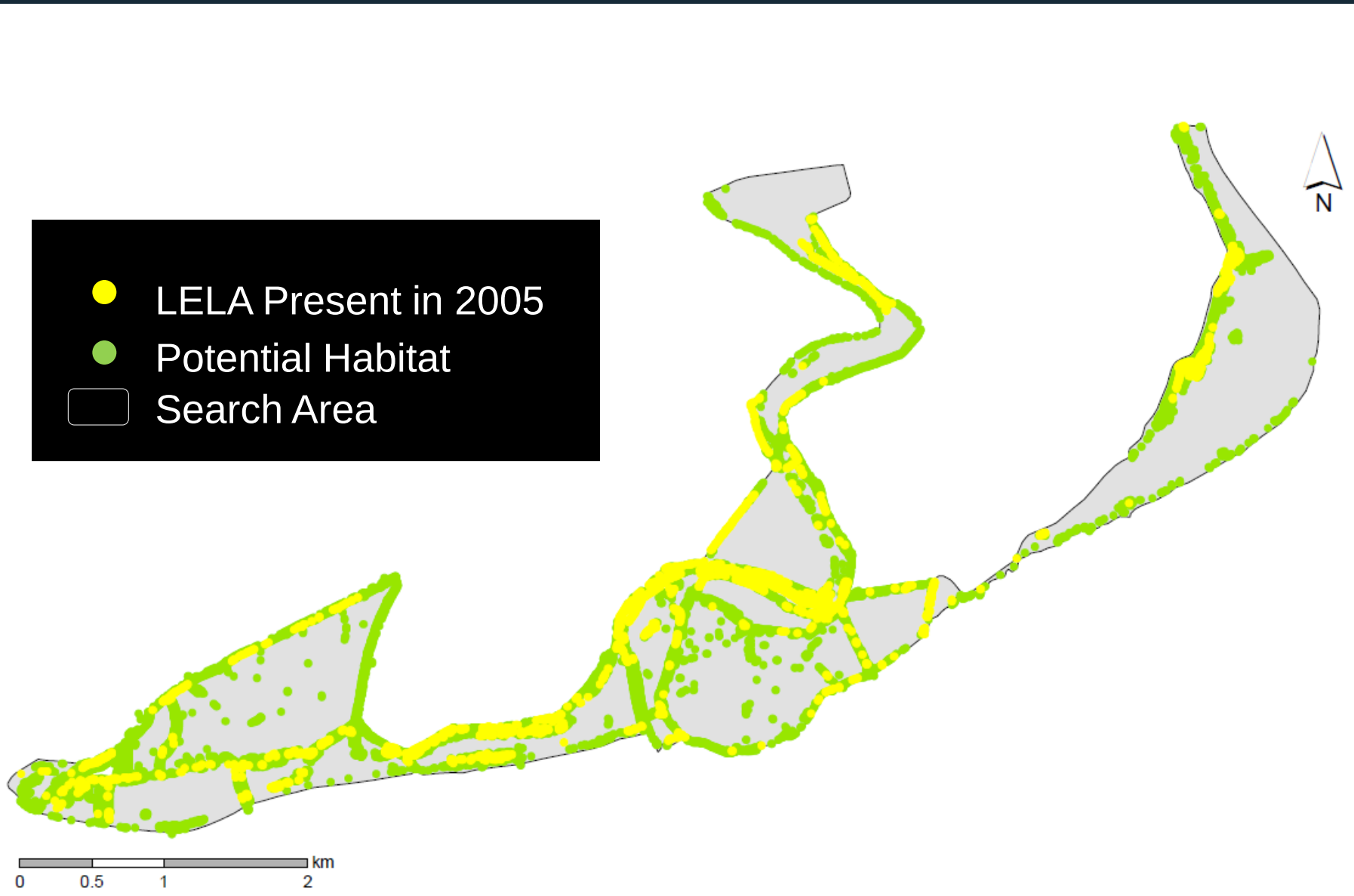
San Pablo Bay


Levee
Channel edge,
Bay edge berm
response
Interior marsh plain,
few channels
High elevation
High water
influence
wfx.chd
lidar
Low water
influence
Low elevation


300
250
200
150
100
50
0
Occurrence (%)
< -0.5
-0.4
-0.3
-0.2
-0.1
0.0
0.1
0.2
0.3
0.4
0.5
> 0.5
Elevation Relative to MHW (m)
SAPA
SCIR
BAPI
LELA
SPAR
FRSA
GRST
JACA
DISP
ATTR


Intermediate elevation, low pickleweed/cordgrass influence
Intermediate elevation, high pickleweed/cordgrass influence
Perimeter levees
Channel edges, bay edge berm
response
lidar
pickle.cord

LELA Habitat



Treatment Results

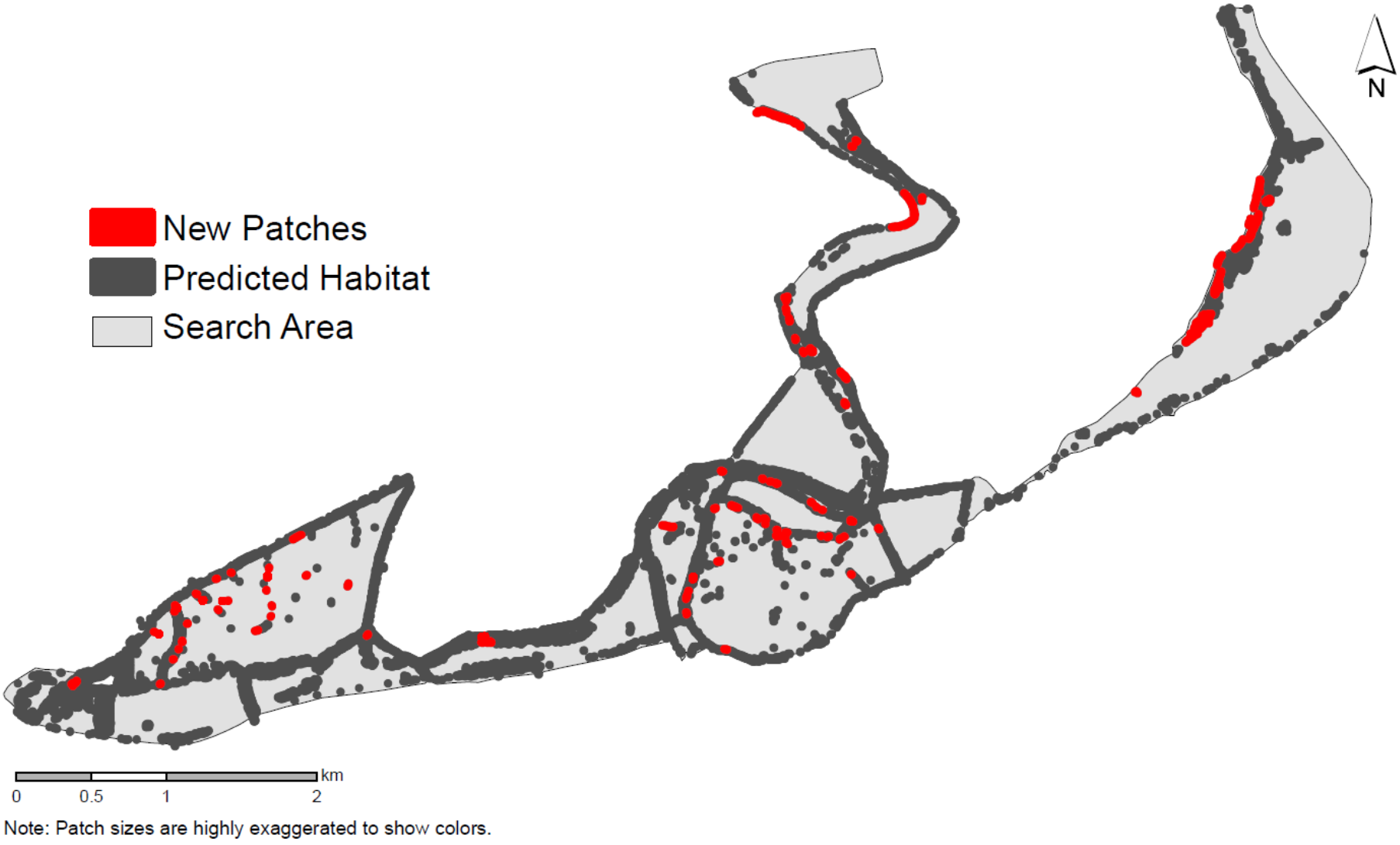
- Analysis area = 837 acres
- Gross acres

  2005 = 30.74 (mean patch size = 0.11)

  2010 = 4.38 (mean patch size = 0.03)

  85.8% decrease in gross acres following 3 treatments (2007-2009)

Model Predictions vs. Actual



Note: Patch sizes are highly exaggerated to show colors.

Summary

Probability of *L. latifolium* occurring is greater at

- Intermediate marsh elevations
- Areas where resistant vegetation is absent
- Areas of intermediate water influence

Focus future search efforts at base of perimeter levees, bay edge berms, and channel edges

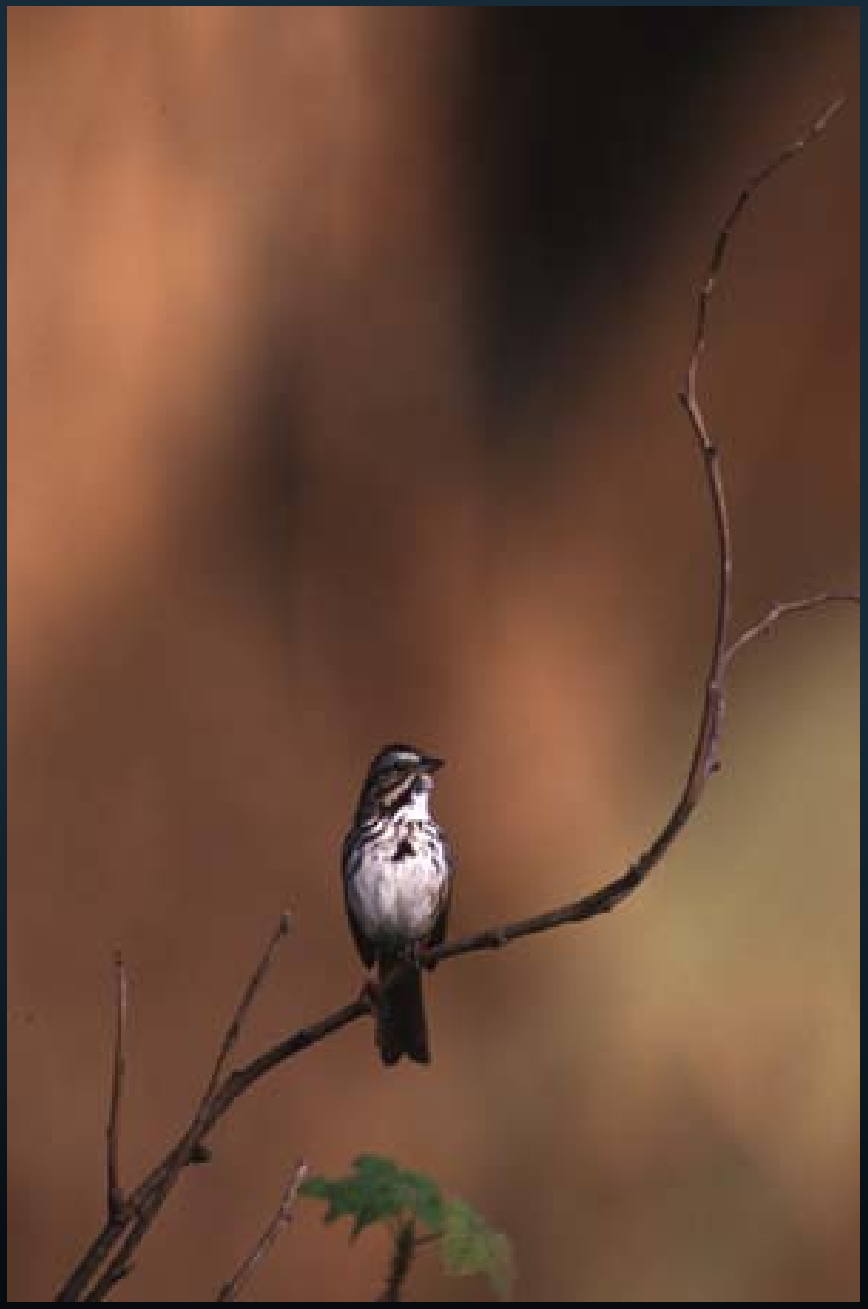
- Imazapyr (Habitat) is an effective tool to control *L. Latifolium* in tidal marsh of San Pablo Bay

- Inventory and monitoring are essential components of weed management programs
  - Increase knowledge of invasion patterns and environmental relationships
  - Efficient use of limited resources - prioritize populations for treatment
  - Estimate treatment costs
  - Increase success – learn and adapt
  - Increase funding
  - Contribute to larger landscape scale strategies

Next Steps

Use results to adapt control plan

- Refine objectives and strategies
- Early detection: focused surveys
- Continued post-treatment monitoring

Expand treatment areas

Continue restoration of the marsh-upland transition zone