Evaluating the Potential for Spread of an Invasive Forb, *Limonium ramosissimum*, in San Francisco Bay Salt Marshes

Gavin Archbald, Kathy Boyer

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San Francisco State University

Outline

- Why investigate invasive plants
- How we evaluate spread potential
- Results highlights
- Spread prediction & next steps


South SF bay tidal salt marsh


Snowy egret


Salt marsh bird's beak

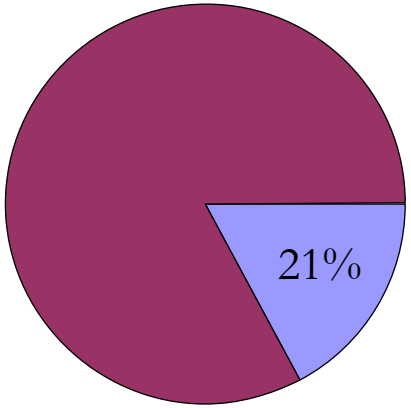

Salt marsh
harvest mouse

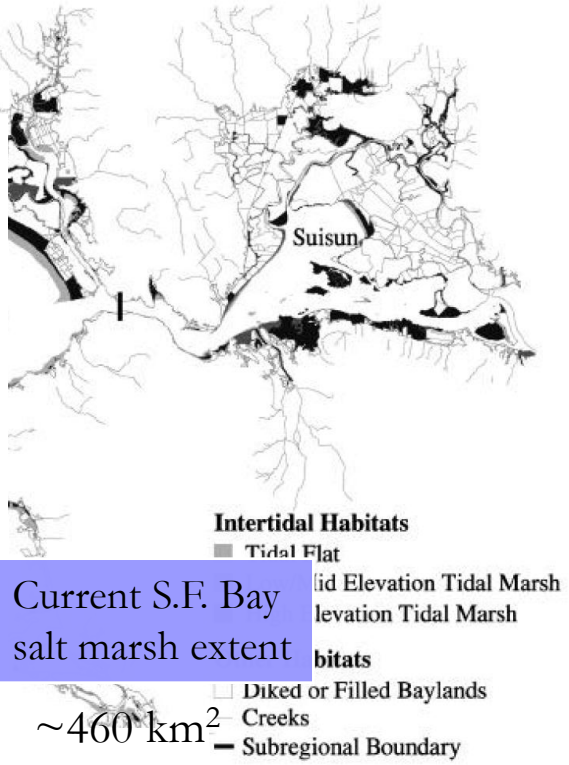

Brown pelican
Photos: cdpr.ca.gov
srmist.gightinc.com
goldrushcam.com

Tidal wetland
restoration projects
~200 km^2

Historic S.F. Bay
salt marsh extent

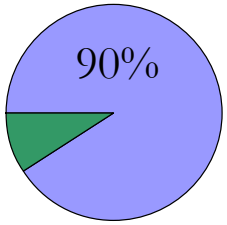
~2200 km^2





Current S.F. Bay
salt marsh extent

~460 km^2



All other CA
salt marshes

~50 km^2

Adapted from Takekawa et al, 2006
Photo: sfbare.com


Remaining salt marsh is prone to plant invasions
• Fragmented
• Disturbed
• Fertilized
• Seeded

- 14 non-native salt tolerant plant species (1998)
- 3 “key species of concern”

Spartina alterniflora x foliosa

Lepidium latifolium

Spartina densiflora

- Inhibit or outcompete native plants
- Alter habitat structure
- Invade restoration sites
- Leave legacy effects

Photos: clr.pdx.edu
logancountyco.gov

In 2007, Algerian sea lavender was found in a SF bay marsh

- From Mediterranean
- Currently invading S. California marshes
- Horticultural escapee.

L. ramosissimum ssp. *provinciale*

Will it spread?

Sanchez Marsh, Burlingame

Photos: G. Archbald

srmist.sightinc.com

Plants require to invade:

1. An "invasible" landscape

Q. What habitat types are commonly invaded?

Searc
marshes &
shoreline

2. Propagules arrive

3. Plants establish and reproduce

Davis, Grime & Thompson, 2000

Photo: G. Archbald

Q. What habitat types are commonly invaded?

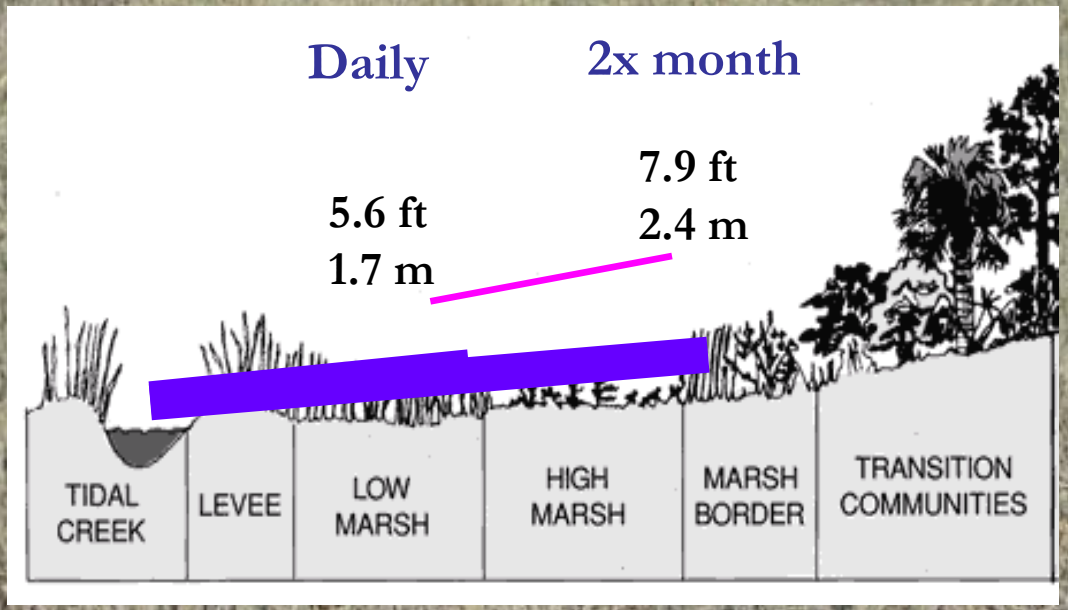


Photo: G.


Google


Q. What habitat types are commonly invaded?

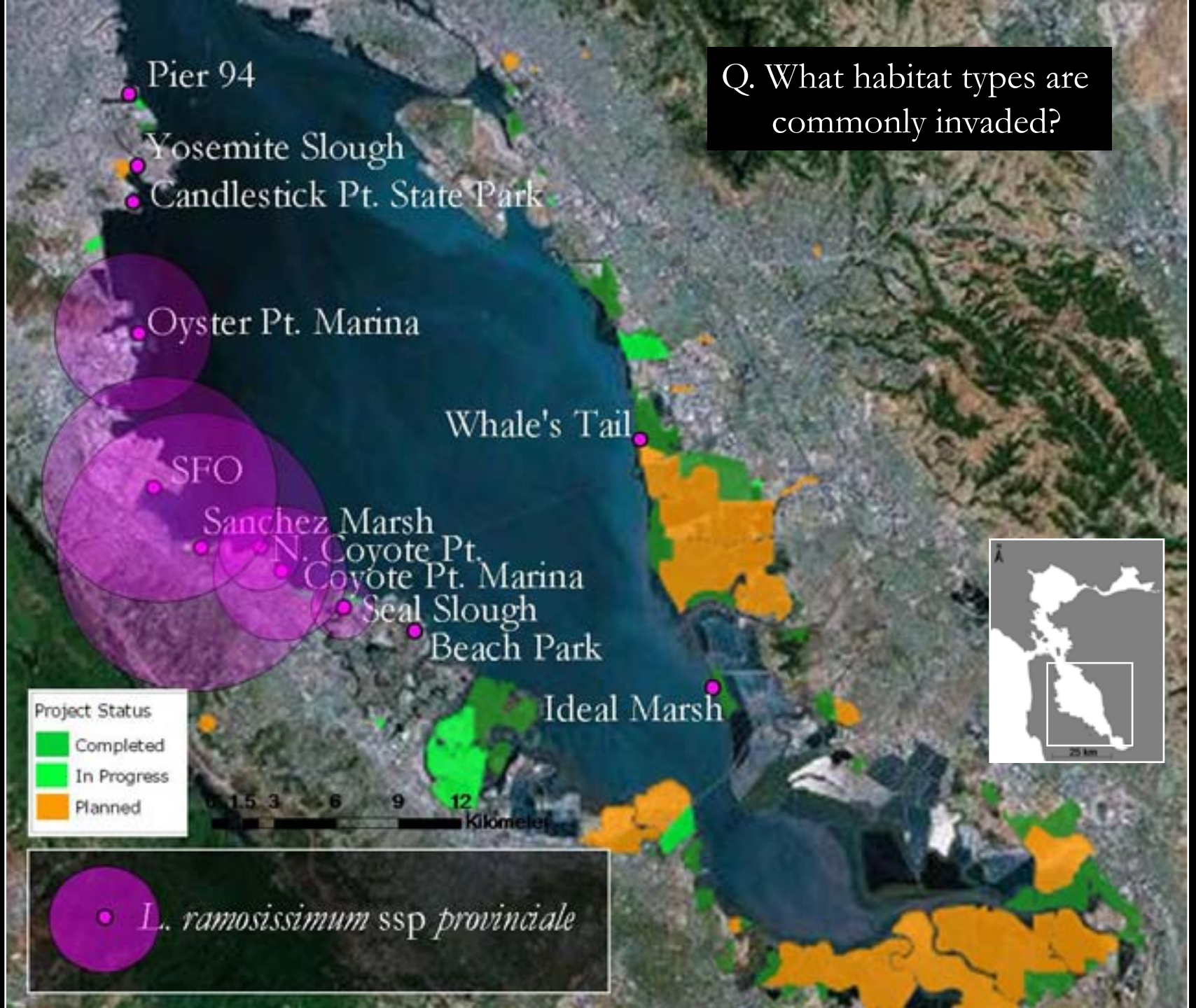

Google


Google

Q. What habitat types are commonly invaded?

Restoration project completed in 1987 (Wetland Tracker, 2009)

20 years later…


Q. What habitat types are commonly invaded?
Pier 94
Yosemite Slough
Candlestick Pt. State Park
Oyster Pt. Marina
Whale's Tail
SFO
Sanchez Marsh
N. Coyote Pt.
Coyote Pt. Marina
Seal Slough
Beach Park
Ideal Marsh
Project Status
Completed
In Progress
Planned
0 1.5 3 6 9 12
Kilometers
L. ramosissimum ssp provinciale


Total invasion: 3 acres
~ 120 million seeds/yr

Plants require to invade:

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Q. What habitat types are commonly invaded?

A. High marsh, disturbed and restored marshes.

2. Propagules arrive

Q. Can seeds reach additional habitat?

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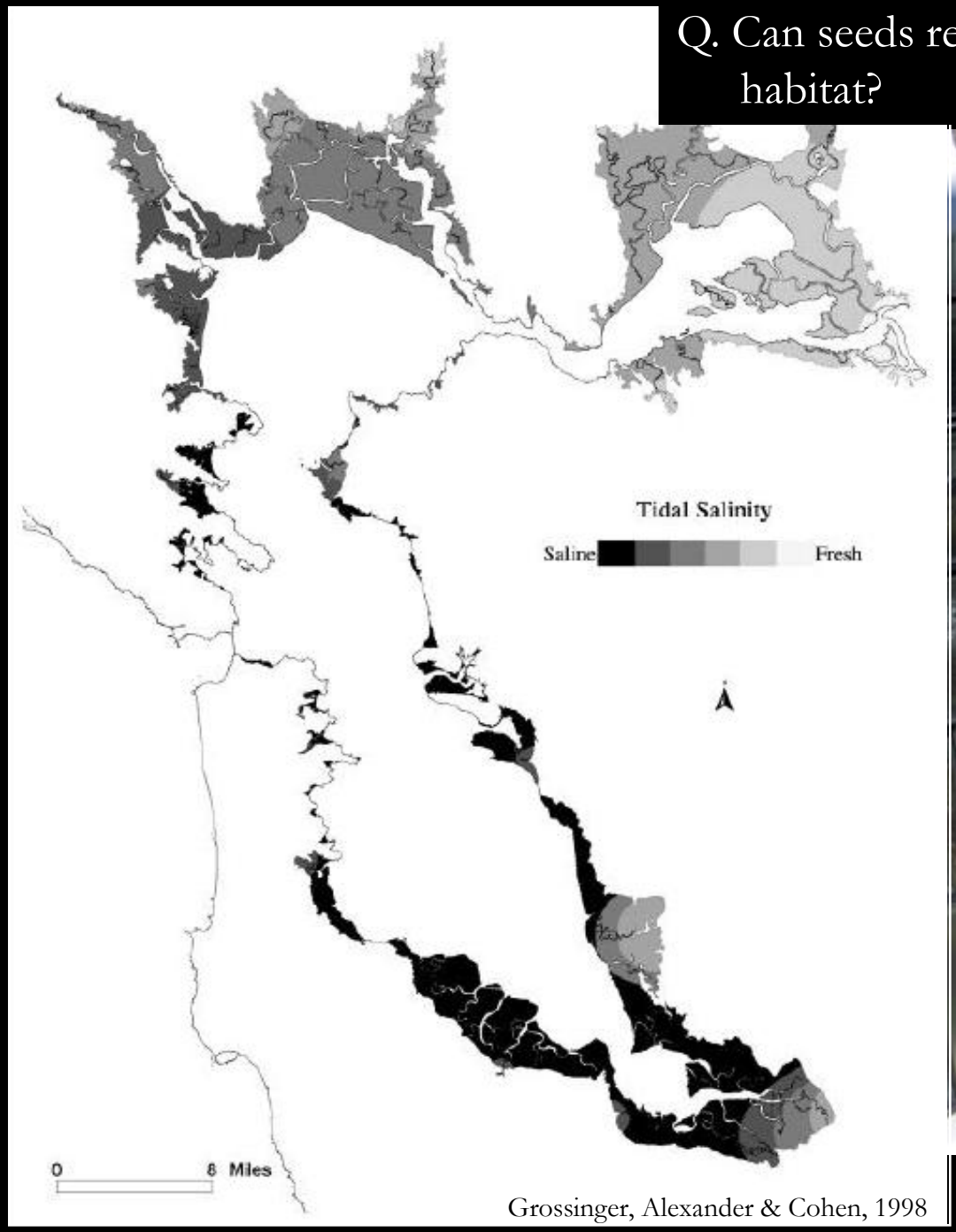
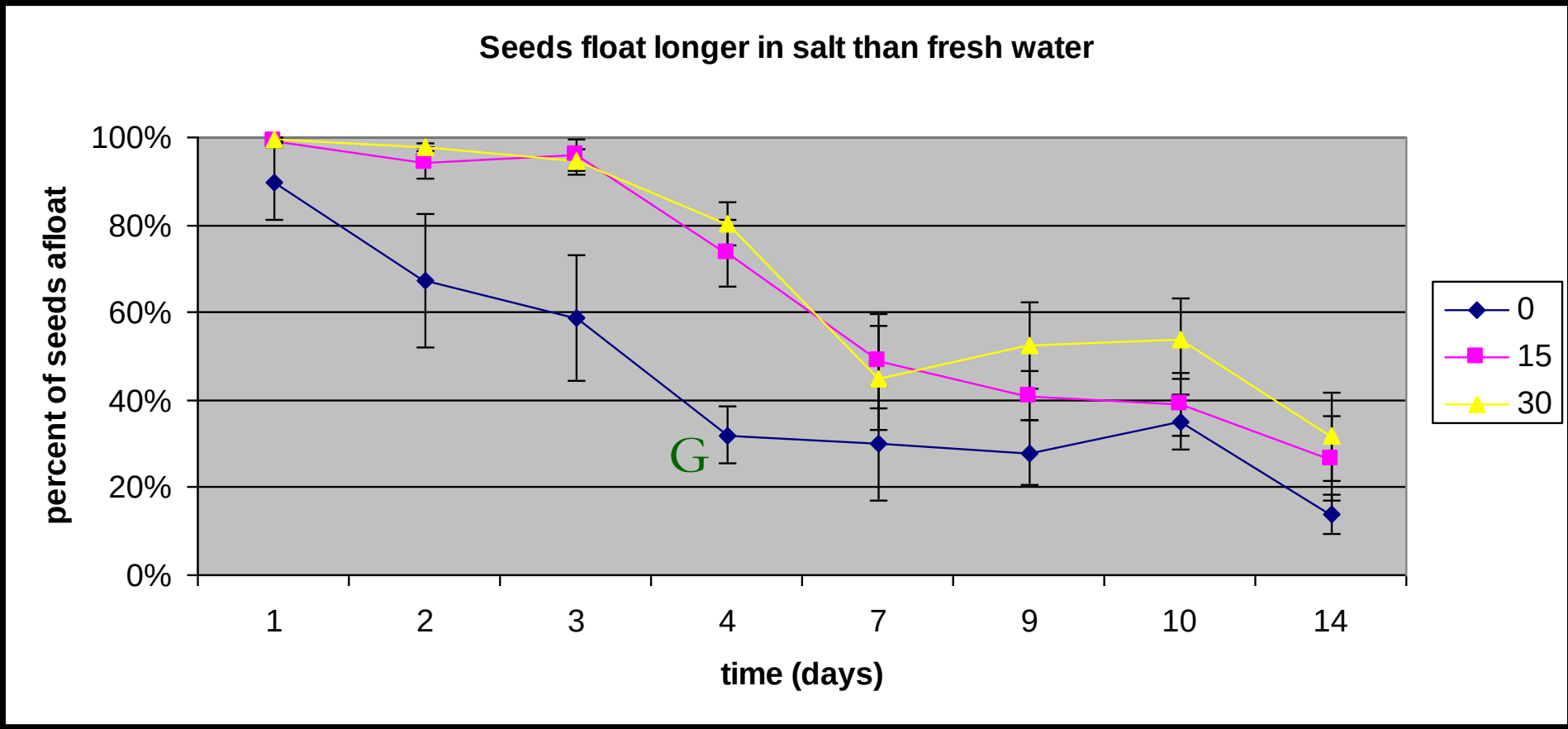
Floated seeds in aquaria tanks:

<u>Salinity:</u>
0
15
30



Grossinger, Alexander & Cohen, 1998

Q. Can seeds reach additional habitat?

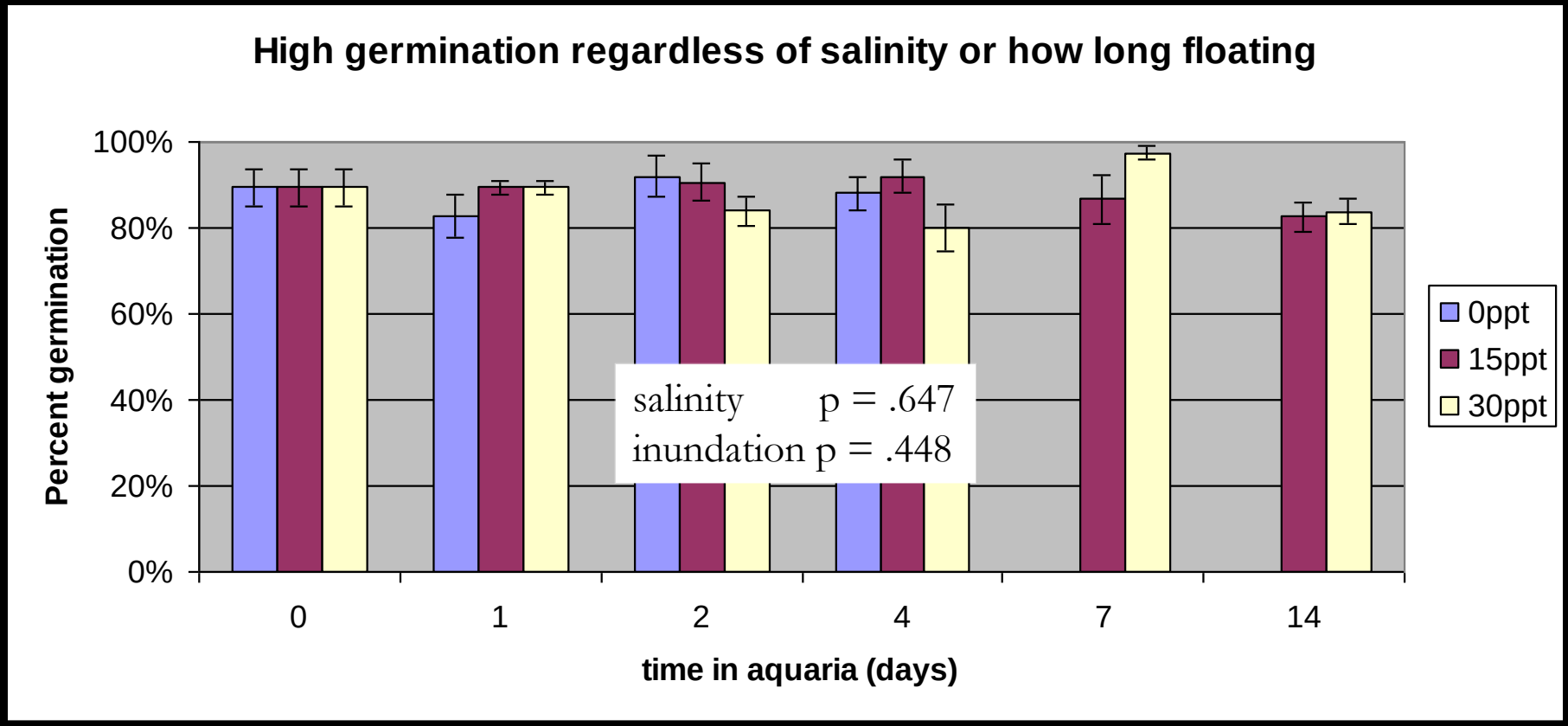


Q. Can seeds reach additional habitat?

Removed seeds from tanks and germinated in fresh water:

<u>Time (days):</u>
0
1
2
4
7
14

Q. Can seeds reach additional habitat?



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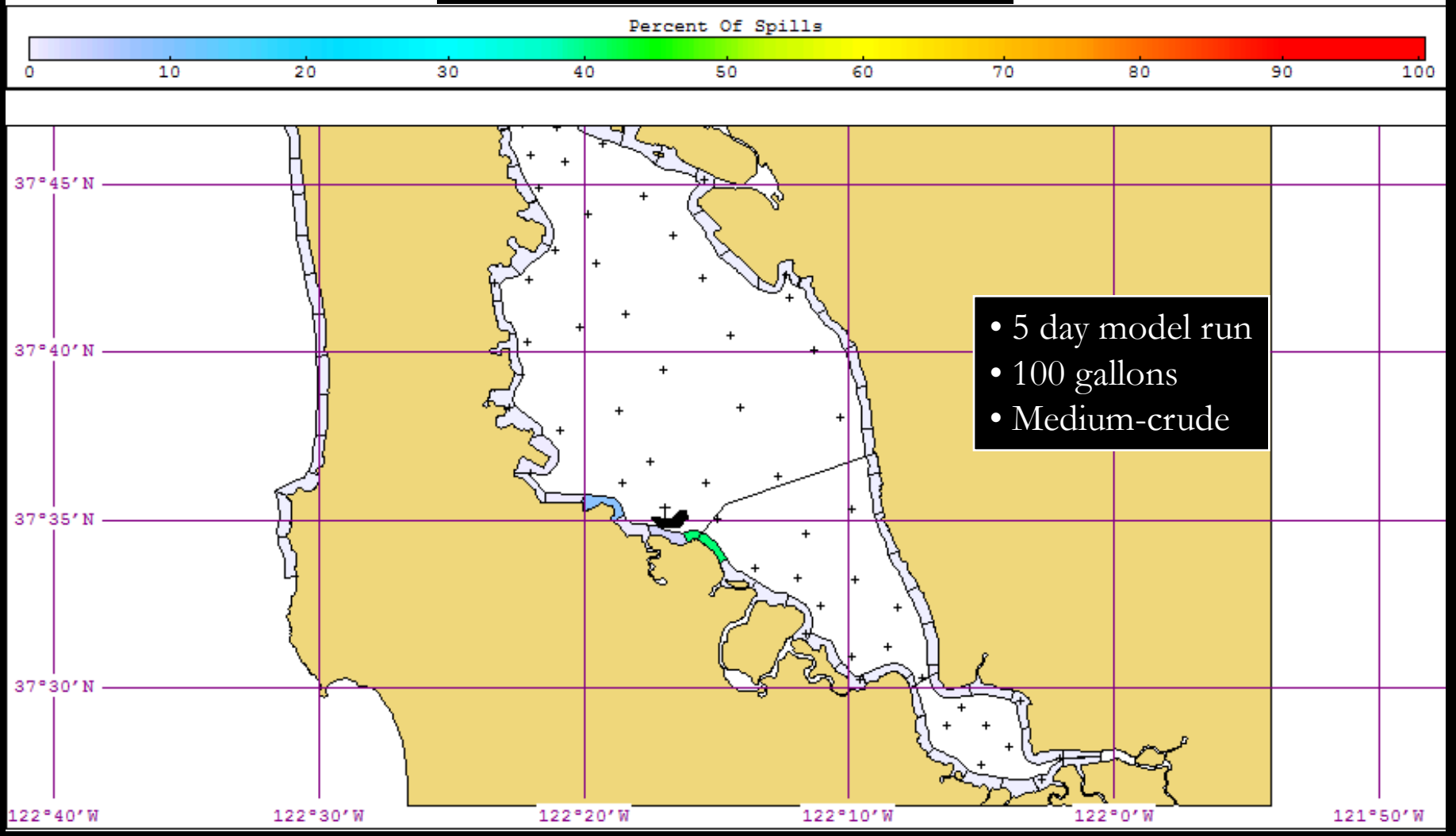
Output from NOAA Tap model 1.2



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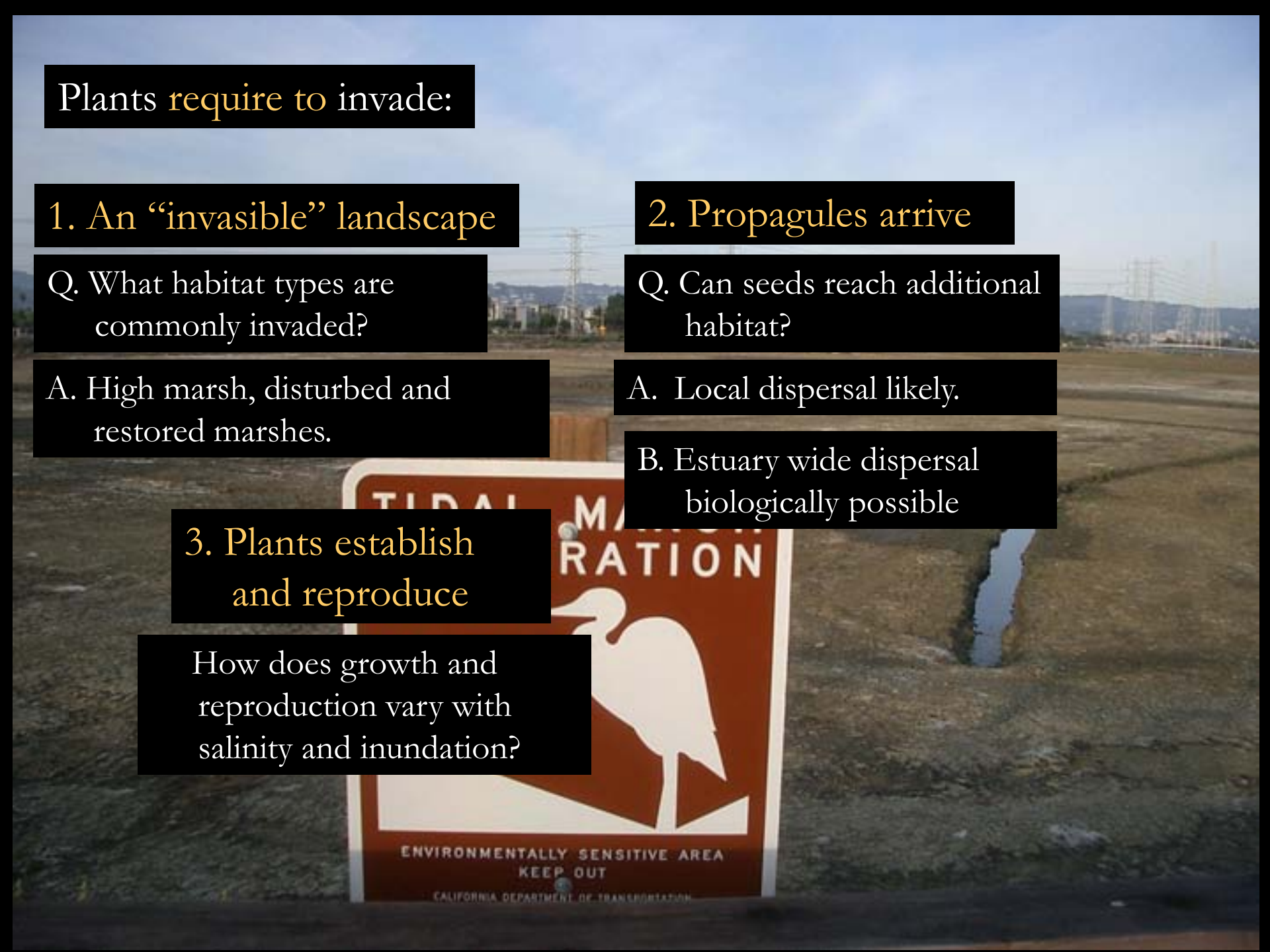
Q. Can seeds reach additional habitat?

A. Local dispersal likely.

B. Estuary wide dispersal biologically possible

3. Plants establish and reproduce

How does growth and reproduction vary with salinity and inundation?



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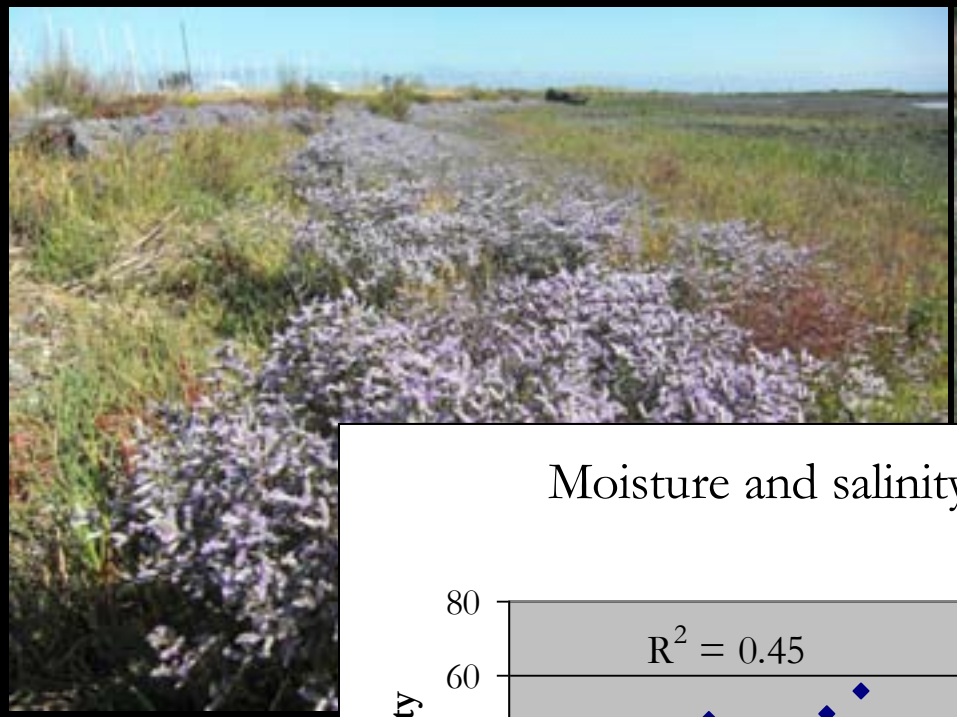
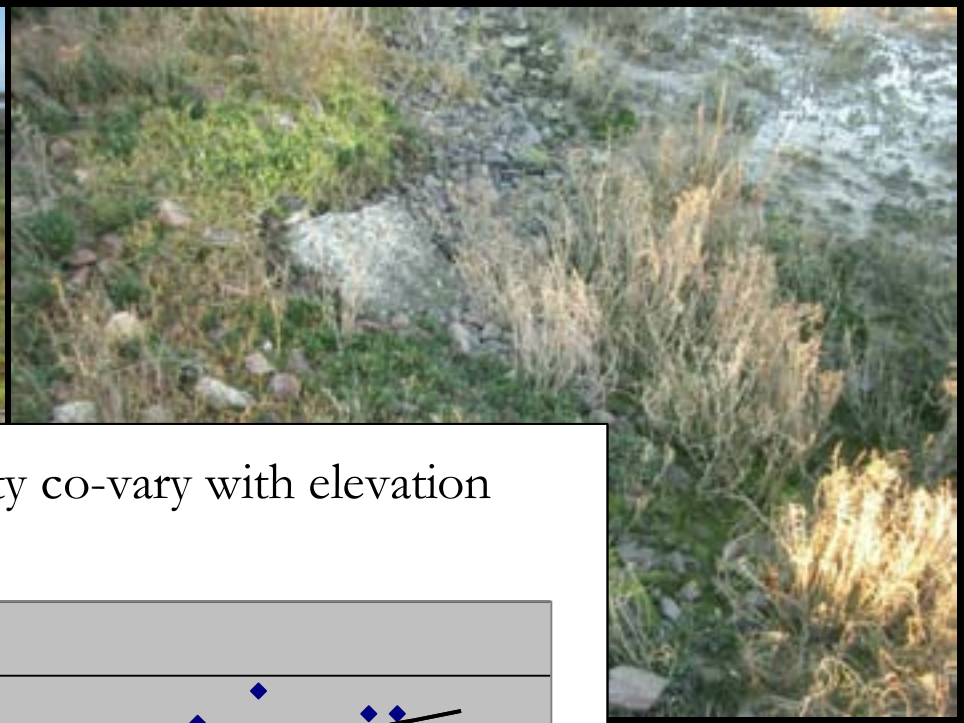
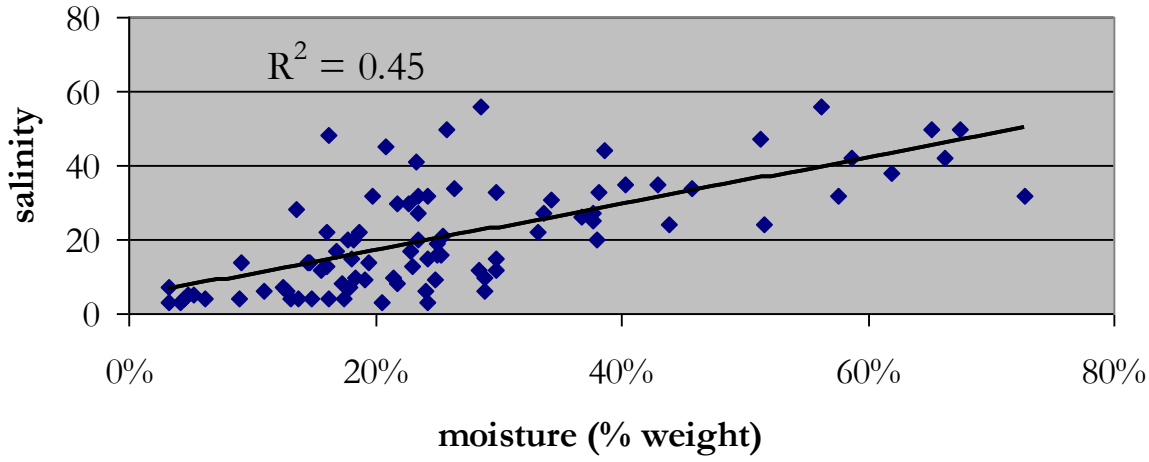




Moisture and salinity co-vary with elevation



How does growth and reproduction vary with salinity and inundation?

Crossed design

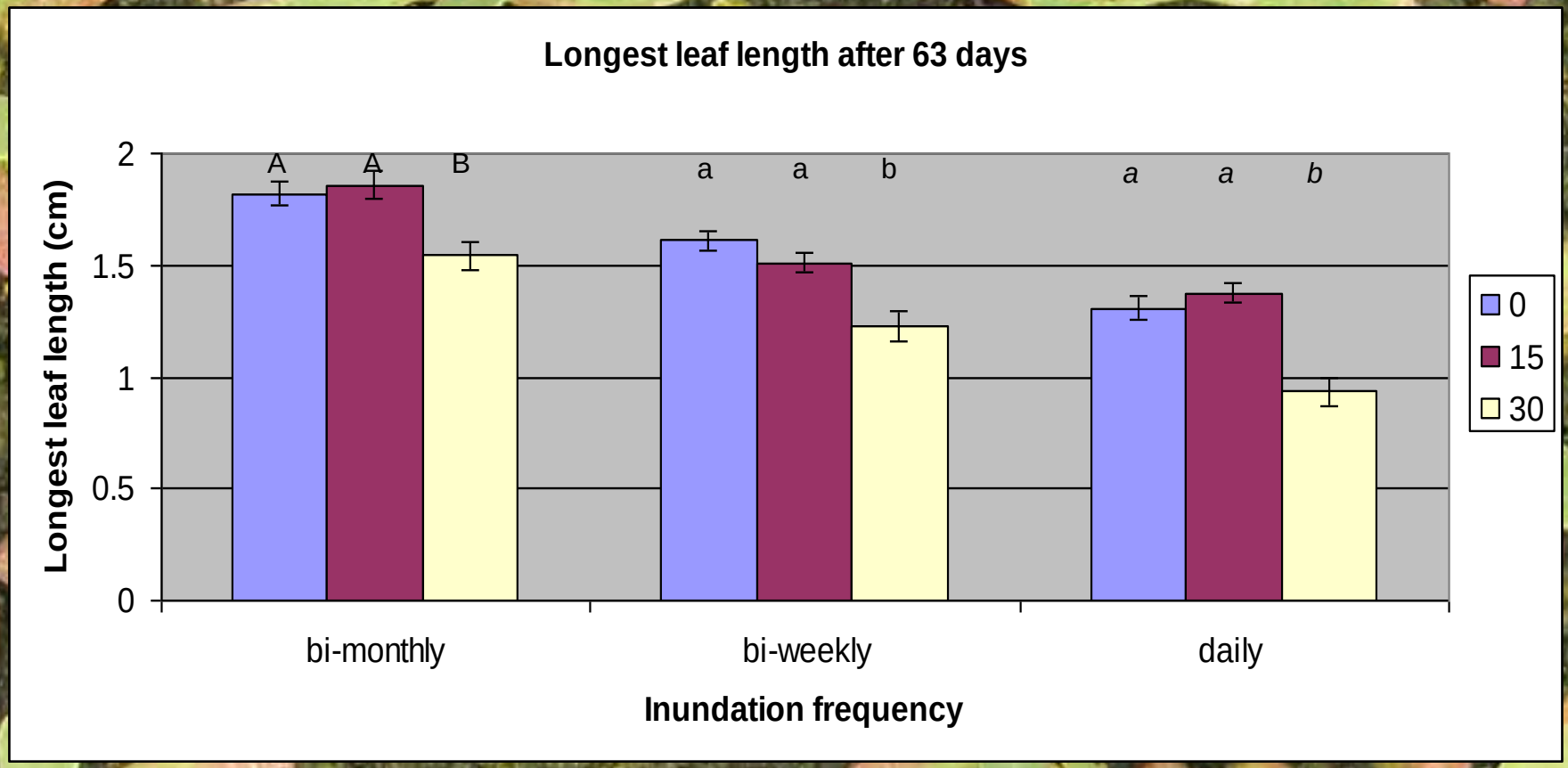
<u>Salinity</u>
0
15
30

<u>Inundation</u>
daily
2x week
2x month

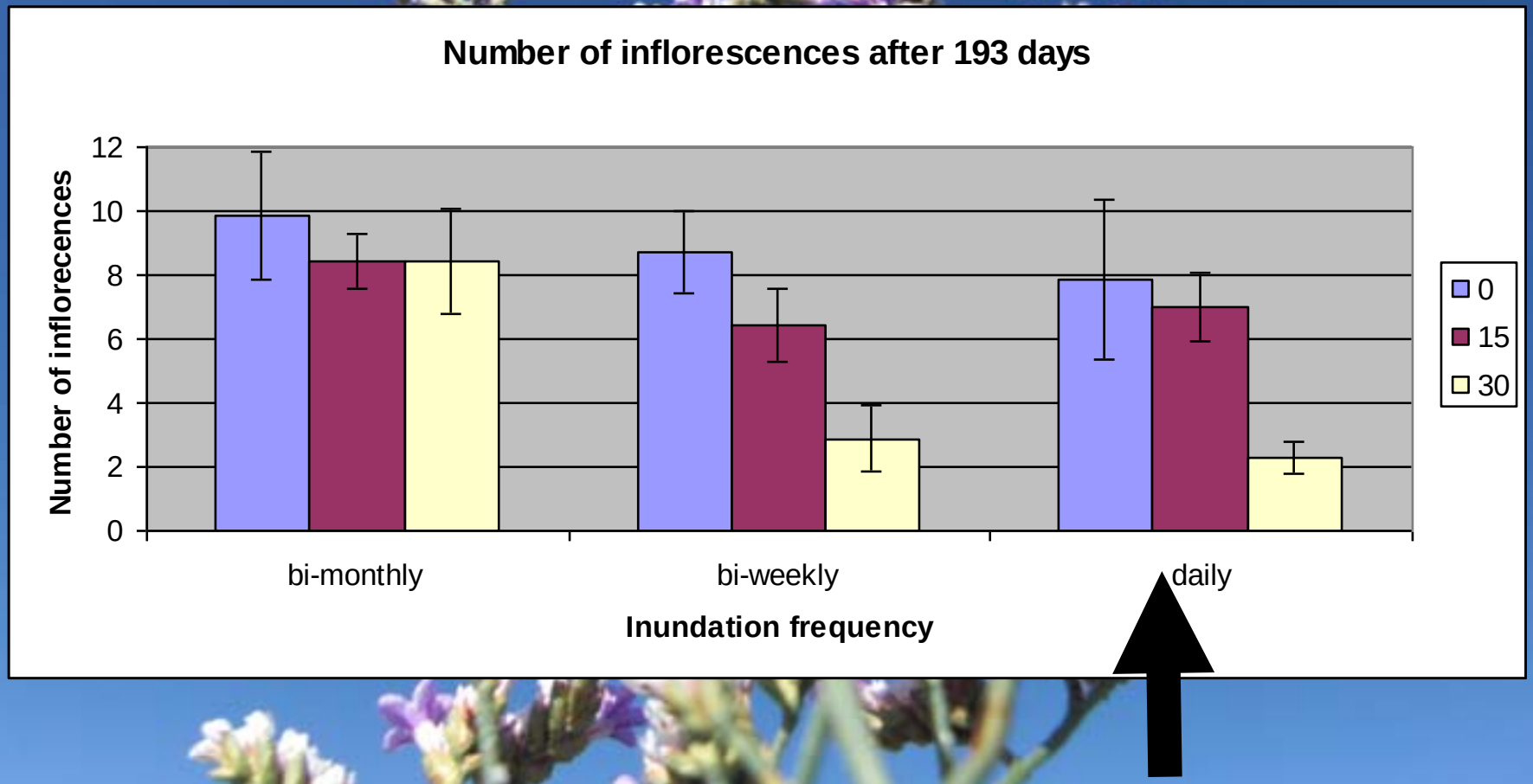
January 21, 2009

June 29, 2009

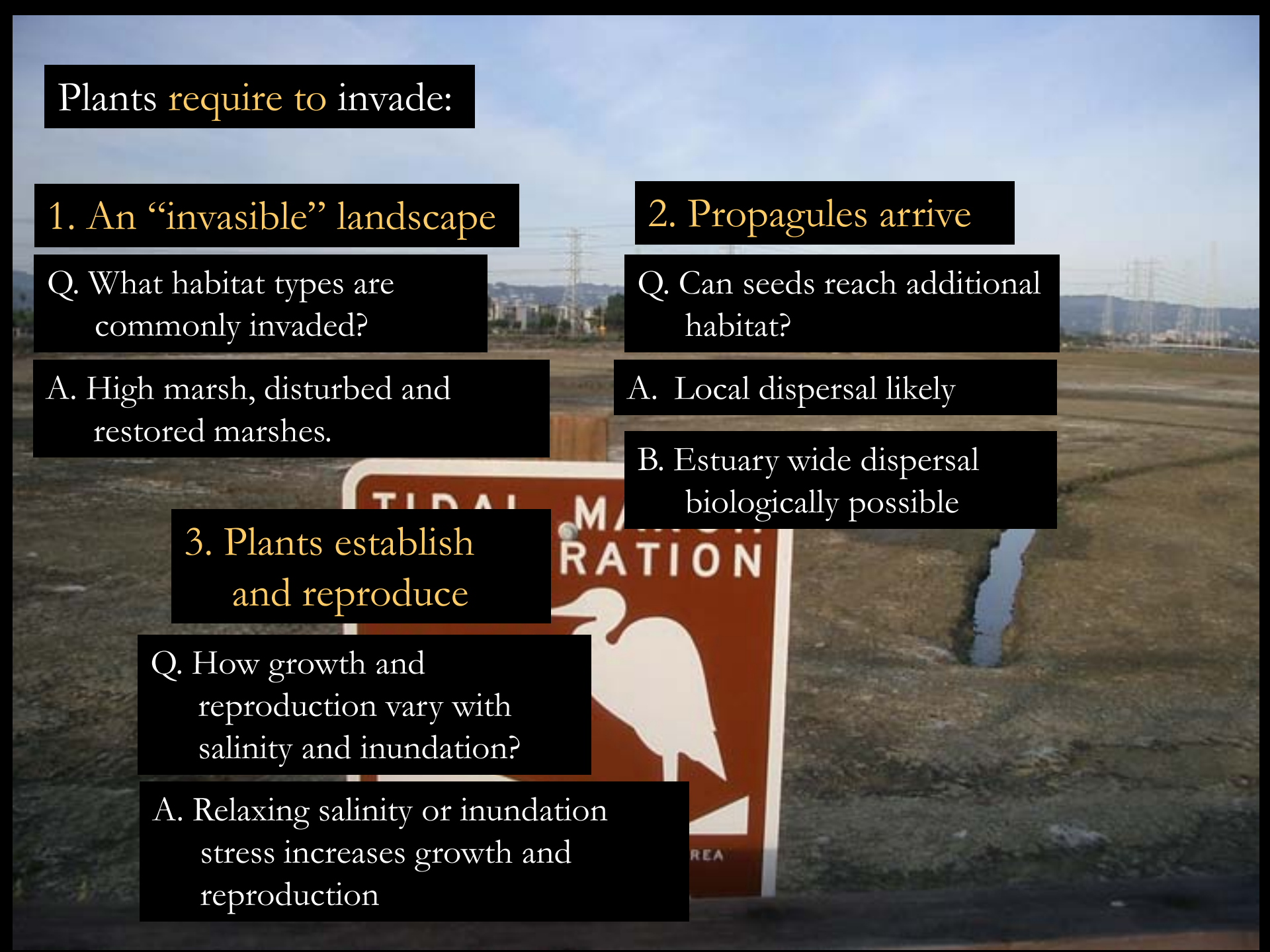
salinity:	**p = .000**
inundation:	**p = .000**
interaction:	p = .408



salinity:	p = .003
inundation:	p = .019
interaction:	p = .444



Indicates higher seed output at low elevations in fresher marshes



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2. Propagules arrive

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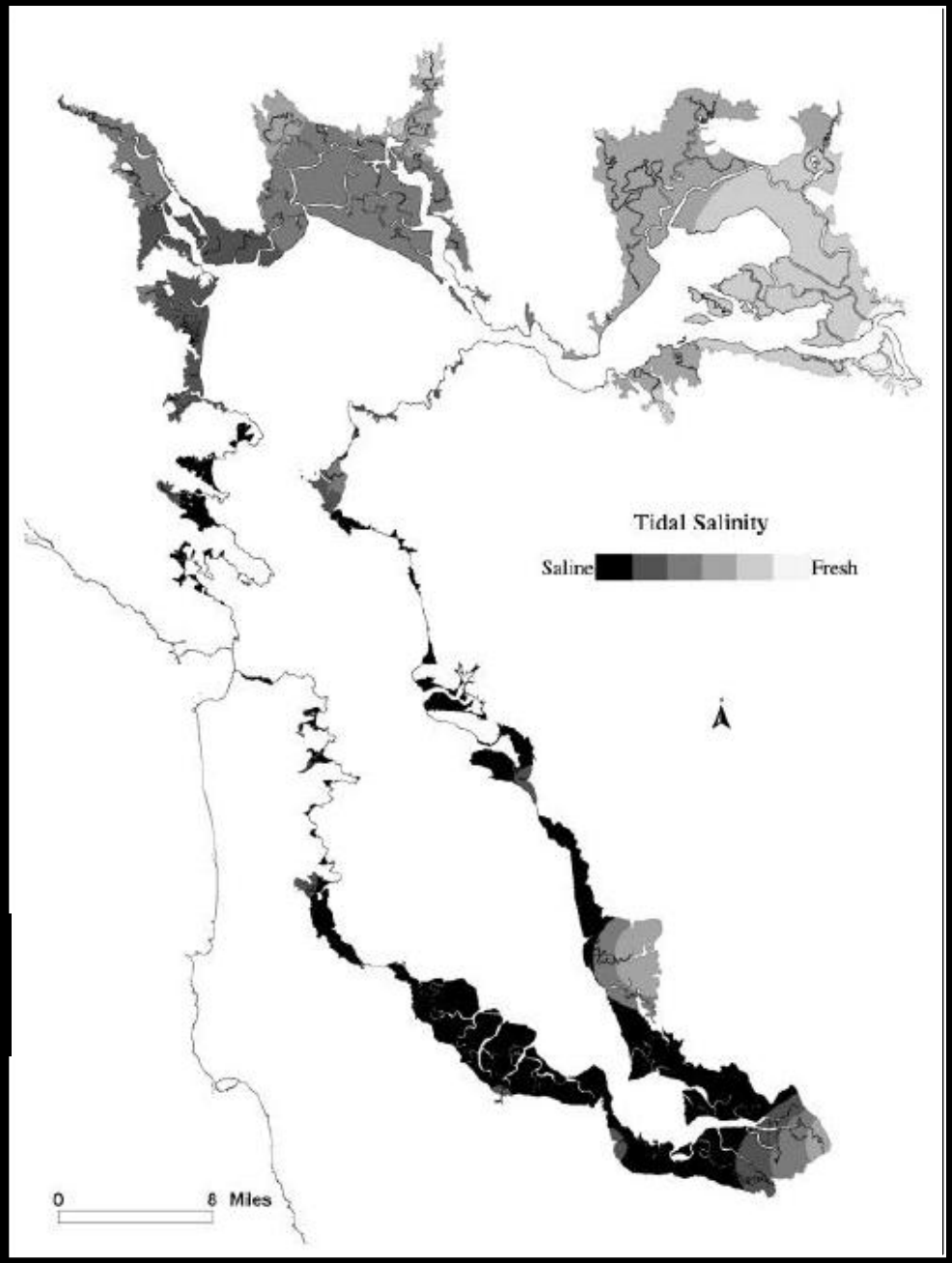
Q. How growth and reproduction vary with salinity and inundation?

A. Relaxing salinity or inundation stress increases growth and reproduction

Potential for spread?

- Likely to invade high marsh, disturbed and restored marshes.
- Estuary wide dispersal biologically possible
- Relaxing salinity or inundation stress increases growth and reproduction
- Potentially higher invasion rates in lower salinity marshes.



Next steps:

- Outcome: survey data to evaluate impact
- BCDC requiring *L. ram* monitoring in marsh restoration site permits

Thanks to:

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Questions?

- 2007-08 visually searched marshes and shoreline.
- Mapped *L. ram* at patch scale w/GPS
- Measured vertical range at 3 marshes w/RTK GPS

Mapping:

methods

Page, 2007
Photo: G. Archbald

Known distribution of *L. ramosissimum* populations in San Francisco Bay marshes

Strawberry Marsh

L. ramosissimum

L. ramosissimum provinciale

Sanchez Marsh

4878m²

Coyote Point Marina

Seal Slough

N. Coyote Pt.

Beach Park

Kilometers

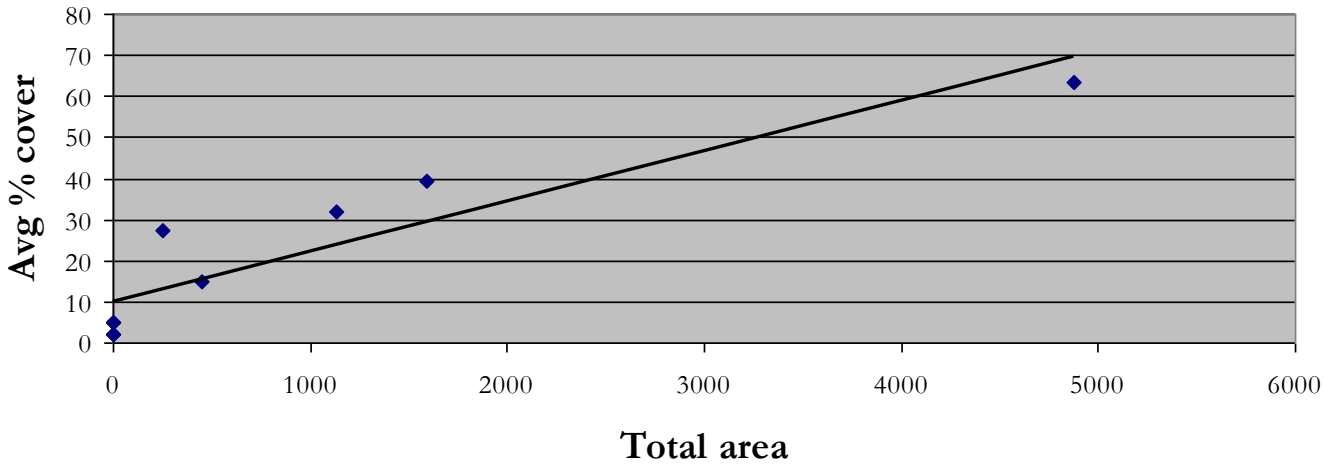
0 1.5 3 6 9 12

Mapping:

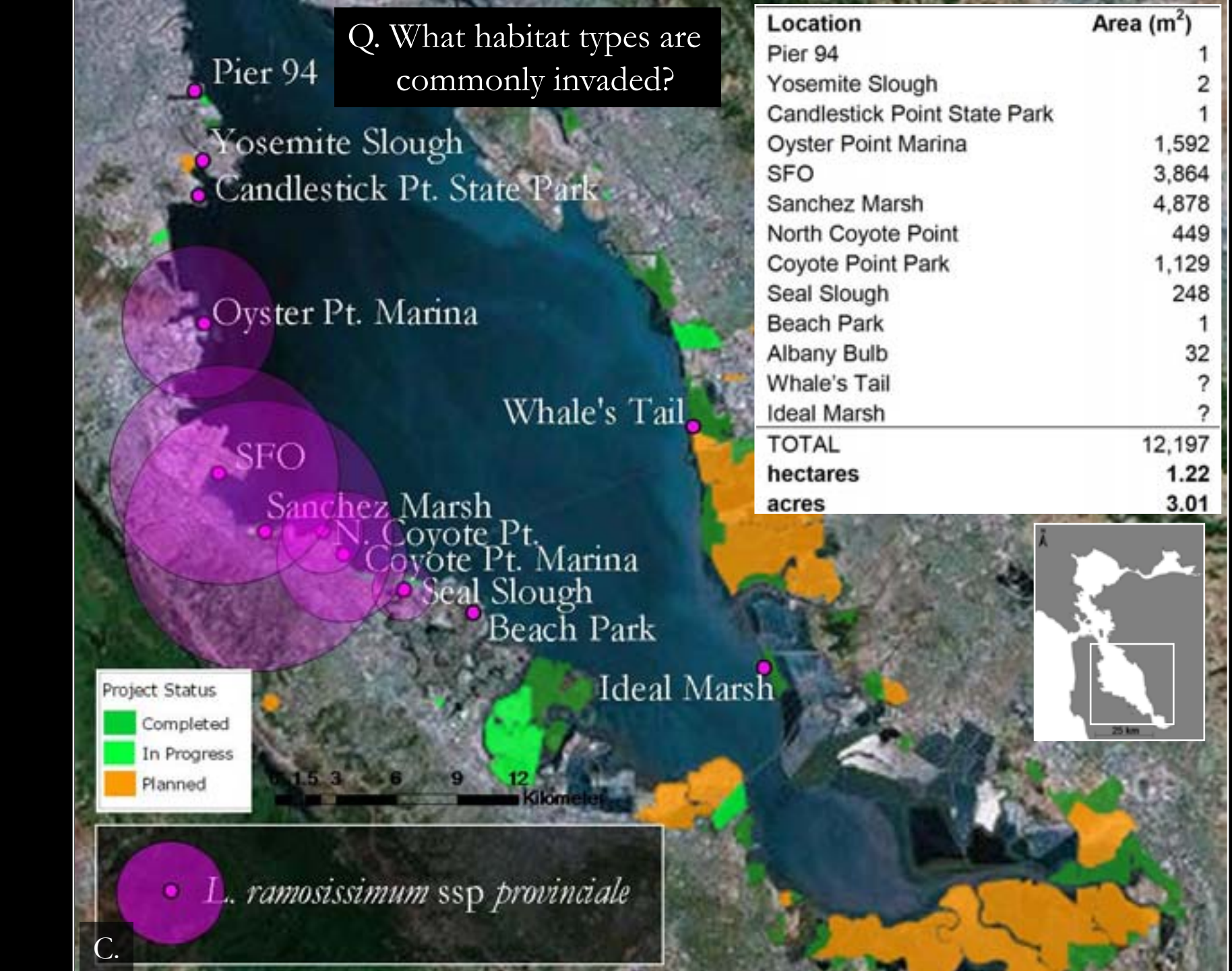
results

% cover increases with area

$R^2 = 0.84$




Well established in high marsh



Location	Area (m^2)
Pier 94	1
Yosemite Slough	2
Candlestick Point State Park	1
Oyster Point Marina	1,592
SFO	3,864
Sanchez Marsh	4,878
North Coyote Point	449
Coyote Point Park	1,129
Seal Slough	248
Beach Park	1
Albany Bulb	32
Whale's Tail	?
Ideal Marsh	?
TOTAL	12,197
hectares	**1.22**
acres	**3.01**