

# Endemic plants of the Channel Islands

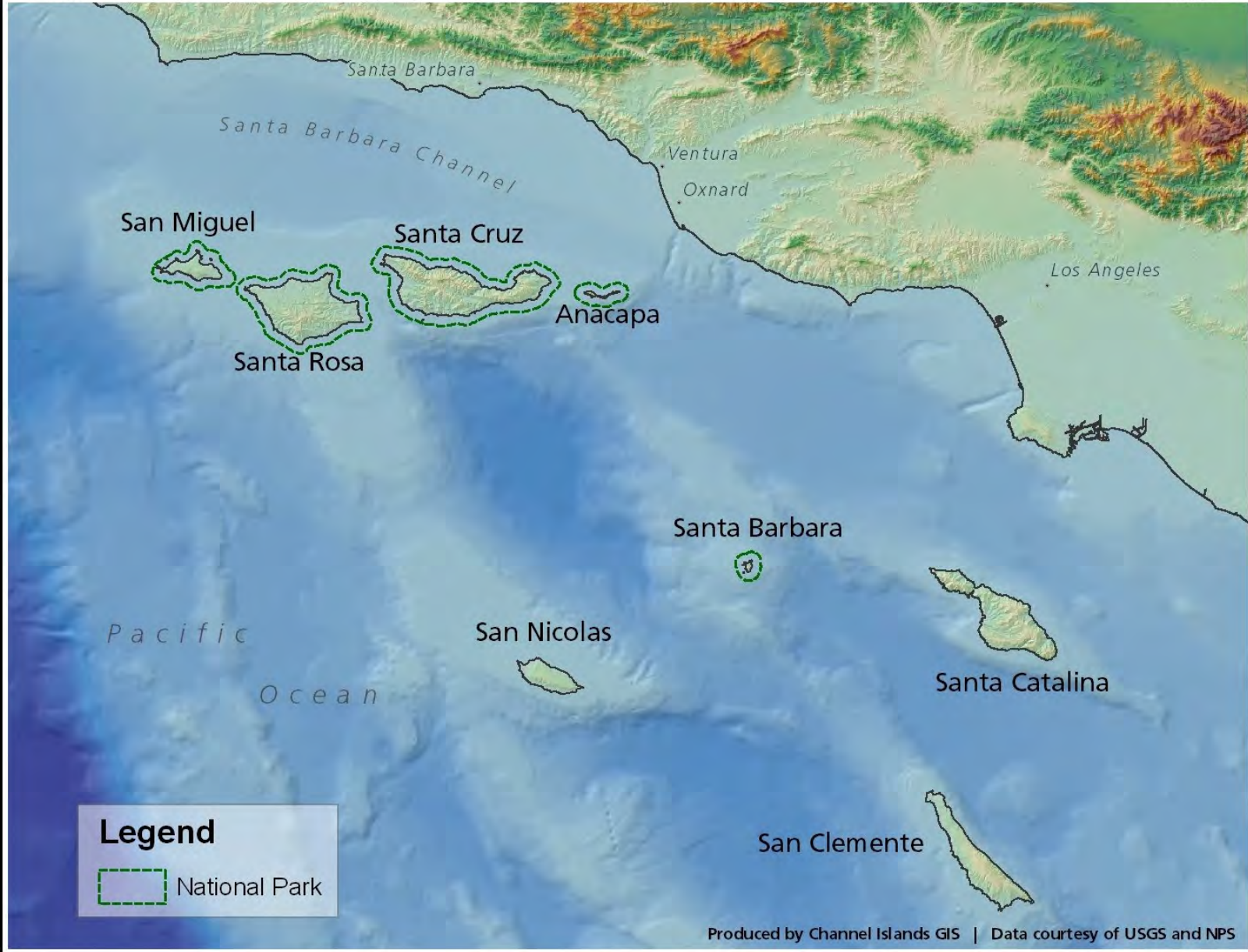





# The California Channel Islands



0 12.5 25  
Miles



## Legend

 National Park



NPS Photograph

# Feral animal timeline

## Santa Rosa Island

1800      1850      1900      1950      2000      2013

### Herbivores

Horse	<u>1844</u>					<u>2011</u>
Feral Pig		<u>1853</u>			<u>1993</u>	
Mule Deer			<u>1880</u>		<u>cull 1998</u>	<u>2013</u>
Roosevelt Elk			<u>1880</u>		<u>cull 1998</u>	<u>2011</u>
Cattle	<u>1844</u>				<u>1998</u>	
Sheep	<u>1844</u>			<u>1950s-early1960s</u>		

## Santa Cruz Island

1800      1850      1900      1950      2000      2013

### Herbivores

Horse	<u>1830</u>					<u>2009</u>
Feral Pig		<u>1853</u>				<u>2006</u>
Cattle	<u>1830</u>				<u>1989</u>	
Sheep		<u>1853</u>				<u>2001</u>
Turkey		<u>1853</u>				<u>2001</u>

# Ranching landscapes







# How did I get into this?

*Malacothrix indecora*  
Santa Cruz Island malacothrix

*M. squalida*  
Island malacothrix

“known from two or three execrable islets...”





# Research Questions

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- 1. Where are the rare plant taxa?**
- 2. How do they compare to the past?**
- 3. How are populations doing now?**
- 4. Are there major threats to populations that we can do something about?**

# Research Methods

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- **Herbarium archives**
- **Field surveys**
- **Repeated counts**
- **Demographic monitoring**
- **Experiments**

# Science can be fun



# 15 Listed taxa 5 Park Islands

Taxon	Life History	Status	# pops	Islands where present <sup>1</sup>
<i>Arabis (Boechera) hoffmannii</i>	Perennial	E	5	SCI, SRI, (AI)
<i>Arctostaphylos confertiflora</i>	Shrub	E	3	SRI
<i>Berberis pinnata</i> ssp. <i>insularis</i>	Shrub	E	5	SCI, (AI, SRI)
<i>Castilleja mollis</i>	Perennial	E	2	SRI
<i>Dudleya nesiotica</i>	Perennial	T	1	SCI
<i>Dudleya traskiae</i>	Perennial	E	10	SBI
<i>Galium buxifolium</i>	Subshrub	E	8	SCI, SMI, (SRI)
<i>Gilia tenuiflora</i> ssp. <i>hoffmannii</i>	Annual	E	2	SRI
<i>Helianthemum greenei</i>	Perennial	T	36	SCI, SRI, SCT
<i>Malacothamnus fasciculatus</i> var. <i>nesioticus</i>	Shrub	E	4	SCI
<i>Malacothrix indecora</i>	Annual	E	6	SCI, SRI
<i>Malacothrix squalida</i>	Annual	E	1	SCI
<i>Phacelia insularis</i> var. <i>insularis</i>	Annual	E	1	SRI, SMI
<i>Sibara filifolia</i>	Annual	E	2	(SCI), SCT, SCL
<i>Thysanocarpus conchuliferus</i>	Annual	E	8	SCI

<sup>1</sup>AI = Anacapa Island, SBI = Santa Barbara Island, SCI = Santa Cruz Island, SCT = Santa Catalina Island (non-NPS), SMI = San Miguel Island, SRI = Santa Rosa Island; parentheses ( ) indicate presumed extirpated.

## Current Condition

## Desired Future

Few  
Small  
Isolated  
Declining

*Constraints*

Many  
Large  
Connected  
Growing

## Constraints

Few plants  
Poor seed production  
Low seed viability  
Low recruitment

Grass competition  
Open canopy  
No seed bed

Isolation  
Habitat fragmentation  
Habitat loss

Pollinator limitation  
Rooting and trampling  
Erosion  
Fog

**POPULATION**

**HABITAT**

**LANDSCAPE**

**ECOSYSTEM**

## Recovery Tools

Seed increase  
Seed banking  
Hand pollination  
Tissue culture

Invasive control  
Habitat restoration  
Population augmentation

New populations

Animal eradication

# Santa Rosa and Santa Cruz Island endemic plant scenarios



# Good as it gets





# Population expansion

Torrey pine  
(*Pinus torreyana* var. *insularis*)



1942



2012

# Moving out of refugia Jolla Vieja endemics

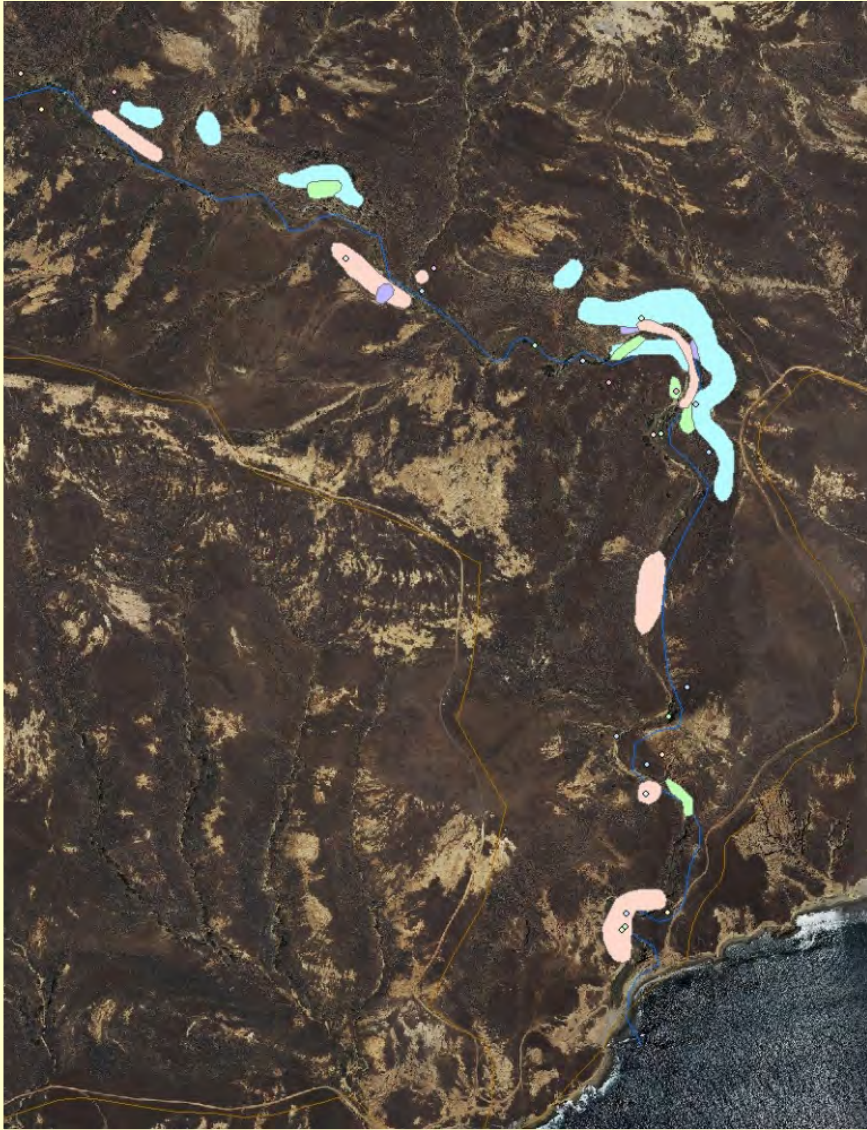


1994

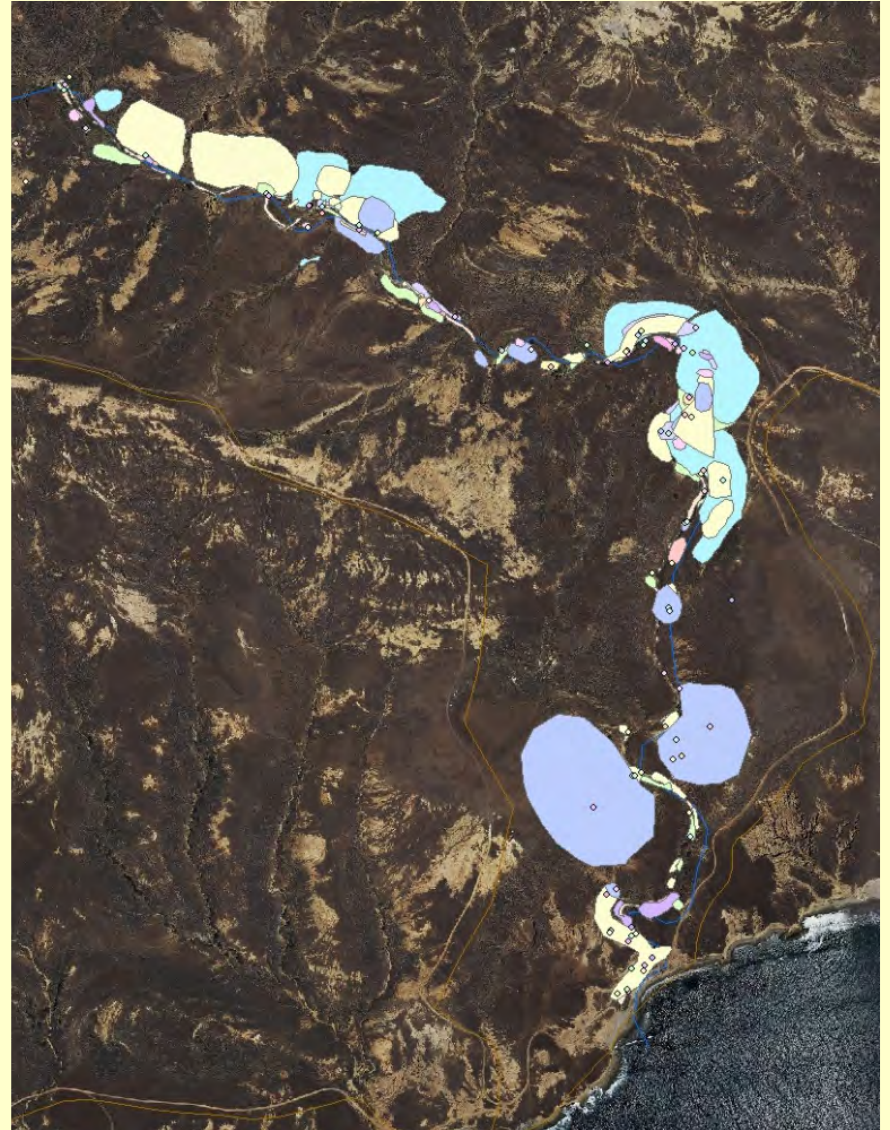


2011

1994 - 11 Species

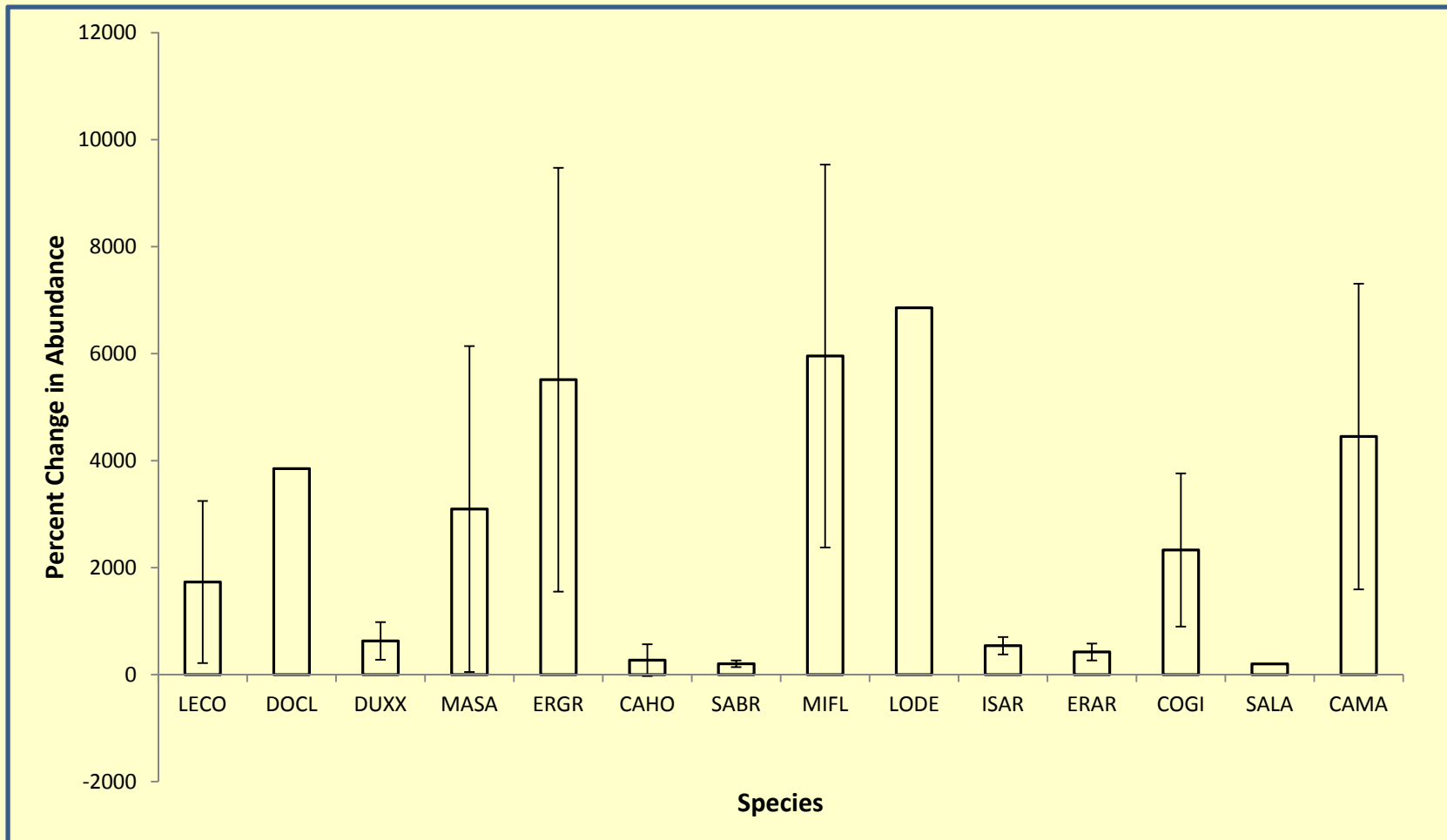


2010 - 17 Species

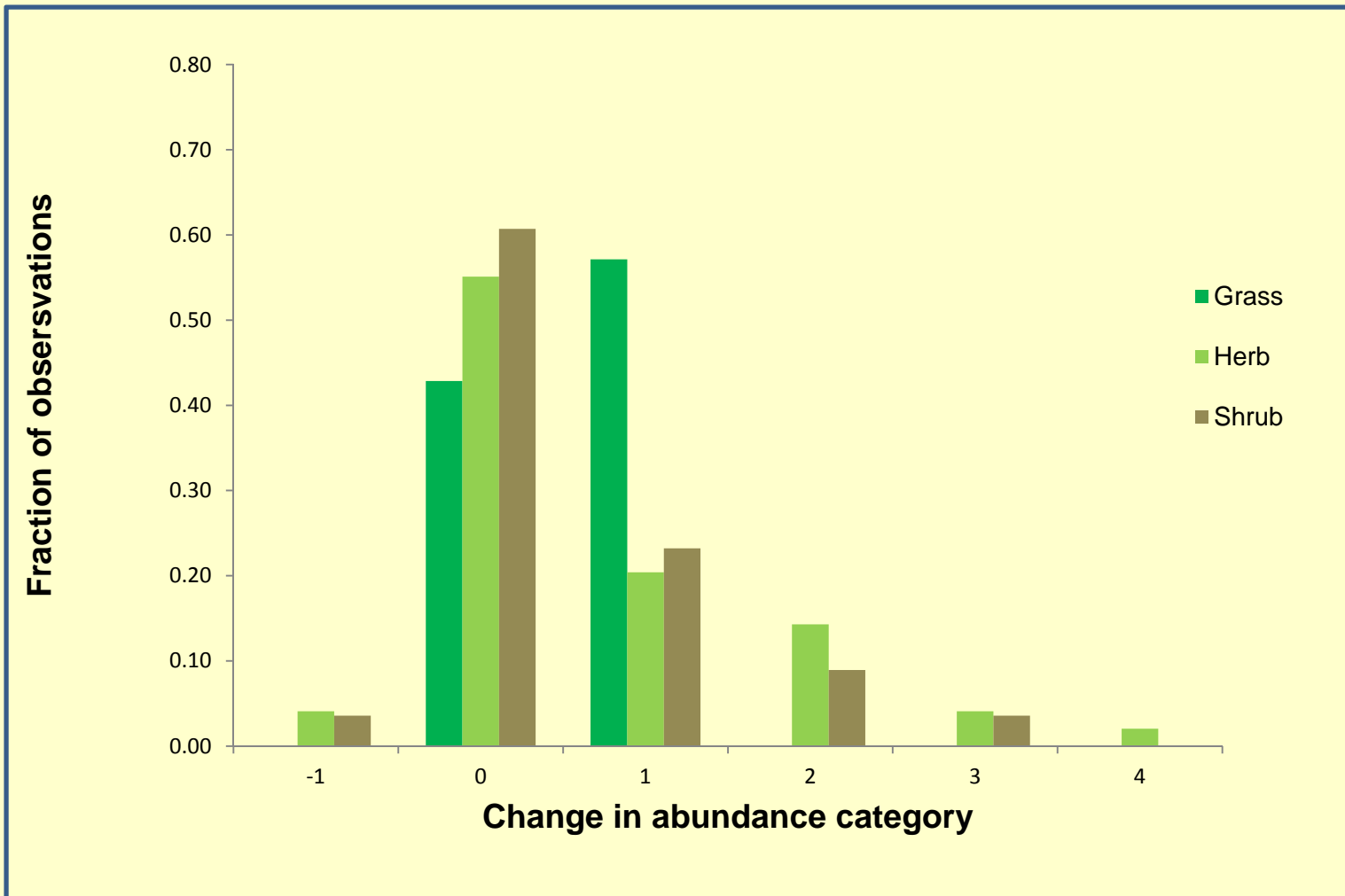


270% Average percent change in abundance

# Change in Abundance all Canyons



# Life History



# **Benefitting from openness without herbivores**



# Fire follower

Island rush-rose

*Crocanthemum (Helianthemum) greenei*

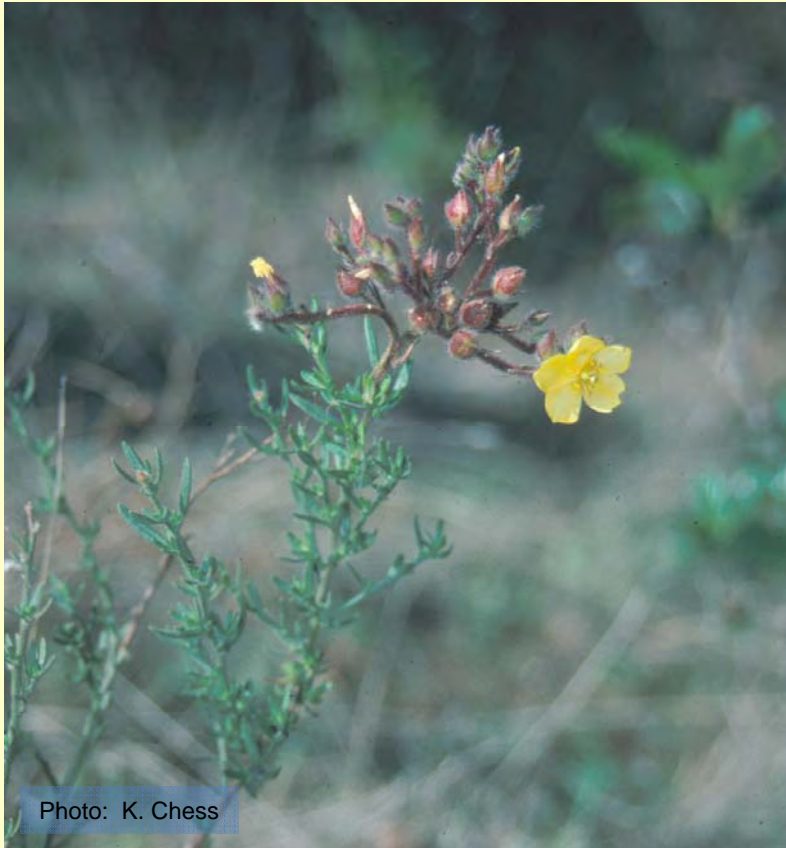
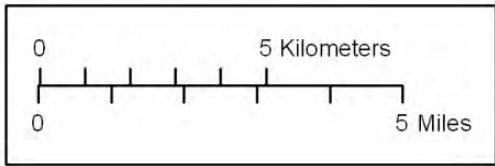


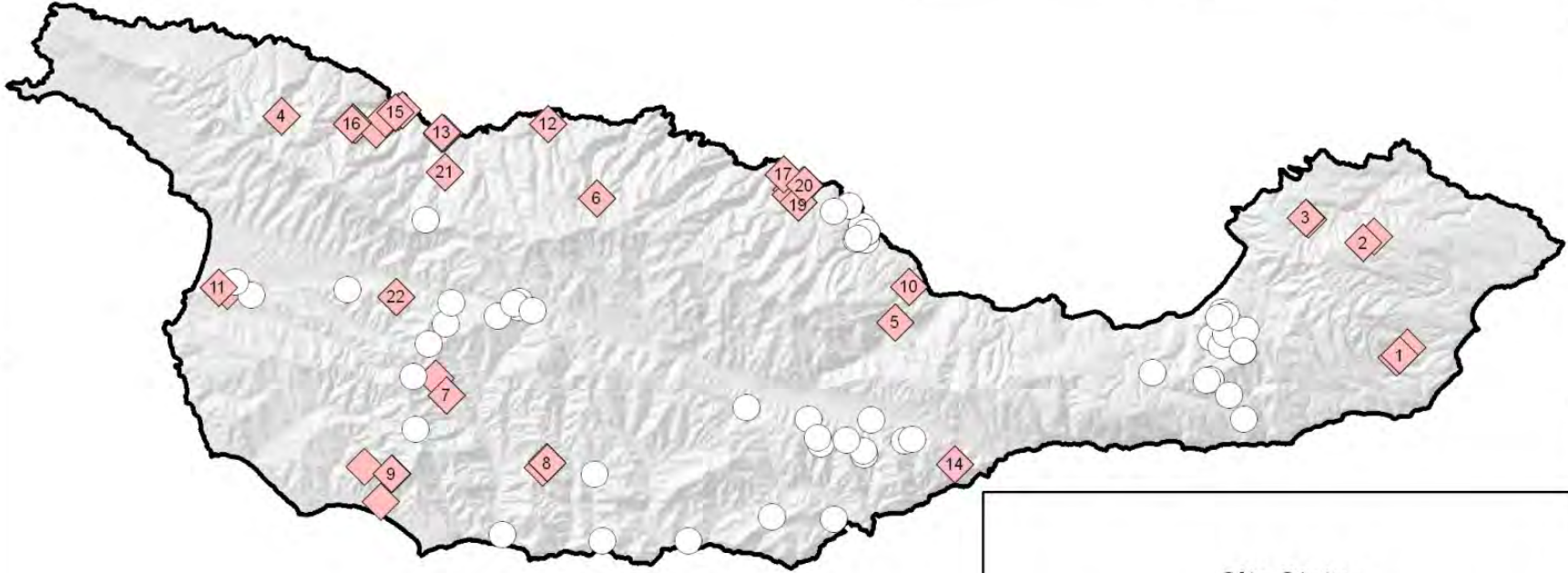
Photo: K. Chess



Photo: M. Barmann



# Santa Cruz Island



## Island rush-rose distribution

**Site Status**

- numbers in symbols indicate site names; see text

- pre-2000 occurrences
- ◊ 2000 - 2006 occurrences

North American Datum 1927  
 Universal Transverse Mercator Zone 11  
 15 May 2009  
 USGS/BRD-WERC Channel Islands Field Station GIS

119°55'0"W

119°50'0"W

119°45'0"W

119°40'0"W

119°35'0"W

34°50'N

34°00'N

33°50'N



Doesn't like pigs or grass or litter  
....or cool weather?

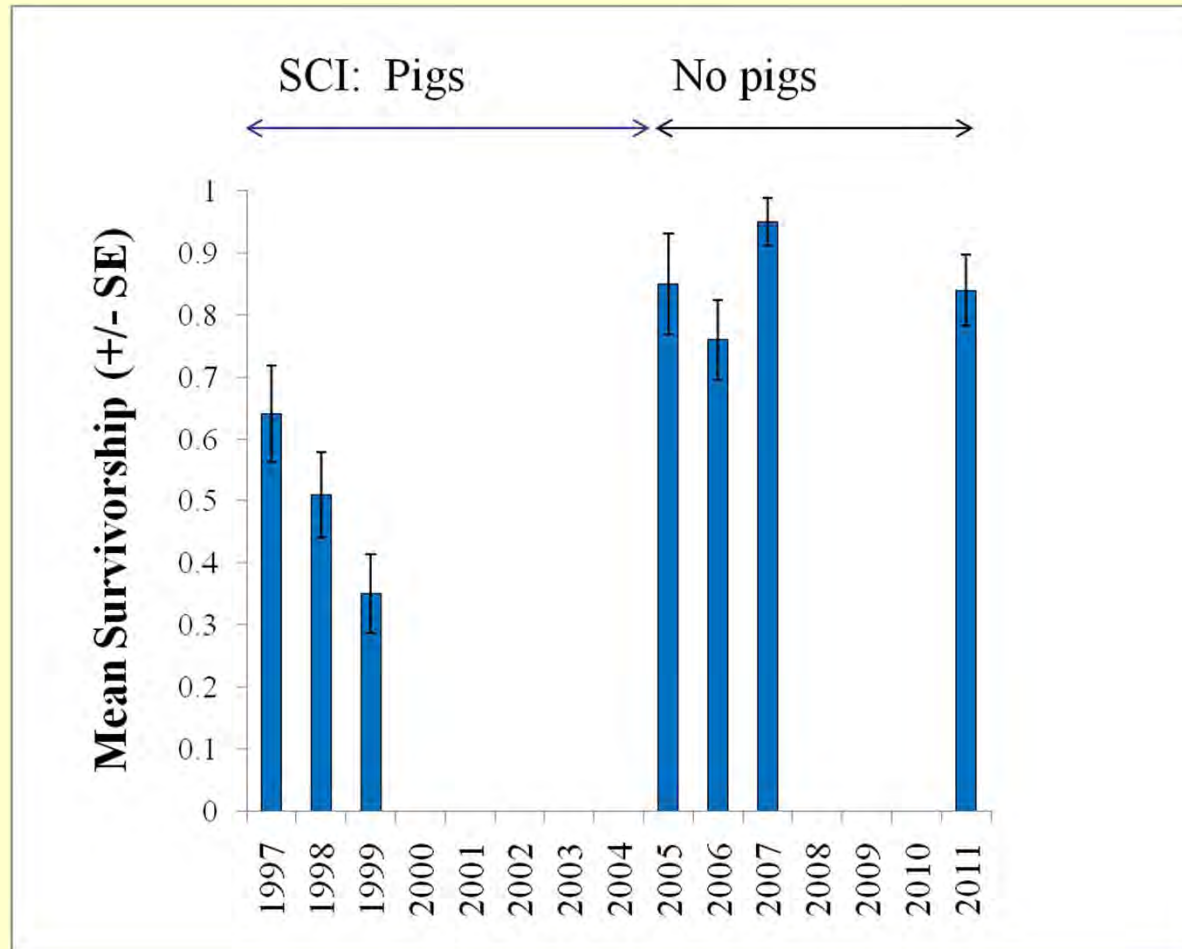
Island jepsonia  
*Jepsonia malvifolia*



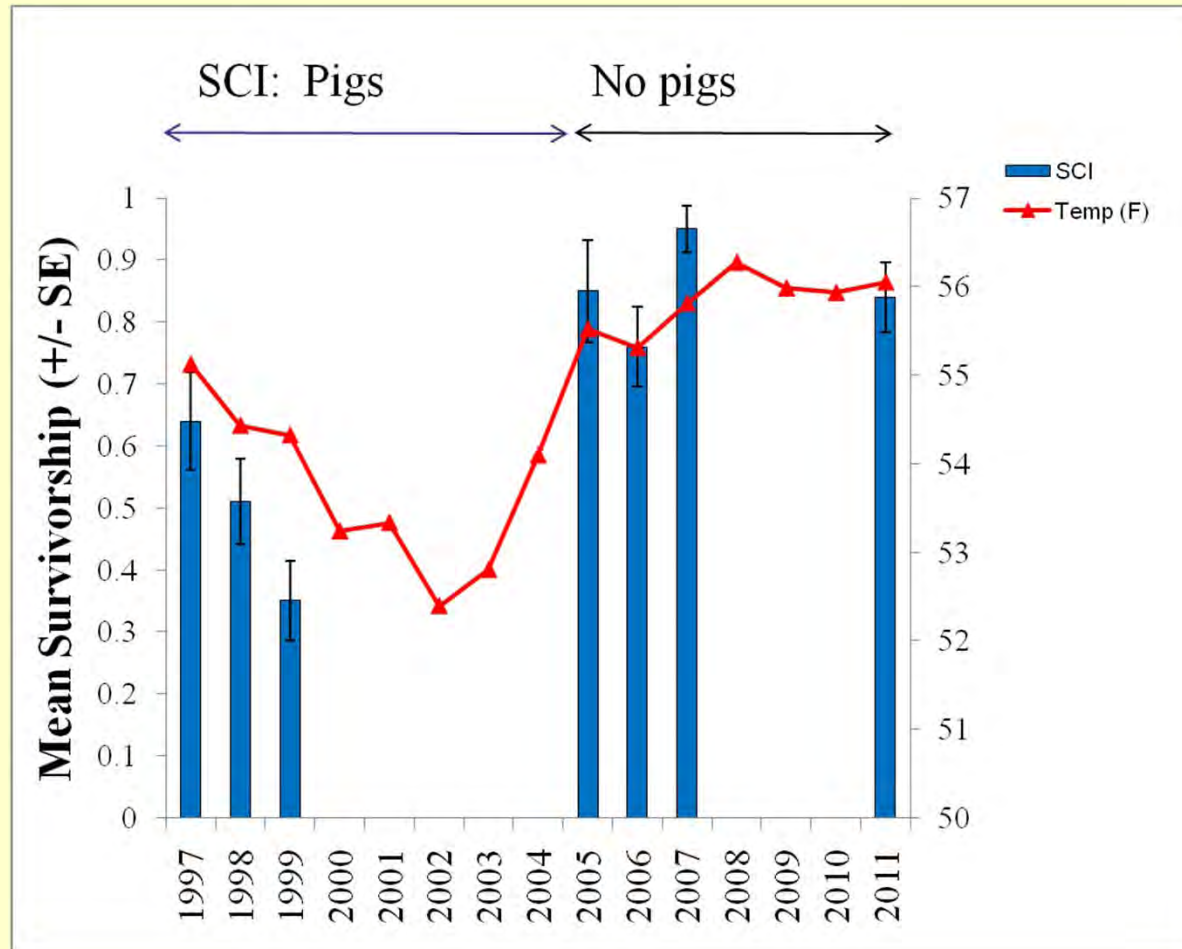


1996 SCI

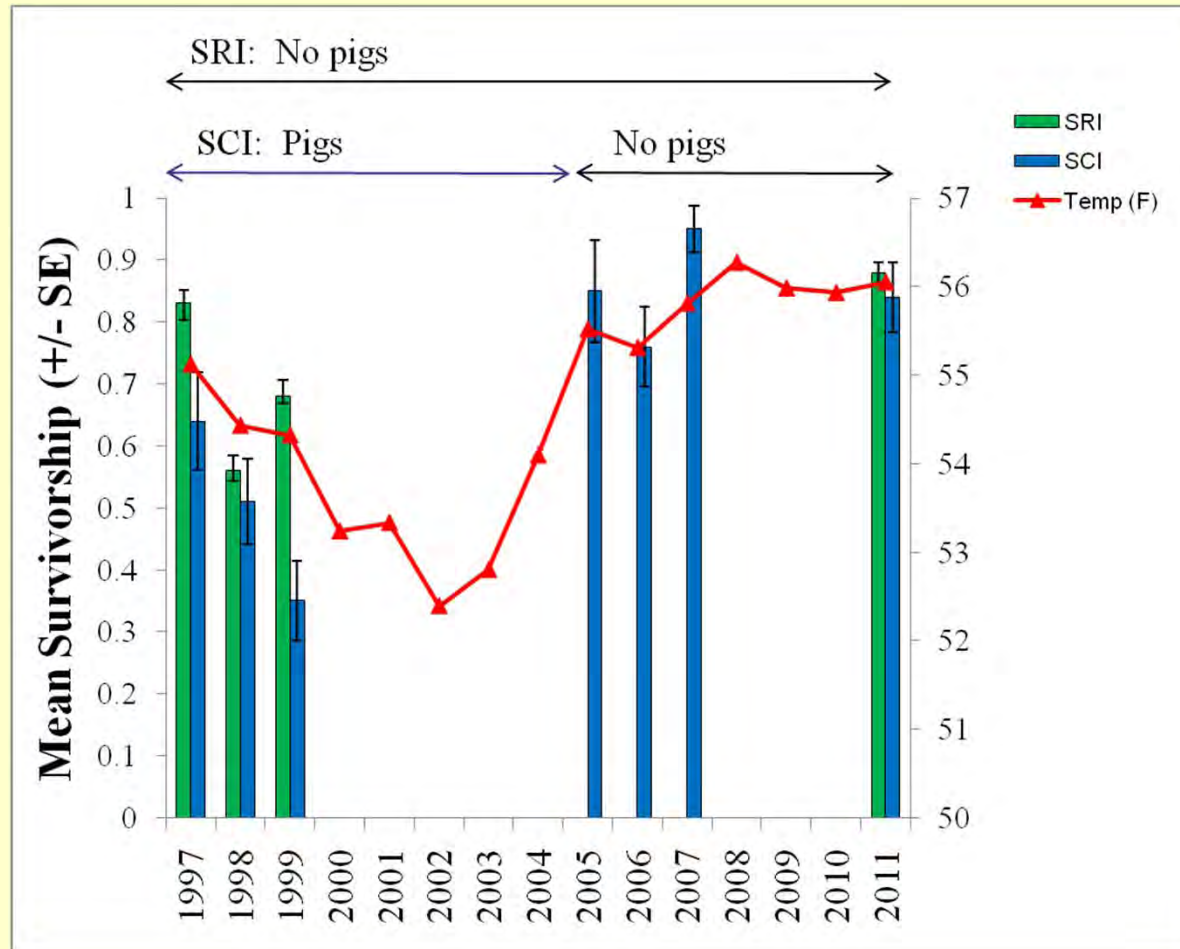
# Large Adult Survivorship: Santa Cruz Island



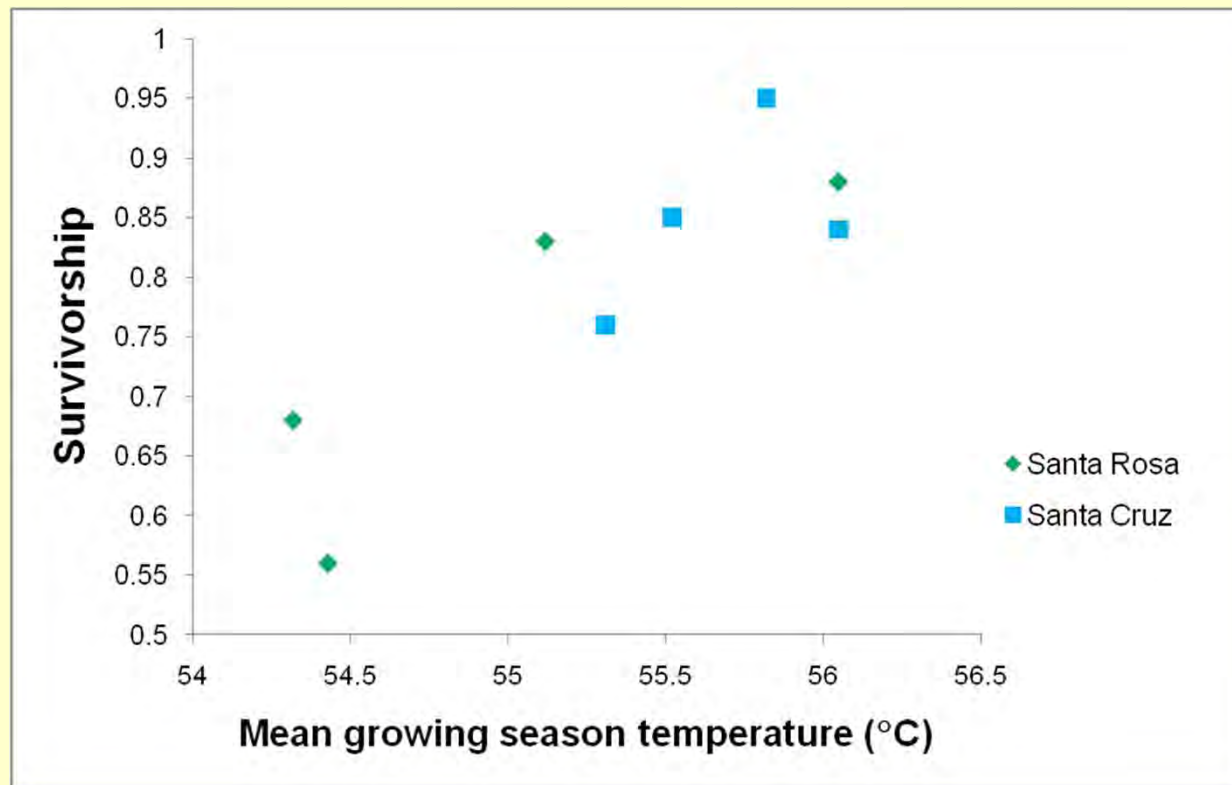
# What about climate?



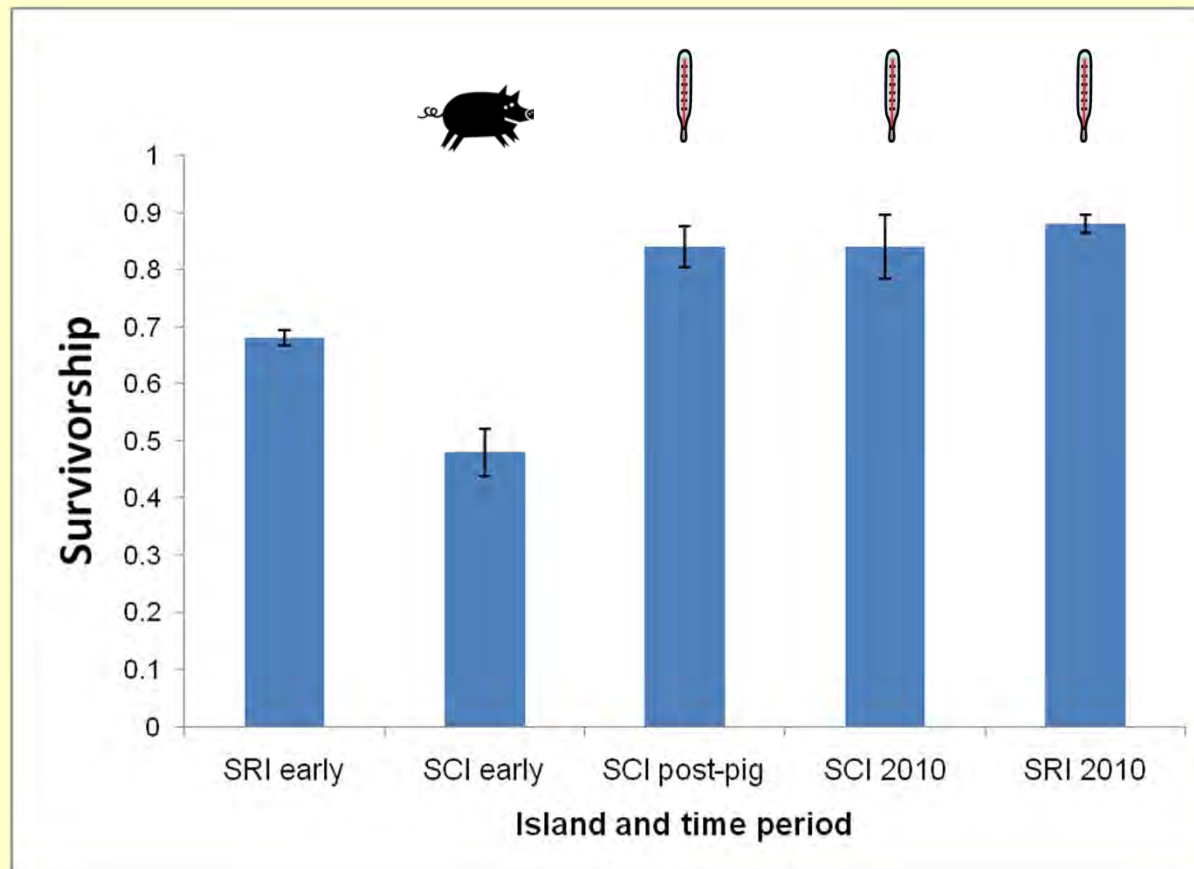
# Santa Rosa to the rescue



# Climate effects without pigs



# Combined effects



# Habitat specialists



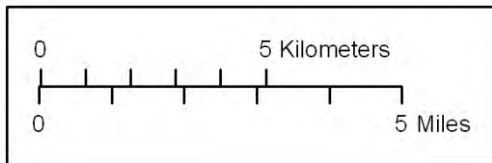


# Can't move out of harm's way

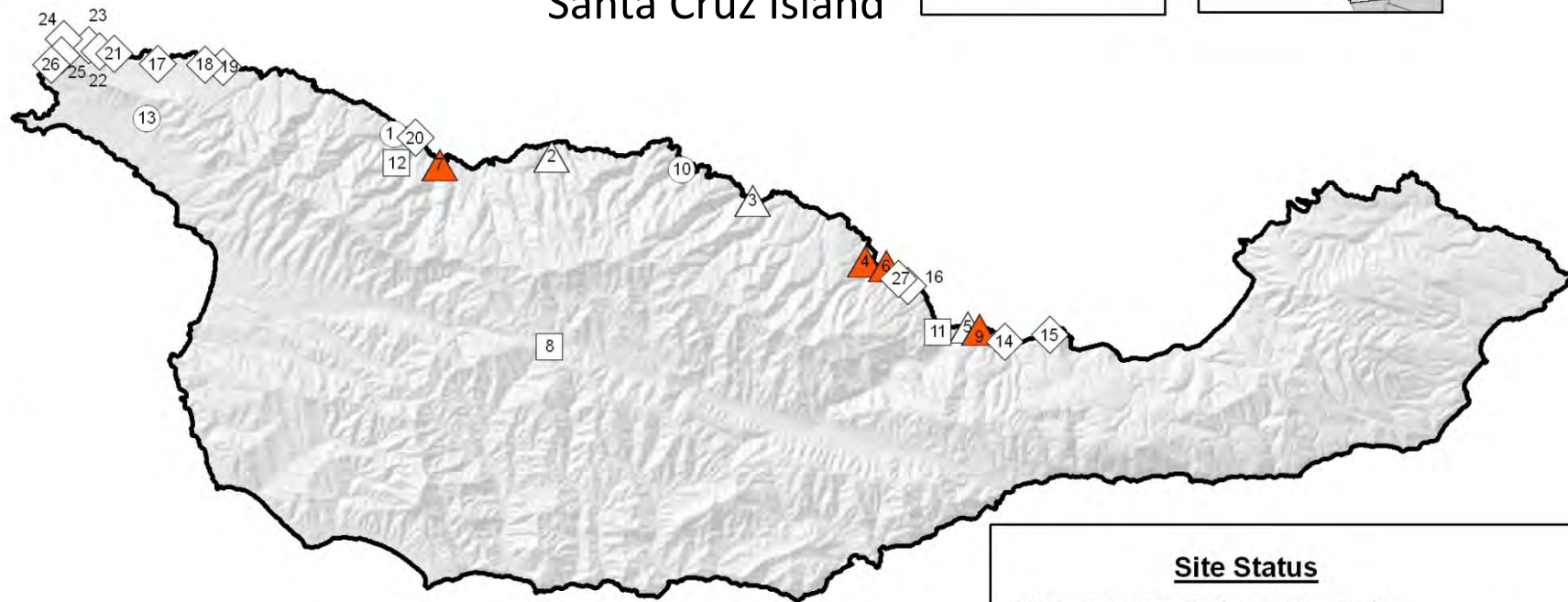
Sea-cliff bedstraw  
*Galium buxifolium*



2004. 4. 28 15:13



## Santa Cruz Island



# Sea-cliff bedstraw distribution

North American Datum 1927  
 Universal Transverse Mercator Zone 11  
 15 May 2009  
 USGS/BRD-WERC Channel Islands Field Station GIS

### Site Status

- filled symbols indicate monitored sites
- numbers in symbols indicate site names; see text
- historic, not surveyed 2000 - 2006
- historic, surveyed 2000 - 2006, not relocated
- △ historic, surveyed 2000 - 2006, relocated
- ◇ new discovery 2000 - 2006

34°50'N  
 34°00'N  
 33°50'N

119°55'0"W      119°50'0"W      119°45'0"W      119°40'0"W      119°35'0"W

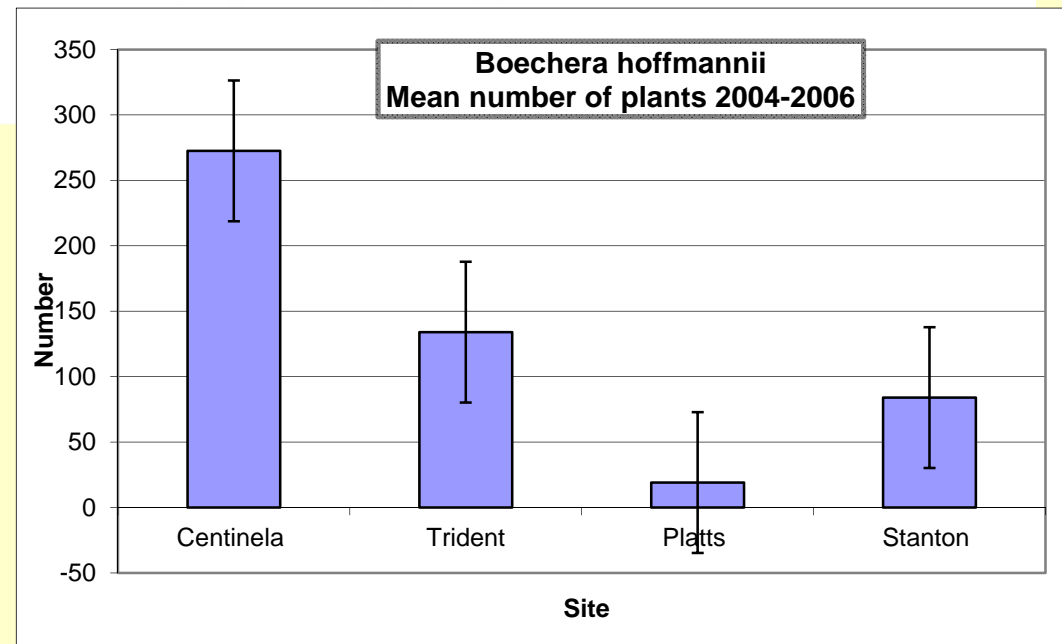
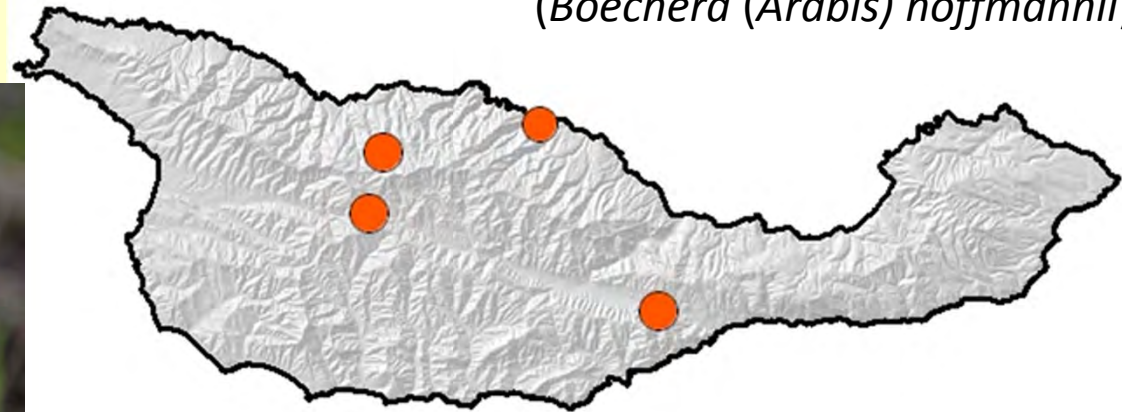
Colonize terraces: seed increase,  
habitat manipulation and outplant



# Can't find the next good place



Hoffmann's rock-cress  
(*Boechera (Arabis) hoffmannii*)



# North-facing and steep and foggy and no litter and no grass



# Hoffmann's rock-cress demography

- Population sizes 20 - 300
- 12 - 20% flower annually
- Self-compatible, self-pollinating
- 30 -125 fruits per plant x 120 seeds per fruit
- 3,750 - 15,000 seeds per plant
- 20% germination in experiments
- 80% of seedlings die first year
- Recruitment 1 - 5 seedlings per parent annually
- No plants in grass or deep litter

# Outplanting Hoffmann's rock-cress



80% survival of plantlets to fruiting  
20% germination from planted seeds  
5% survival of seed plants to fruiting  
2<sup>nd</sup> generation fruiting now

Deep litter accumulation is preventing recruitment at 2 sites

# Santa Rosa Island Sierra Pablo





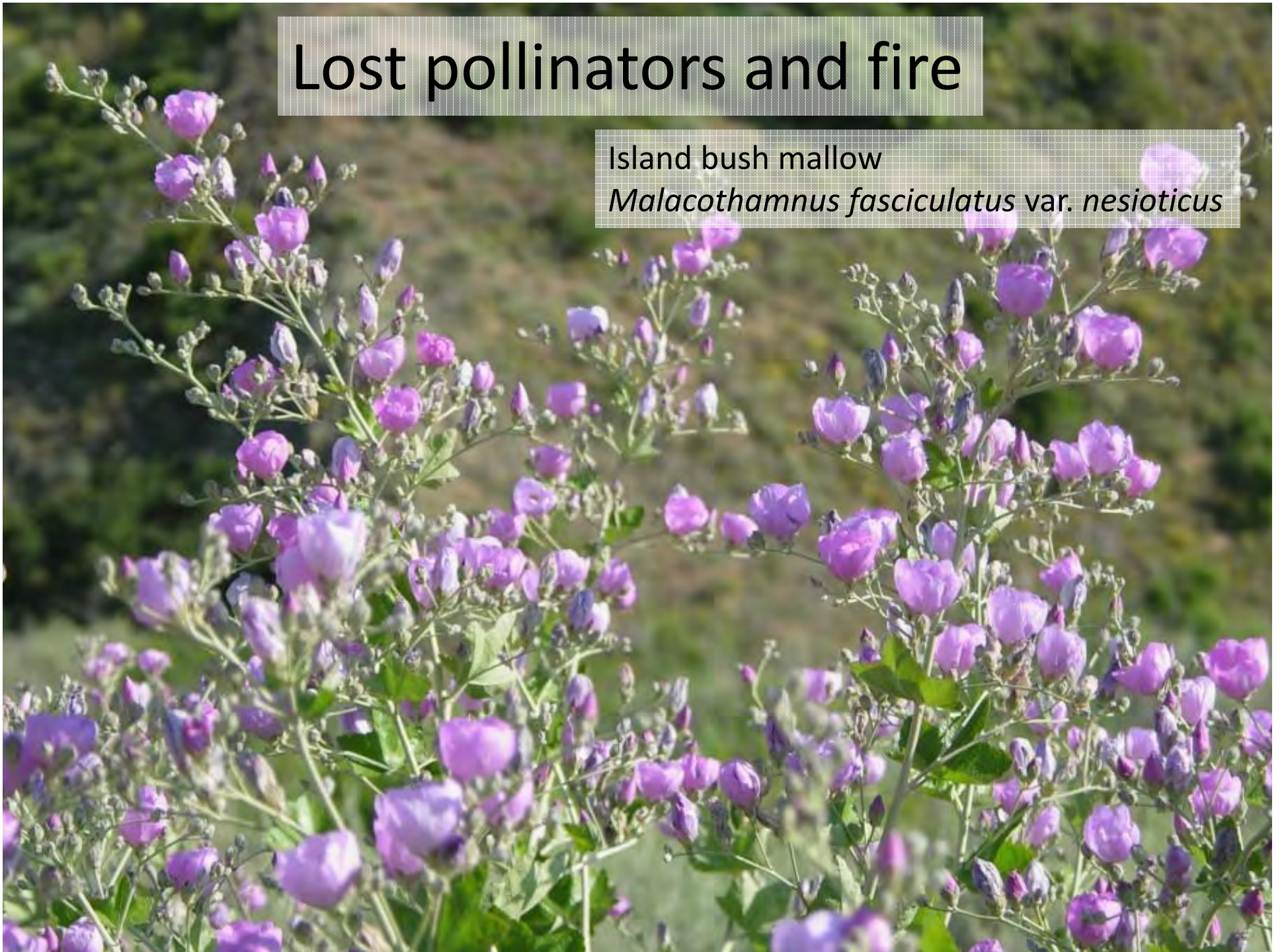
# Changed ecosystem processes



# Lost pollinators and fire

Island bush mallow

*Malacothamnus fasciculatus* var. *nesioticus*



# Island bush mallow distribution

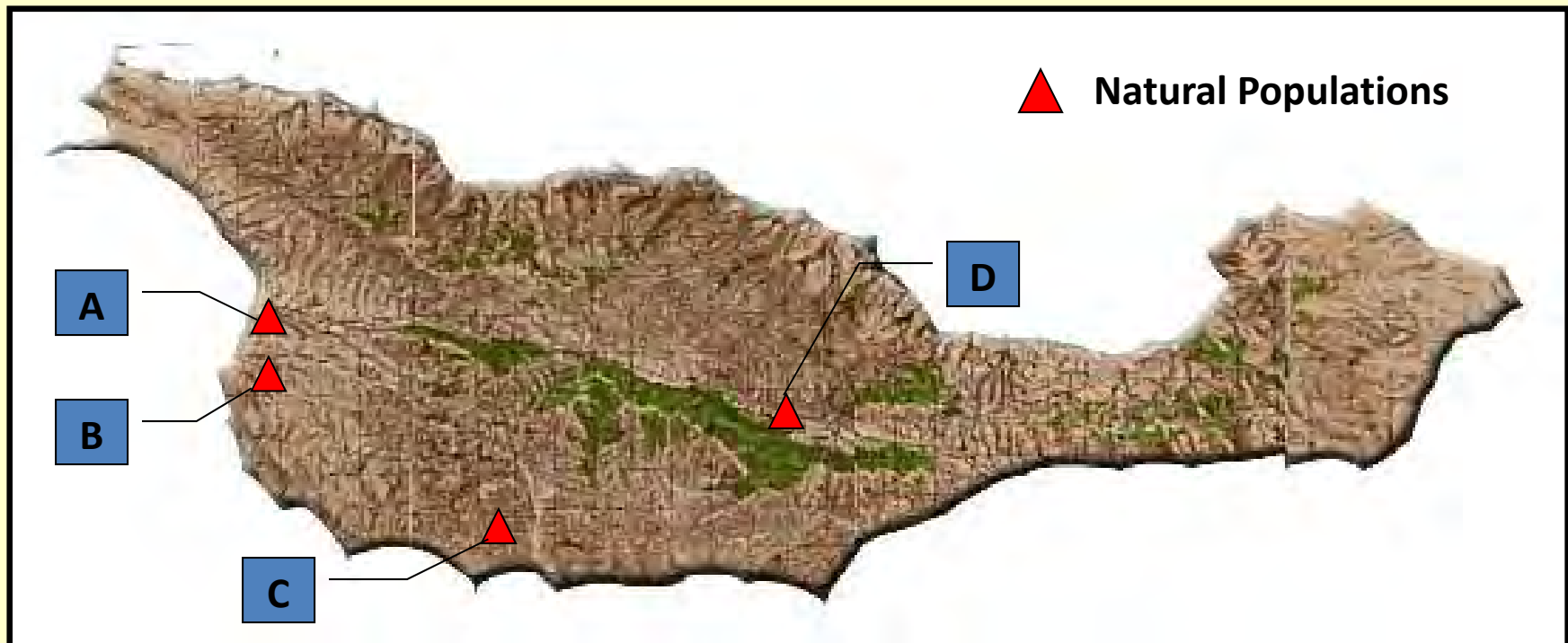
4 clones, ca. ~ 150 ramets

**A: 1965 > 2006; 10 > 35 ramets**

**C: 1996 > 2006; 18 > 34**

**B: 1997 > 2006; 3 > 50**

**D: 1993 > 2006; 32 > 16**



# Fruit and Seed Set

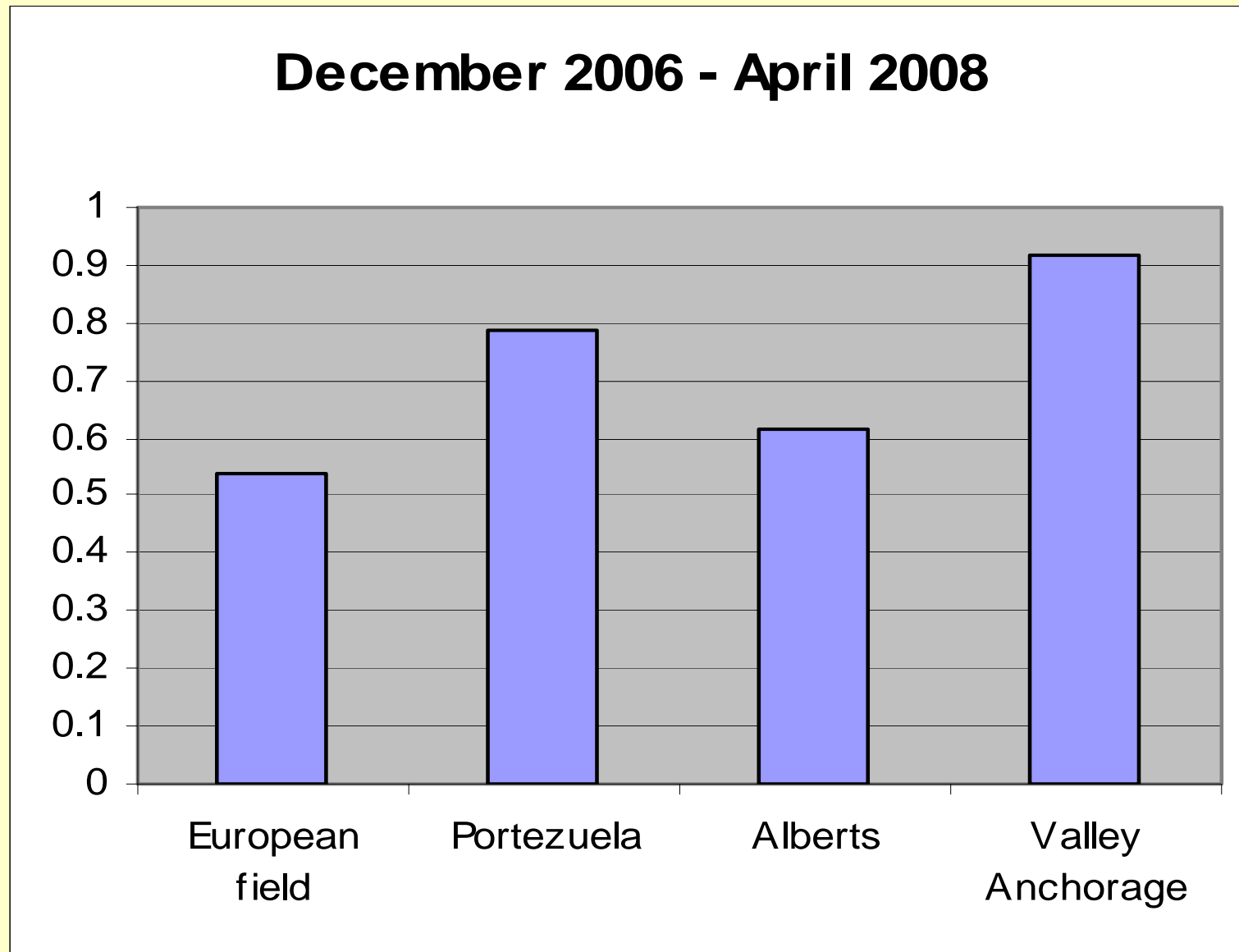


- **Self-compatible; “mixed-mating”**
- **Fruit set in natural populations relatively low (0 – 12 %)**
- **Seed set in natural populations variable (17 – 50 %) among years and sites**
- ***Ex situ* outcrossed fruit and seed set relatively high**  
**overall fruit set = 57 %**  
**overall seed set = 65 %**
- **Overall seed viability = 81 %**
- **Seed viability of buried *in situ* seeds = 67 % after 2 years**

# Outplant experiment



# Island bush-mallow outplanting survival



January 2010



July 2011



90% survival - March 2013

# Lost fog drip, soil and litter

Island oak  
(*Quercus tomentella*)





# Fragmented habitat, herbivory and climate change

Soft-leaved island paintbrush  
*Castilleja mollis*





# Herbivore damage

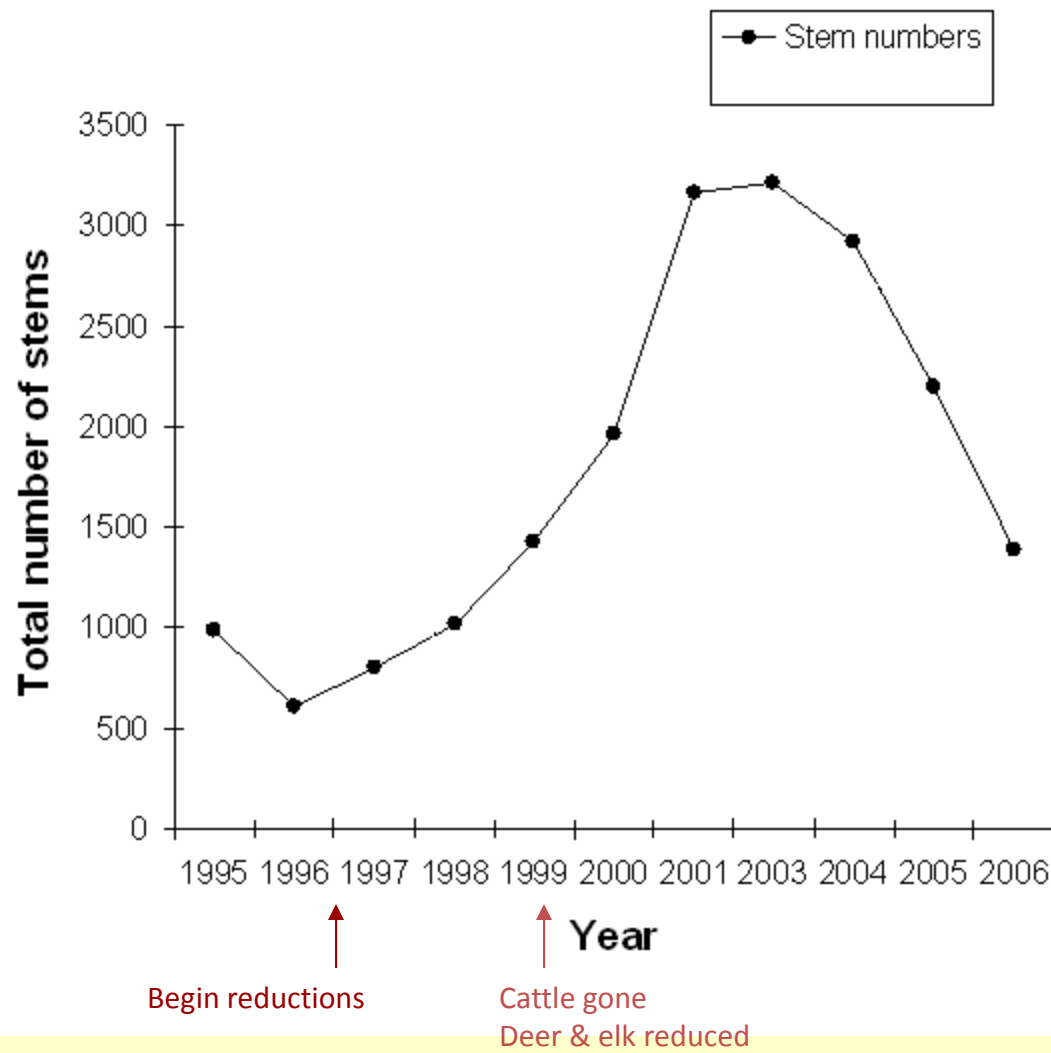


Scraping

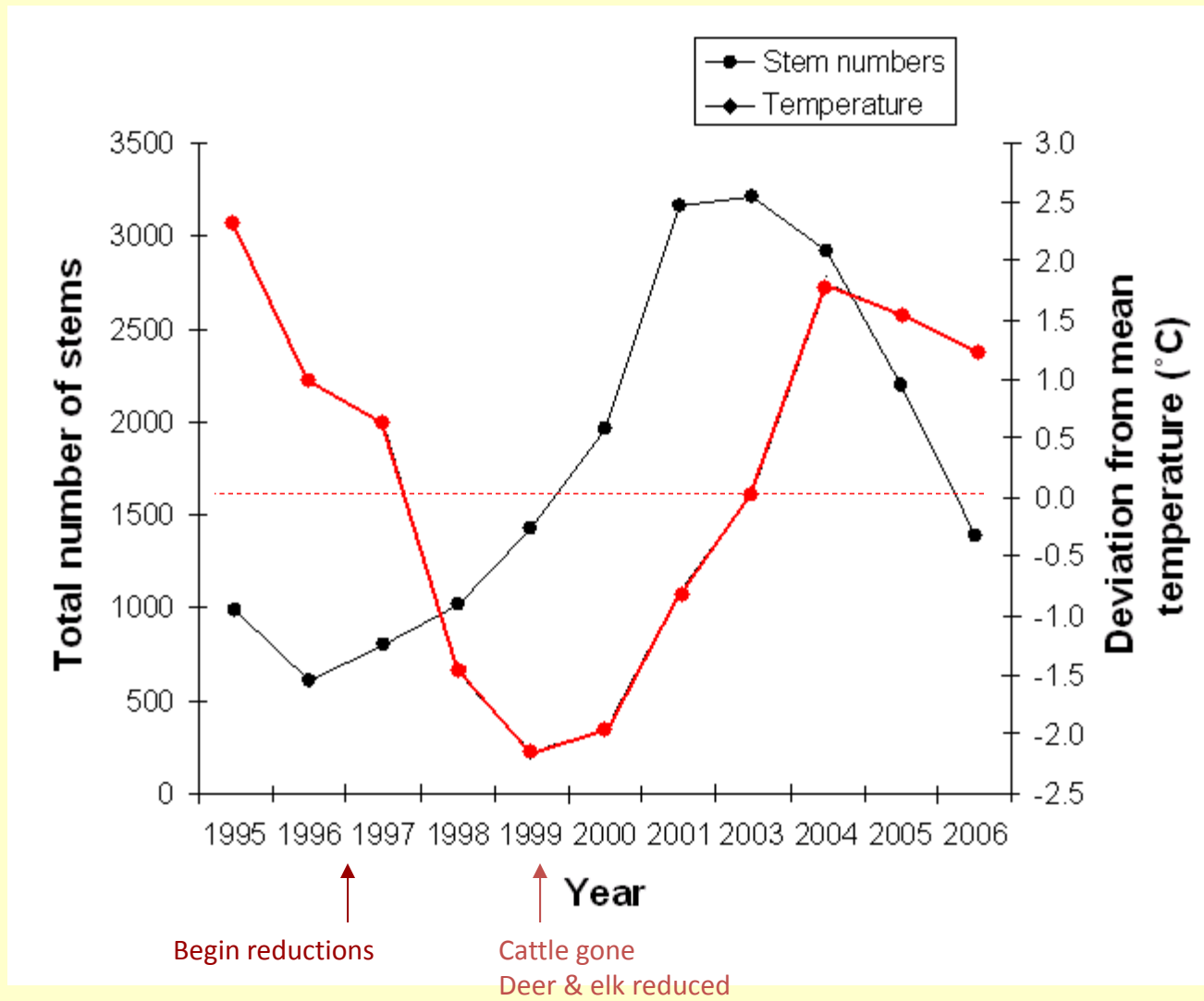
Browsing



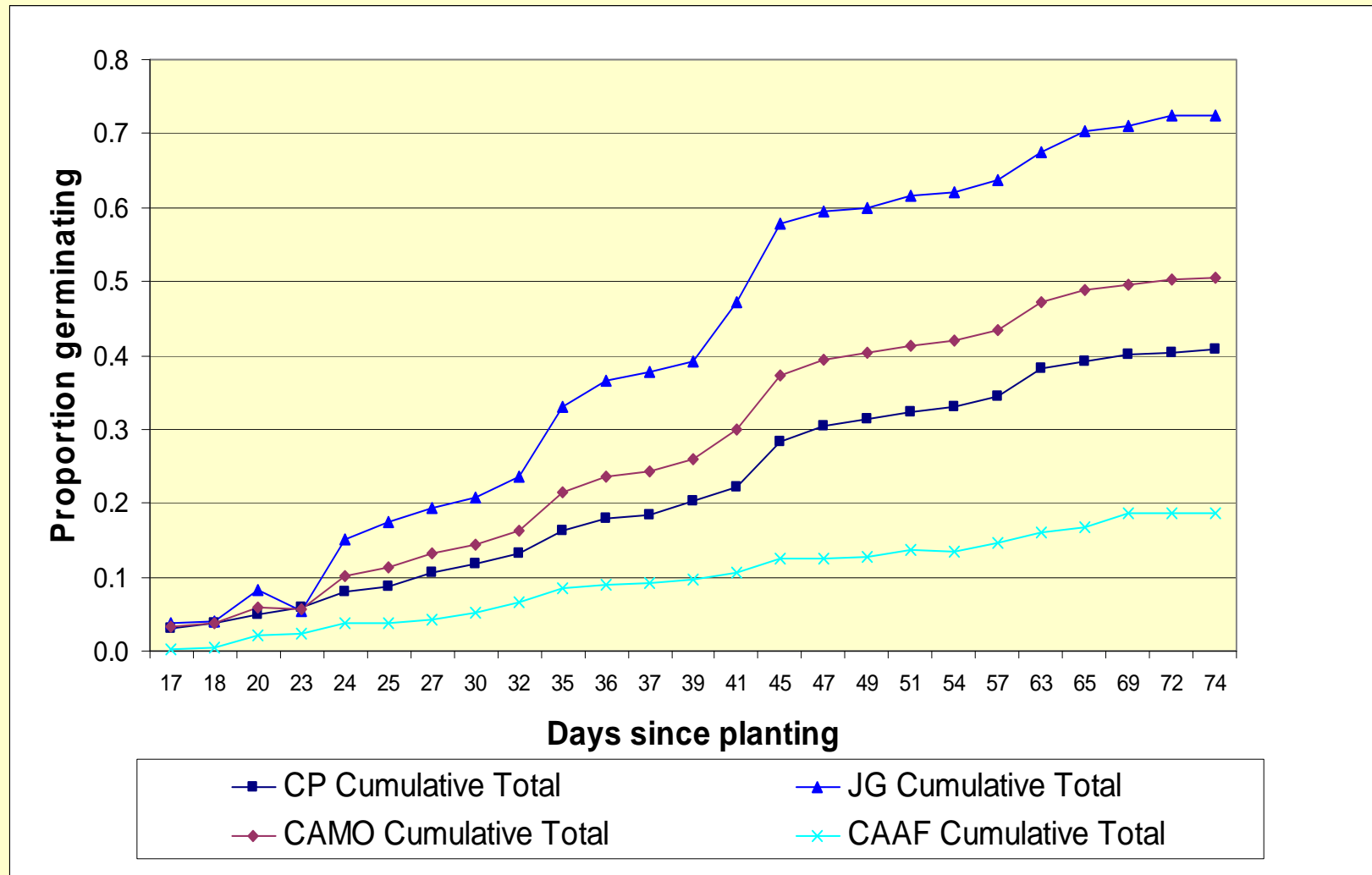
# Paintbrush trend, herbivores



# Paintbrush trend, herbivores, temperature



## Cumulative proportion of *Castilleja mollis* seeds germinating, October 26, 2001 - January 9, 2002



# Hybridization

*Castilleja mollis*



*Castilleja affinis*



*Castilleja mollis* x *affinis*



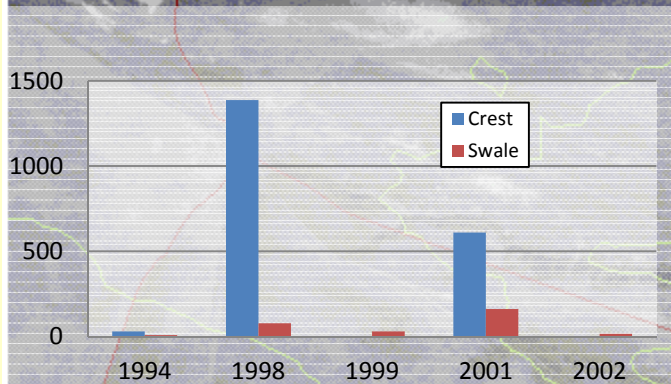
# Changed climate regime, habitat invaded

Island Phacelia (*Phacelia insularis*)





# Island Phacelia 1998



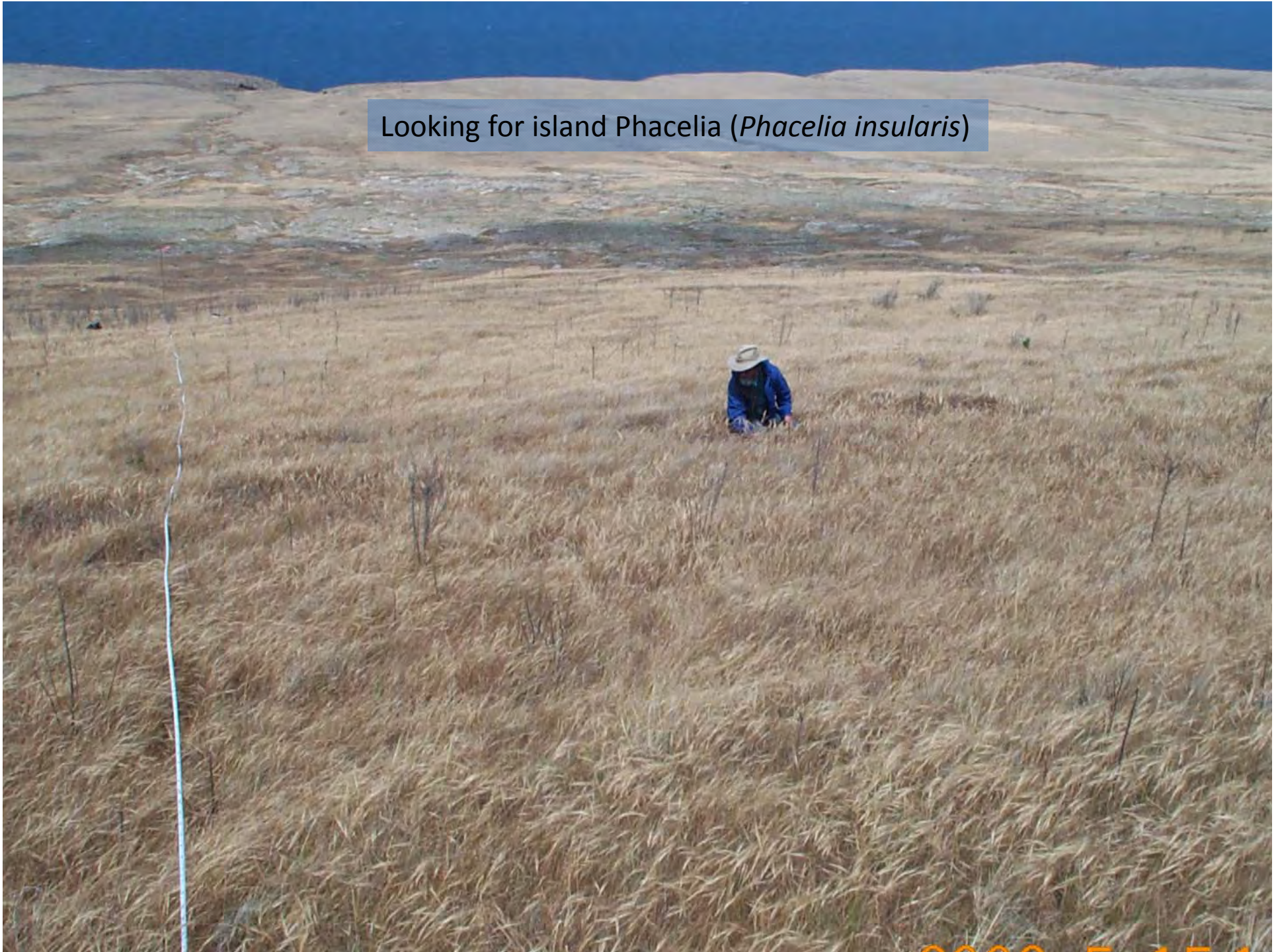
0.5

0

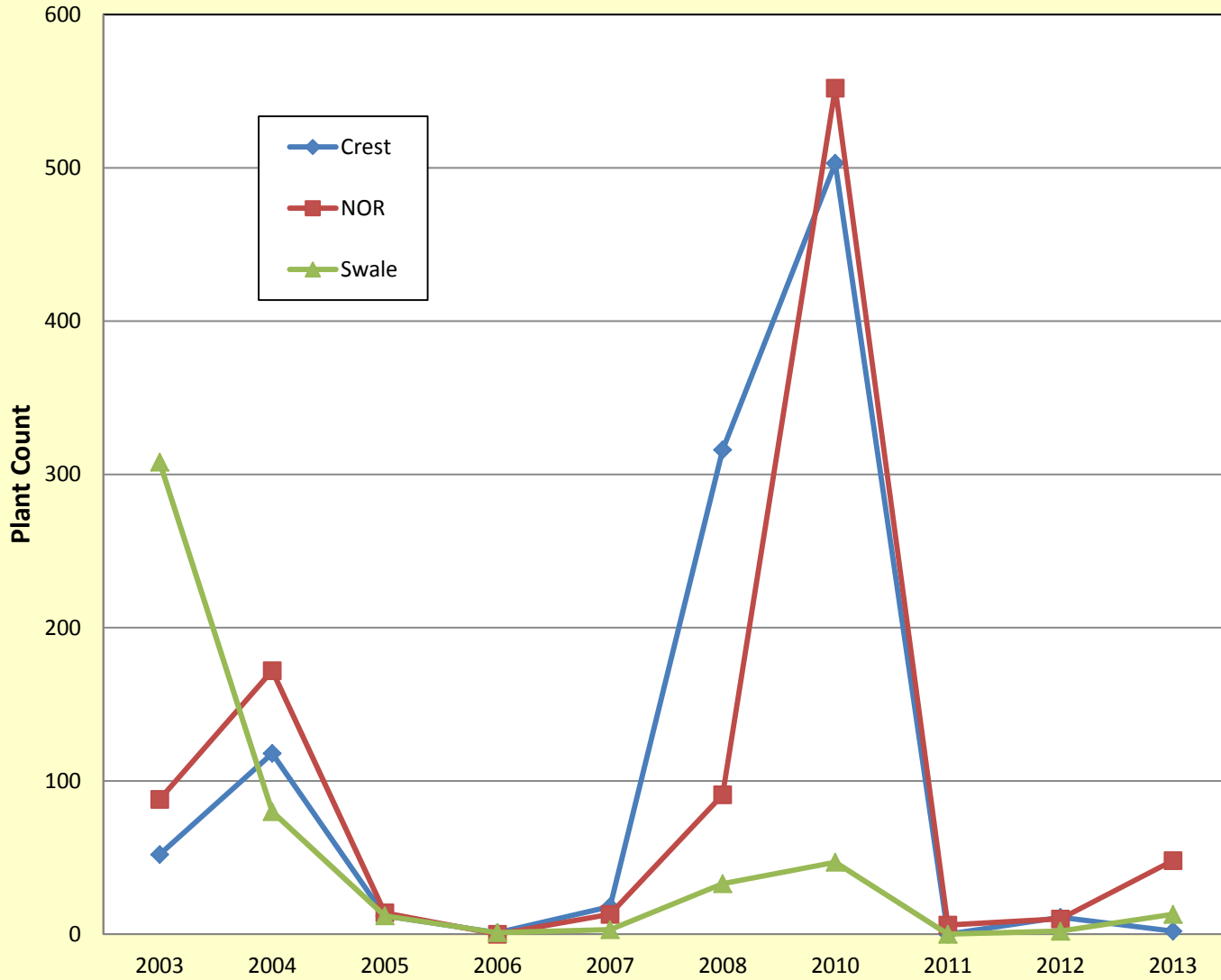
0.5

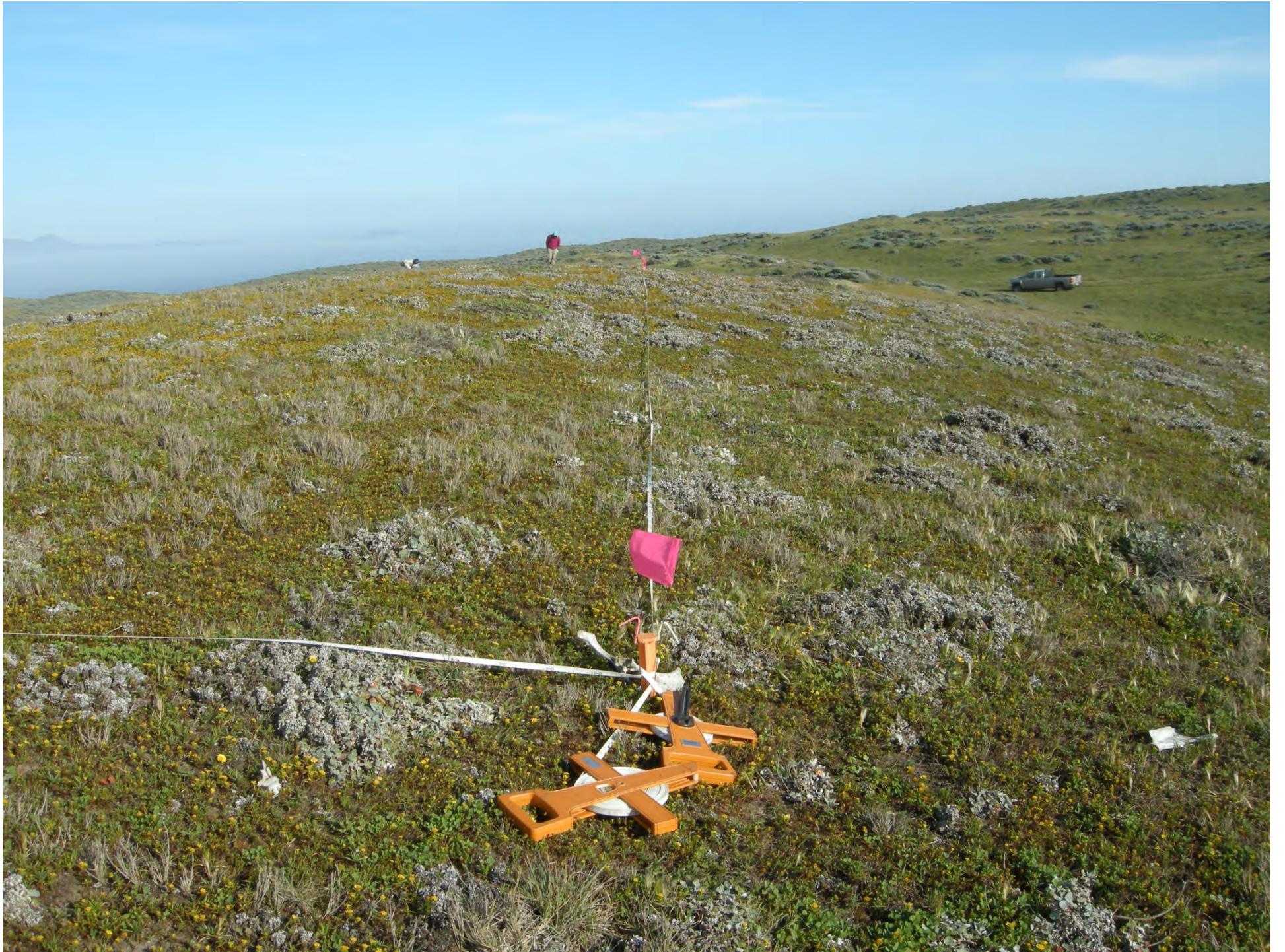


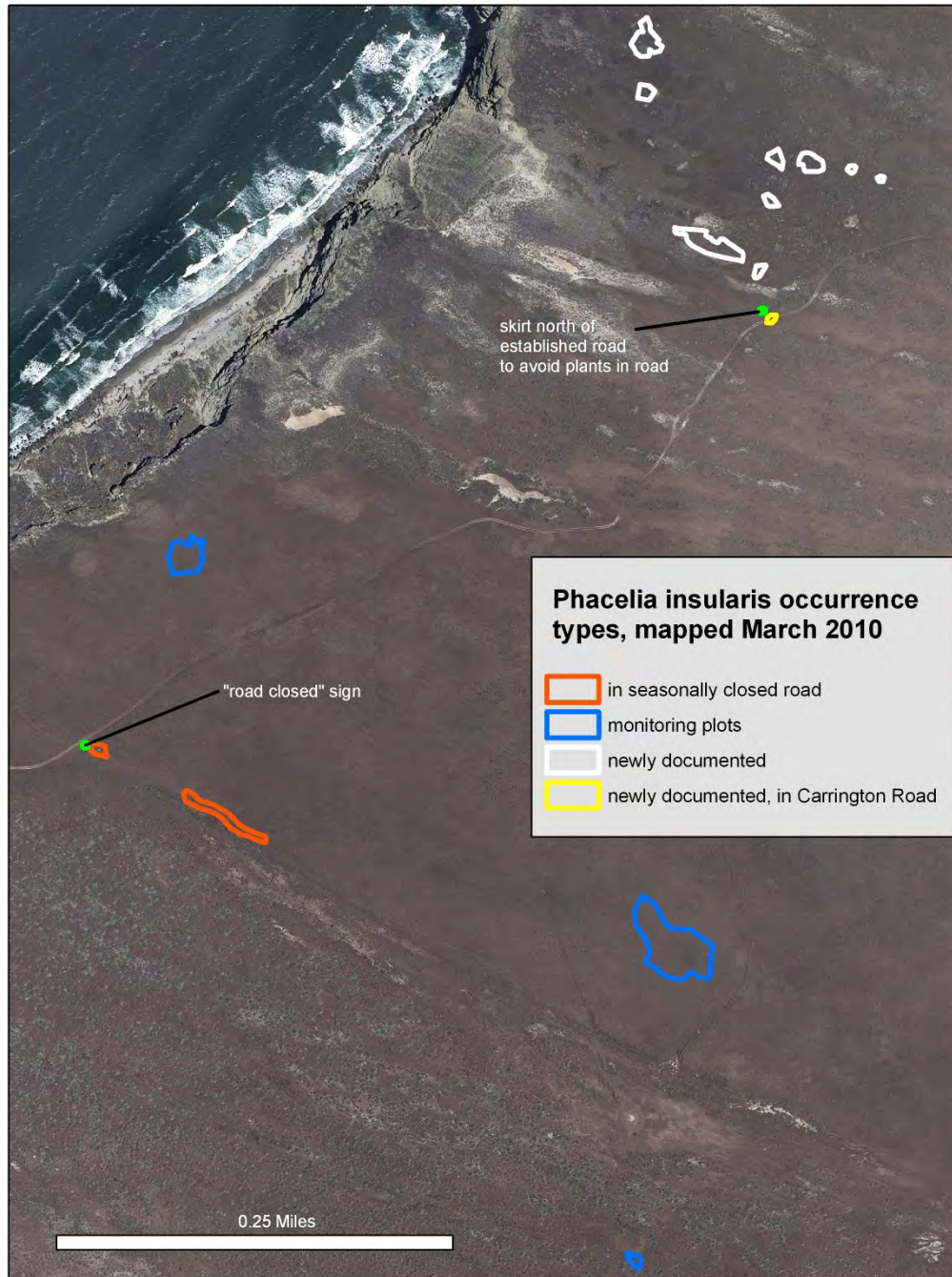
Looking for island Phacelia (*Phacelia insularis*)



### Phacelia plot counts 2003-2013



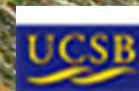




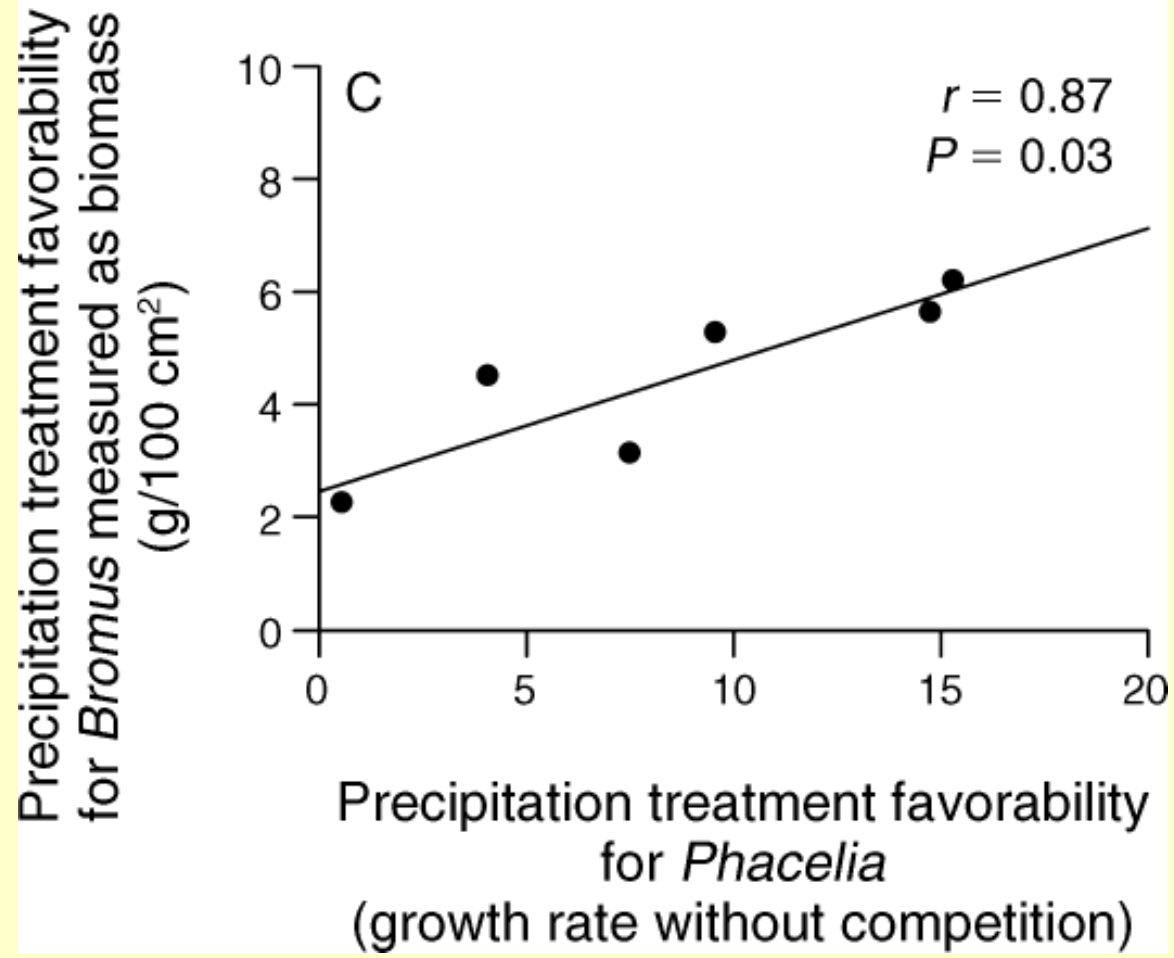
# Competition and climate change



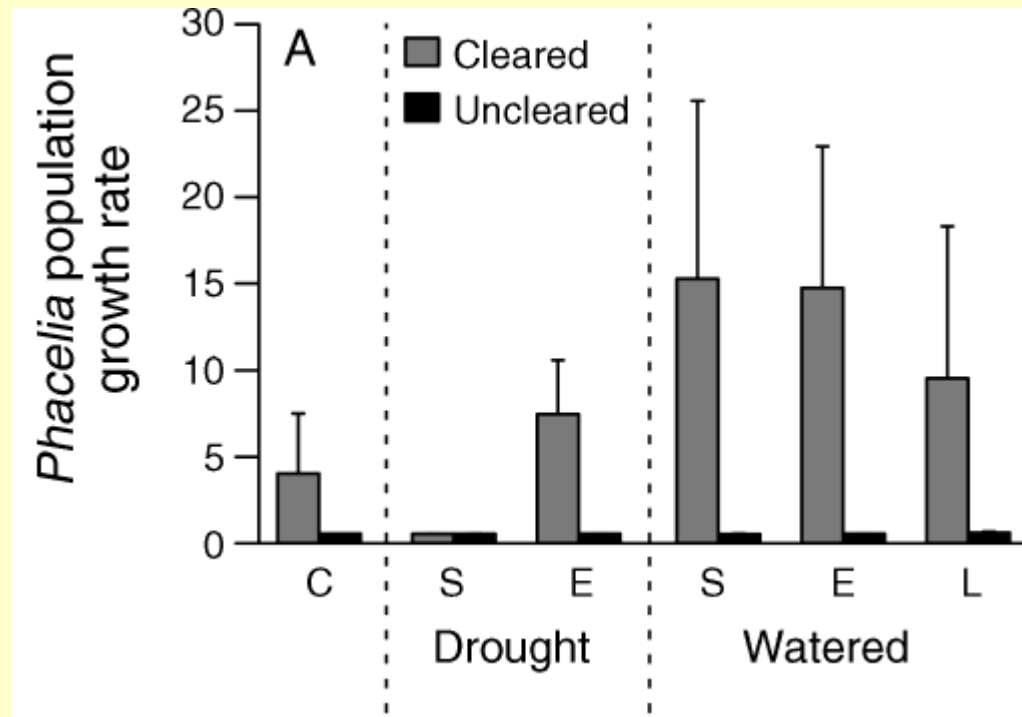
2000



# Precipitation treatments Bromus and Phacelia biomass

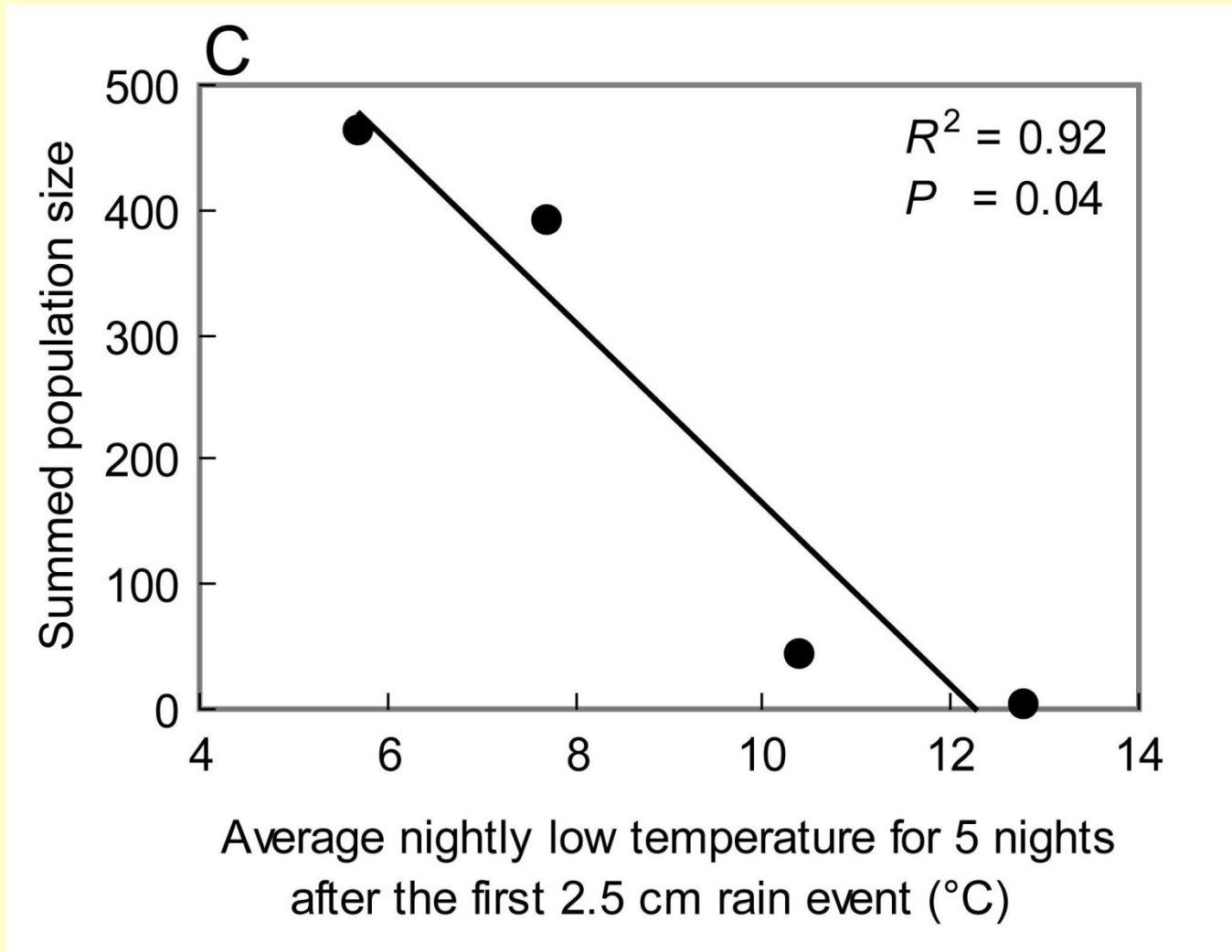


# Bromus clearing treatments and Phacelia growth





## Temperature after first rains and Phacelia population size





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## Desired Future

Few  
Small  
Isolated  
Declining

*Constraints*

Many  
Large  
Connected  
Growing

## *Constraints - Population*

Few plants

Poor seed production

Low seed viability

Low recruitment

## *Constraints - Habitat*

Few plants

Poor seed production

Low seed viability

Low recruitment

Grass competition

Open canopy

No seed bed

## *Constraints - Landscape*

Few plants

Poor seed production

Low seed viability

Low recruitment

Grass competition

Open canopy

No seed bed

**Isolation**

**Habitat fragmentation**

**Habitat loss**

## *Constraints - Ecosystem*

Few plants

Poor seed production

Low seed viability

Low recruitment

Grass competition

Open canopy

No seed bed

Isolation

Habitat fragmentation

Habitat loss

Pollinator limitation

Rooting and trampling

Erosion

Fog

## *Constraints*

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*Recovery tools*

Seed increase

Seed banking

Hand pollination

Tissue culture

Invasive control

Habitat restoration

Population augmentation

New populations

Animal eradication

Monitoring

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Erosion  
Fog

**POPULATION**

**HABITAT**

**LANDSCAPE**

**ECOSYSTEM**

## Recovery Tools

Seed increase  
Seed banking  
Hand pollination  
Tissue culture

Invasive control  
Habitat restoration  
Population augmentation

New populations

Animal eradication

# Credits

Thanks to:

Dieter Wilken

Katie Chess

Pat Corry

Steve Junak

Lyndal Laughrin

Matthew Barmann

Clark Cowan

Karen Flagg

Sarah Chaney

Dirk Rodriguez

Julie Christian

Jonathan Levine

Stephanie Yelenik

Ken Niessen

Diane Thomson

Emily Schultz

Major Funding:

National Park Service

US Geological Survey

National Science Foundation



Aaron Schmidt photo

**Kathryn McEachern, Ph.D.**  
**Research Ecologist**

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**U.S. Geological Survey**  
**Western Ecological Research Center**  
**Channel Islands Field Station,**  
**Ventura, CA**

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