Matching restoration tools to rare plant recovery needs in invaded Channel Island landscapes

Kathryn McEachern
Research Ecologist
U.S. Geological Survey
The California Channel Islands
Santa Rosa Island 2014
Edward Demmond photo
Santa Cruz Island 2005

Dan Richards photo
Research Questions

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

Herbarium archives

Field surveys

Repeated counts

Demographic monitoring

Experiments
<table>
<thead>
<tr>
<th>15 Listed Taxa</th>
<th>Life History</th>
<th># Pops</th>
<th>Islands</th>
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<tbody>
<tr>
<td>Gilia tenuiflora ssp. hoffmannii</td>
<td>Annual</td>
<td>2</td>
<td>SRI</td>
</tr>
<tr>
<td>Malacothrix indecora</td>
<td>Annual</td>
<td>6</td>
<td>SCI SRI</td>
</tr>
<tr>
<td>Malacothrix squalida</td>
<td>Annual</td>
<td>1</td>
<td>SCI</td>
</tr>
<tr>
<td>Phacelia insularis var. insularis</td>
<td>Annual</td>
<td>3</td>
<td>SRI SMI</td>
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<tr>
<td>Sibara filifolia</td>
<td>Annual</td>
<td>2</td>
<td>SCT SCL (SCI)</td>
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<tr>
<td>Thysanocarpus conchuliferus</td>
<td>Annual</td>
<td>8</td>
<td>SCI</td>
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<tr>
<td>Boechera hoffmannii</td>
<td>Perennial</td>
<td>6</td>
<td>SCI SRI (AI)</td>
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<tr>
<td>Castilleja mollis</td>
<td>Perennial</td>
<td>2</td>
<td>SRI</td>
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<tr>
<td>Dudleya nesiotica</td>
<td>Perennial</td>
<td>1</td>
<td>SCI</td>
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<tr>
<td>Dudleya traskiae</td>
<td>Perennial</td>
<td>10</td>
<td>SBI</td>
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<td>Crocanthemum greenei</td>
<td>Perennial</td>
<td>36</td>
<td>SCI SRI SCT</td>
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<td>Galium buxifolium</td>
<td>Subshrub</td>
<td>26</td>
<td>SCI SMI (SRI)</td>
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<tr>
<td>Arctostaphylos confertiflora</td>
<td>Shrub</td>
<td>3</td>
<td>SRI</td>
</tr>
<tr>
<td>Berberis pinnata ssp. insularis</td>
<td>Shrub</td>
<td>5</td>
<td>SCI SRI (AI)</td>
</tr>
<tr>
<td>Malacothamnus fasciculatus var. nesioticus</td>
<td>Shrub</td>
<td>6</td>
<td>SCI</td>
</tr>
</tbody>
</table>

AI = Anacapa Island, SCI = Santa Cruz, SRI = Santa Rosa, SMI = San Miguel, SBI = Santa Barbara, SCT = Santa Catalina, S CL=San Clemente; ( ) presumed extirpated.
Current Condition

Few
Small
Isolated
Declining

Desired Future

Many
Large
Connected
Growing

Constraints
**Constraints**

- Few plants
- Poor seed production
- Low seed viability
- Low recruitment
- Invasive competition
- Altered canopy
- No seed bed
- Isolation
- Habitat fragmentation
- Habitat loss
- Pollinator limitation
- Herbivory & trampling
- Erosion
- Changed climate

**Recovery tools**

- Seed increase
- Seed banking
- Hand pollination
- Tissue culture
- Augmentation
- Invasive control
- Habitat management
- New populations
- Animal eradication
- Monitoring
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Santa Rosa and Santa Cruz Island recovery scenarios
Scenario 1 – Passive Recovery
Population expansion

Torrey pine
*Pinus torreyana* var. *insularis*

**Constraints**
- Herbivory & trampling

**Recovery tools**
- ECOSYSTEM
- Animal eradication
Moving out of refugia

Jolla Vieja Canyon endemics, Santa Rosa Island

**Constraints**

- Herbivory & trampling

ECOSYSTEM

**Recovery tools**

- Animal eradication
270% Average percent change in abundance
Scenario 2 – Benefitting from openness without herbivores
Doesn’t like pigs or leaf litter

Island jepsonia
*Jepsonia malvifolia*

**Constraints**
- Herbivory & trampling

**ECOSYSTEM**

**Recovery tools**
- Animal eradication
New Constraint – increased litter?

**Constraints**
- Altered canopy

**Recovery tools**
- Habitat management
Scenario 3 – Changed ecosystem processes
Island oak
*Quercus tomentella*

**Lost water cycle**

**Constraints**
- Altered canopy
- Erosion
- No seed bed
- Few isolated populations
- Herbivory and trampling
- No fog drip

**Recovery tools**
- Habitat management
- New populations
- Animal eradication
- Habitat management

**HABITAT**

**LANDSCAPE**

**ECOSYSTEM**
Santa Rosa Island
Soledad Ridge
Cloud forest restoration
Capture fog, slow erosion, rebuild seedbed, plant
Lost pollinators and fire

Island bush mallow
*Malacothamnus fasciculatus* var. *nesioticus*

### Constraints
- Few plants
- Poor seed production
- Low seed viability
- Few isolated populations
- Pollinator loss
- Changed fire regime

### Recovery tools
- Augmentation
- Hand pollination
- New populations
- Animal eradication
- Fire management
Out-plant Experiment
Island bush-mallow planting survival

December 2004 - April 2008

- European field
- Portezuela
- Alberts
- Valley Anchorage
Plant new populations

January 2010

July 2011

Karen Flag photos
Status Jan 2016
6 natural populations
14 new sites
350 new plants
Santa Cruz Island bush mallow
Malacothamnus fasciculatus var. nesioticus

Santa Cruz Island

Site status

- Native
- Planted 2004-2015
Good vegetative recruitment
Poor recruitment from seed
Island Phacelia
*Phacelia insularis*

**Changed climate, Competition**

**Constraints**
- Invasive competition
- Changed climate

**Recovery tools**
- Habitat management
- Seed banking

Edie Raburn photo
Looking for island Phacelia 2003
Competition and climate change
Bromus clearing and Phacelia growth

From Levine McEachern and Cowan 2010
Habitat restoration
Reduce grass and thatch, restore lupine scrub

October 2015
Current Condition  Desired Future

Few
Small
Isolated
Declining

Constraints

Many
Large
Connected
Growing
Constraints - Population

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- Low recruitment
Constraints - **Habitat**

- Few plants
- Poor seed production
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- Altered canopy
- No seed bed
Constraints - Landscape

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Tissue culture
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New populations
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### Collaborators

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<table>
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<tbody>
<tr>
<td>Dieter Wilken</td>
<td>Julie Christian</td>
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<tr>
<td>Andrew Wyatt</td>
<td>Jonathan Levine</td>
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<tr>
<td>Connie Rutherford</td>
<td>Stephanie Yelenik</td>
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<td>Tim Thomas</td>
<td>Nancy Vivrette</td>
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<td>Katie Chess</td>
<td>Ken Niessen</td>
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<td>Pat Corry</td>
<td>Diane Thomson</td>
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<td>Steve Junak</td>
<td>Emily Schultz</td>
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<td>Lyndal Laughrin</td>
<td>Ken Owen</td>
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<td>Matthew Barmann</td>
<td>Kevin Thompson</td>
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<tr>
<td>Clark Cowan</td>
<td>Denise Knapp</td>
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<tr>
<td>Karen Flagg</td>
<td>John Knapp</td>
</tr>
<tr>
<td>Don Hartley</td>
<td>Numerous students</td>
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<tr>
<td>Sarah Chaney</td>
<td>Many many volunteers</td>
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<td>Dirk Rodriguez</td>
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- U.S. Geological Survey
- National Science Foundation

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Thanks!
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