Invasive Plant Management on the Farallon Islands National Wildlife Refuge

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Assistant Manager
Farallon Islands NWR - Orientation

- 30 miles from the Golden Gate Bridge, San Francisco, California
- Managed by the U.S. Fish and Wildlife Service
- Administered by the San Francisco Bay National Wildlife Refuge Complex in Fremont, CA
Farallon Islands NWR - Land Area

- Total Refuge area is: **211 acres**
- Invasive plants only on the South Farallon Islands: **120 acres**
- Primary management occurs on Southeast Farallon which is largest island at: **70 acres**
- Closed to public access
South Farallon Islands
(aerial infrared ortho-photo)

Aulon Islets
(Wilderness Area)

Maintop Island
(Wilderness Area)

Southeast Farallon Island
Human History

- Russian fur sealers 1812 to 1842
- Common murre egging 1848 to 1881 (Introduction of mice and rabbits)
Human History

➢ U.S. Army Corps of Engineers, Weather Bureau, U.S. Navy, Lighthouse Service and U.S. Coast Guard
1858-1972
Point Blue Conservation Science (founded as Point Reyes Bird Observatory or PRBO)

- Point Blue Biologists have staffed the biological field station since 1968.
- In 1971, Point Blue and USFWS began joint protection, monitoring, research, and management of the Refuge through a cooperative agreement.
Natural Resources
300,000 Breeding Seabirds
12 Species

Brandt’s Cormorant
Ashy Storm-Petrel
Western Gull
Tufted Puffin

Common Murre
Pigeon Guillemot
Rhinoceros Auklet
Cassin’s Auklet
Natural Resources

Five Species of Pinnipeds

~3,000 - 6,000 Animals

California Sea Lion

Northern Elephant Seal

Harbor Seal

Steller Sea Lion

Northern Fur Seal
Native Plant Community

- Lasthenia maratima (Maritime goldfields)
- Spergularia macrotheca (Sticky sandspurry)
Native Plant Community

➢ Most natives are annuals
## Farallon Islands NWR - Invasive Plants

### Focal species

<table>
<thead>
<tr>
<th>Scientific Name ITIS</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chenopodium murale</td>
<td>nettle-leaf goosefoot, nettleleaf goosefoot</td>
</tr>
<tr>
<td>Coprosma repens</td>
<td>creeping mirrorplant</td>
</tr>
<tr>
<td>Ehrharta erecta</td>
<td>panic veldt grass, panic veldtgrass, erect veldtgrass</td>
</tr>
<tr>
<td>Malva arborea</td>
<td>tree mallow</td>
</tr>
<tr>
<td>Oxalis pes-caprae</td>
<td>African woodsorrel, Bermuda buttercup, buttercup oxalis</td>
</tr>
<tr>
<td>Plantago coronopus</td>
<td>Plantain</td>
</tr>
<tr>
<td>Rubus bifrons</td>
<td>Himalayan berry, Himalaya blackberry</td>
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<tr>
<td>Senecio vulgaris</td>
<td>old-man-in-the-spring, common groundsel</td>
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<tr>
<td>Sisymbrium orientale</td>
<td>Indian hedge-mustard</td>
</tr>
<tr>
<td>Tetragonia tetragoniioides</td>
<td>New Zealand-spinach, New Zealand spinach</td>
</tr>
</tbody>
</table>

Holzman et al. 2016
### SPECIES GROUPS

<table>
<thead>
<tr>
<th>SPECIES GROUPS</th>
<th>Common name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Grasses</strong></td>
<td></td>
</tr>
<tr>
<td><em>Avena fatua</em></td>
<td>wild oat, wild oats, flaxgrass, oatgrass, wheat oats</td>
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<tr>
<td><em>Avena barbata</em></td>
<td>slender oat, slender oats, slender wild oat</td>
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<tr>
<td><em>Bromus diandrus</em></td>
<td>ripgut brome</td>
</tr>
<tr>
<td><em>Hordeum murinum</em></td>
<td>mouse barley, bulbous barley</td>
</tr>
<tr>
<td><em>Vulpia bromoides</em></td>
<td>brome fescue</td>
</tr>
<tr>
<td><strong>Rumex Species</strong></td>
<td></td>
</tr>
<tr>
<td><em>Rumex acetosella</em></td>
<td>sheep sorrel, field sorrel, red sorrel, common sheep sorrel</td>
</tr>
<tr>
<td><em>Rumex crispus</em></td>
<td>curly dock, narrowleaf dock, sour dock, yellow dock</td>
</tr>
<tr>
<td><strong>Sonchus Species</strong></td>
<td></td>
</tr>
<tr>
<td><em>Sonchus asper</em></td>
<td>spiny sowthistle, prickly sow thistle, prickly sowthistle, perennial sowthistle</td>
</tr>
<tr>
<td><em>Sonchus oleraceus</em></td>
<td>common sowthistle, sow-thistle, common sowthistle, annual sowthistle, pualele, sow thistle</td>
</tr>
<tr>
<td><strong>Malva Species</strong></td>
<td></td>
</tr>
<tr>
<td><em>Malva neglecta</em></td>
<td>buttonweed, cheeseplant, cheeseweed, common mallow, dwarf mallow, roundleaf mallow</td>
</tr>
<tr>
<td><em>Malva parviflora</em></td>
<td>small-whorl mallow, cheeseweed, cheeseweed mallow, little mallow</td>
</tr>
</tbody>
</table>

Focal species groups: Holzman et al. 2016
Invasive Plants

*Tetragonia tetragoniioides* (New Zealand spinach)

➢ Potential impacts to seabird crevice nesting habitat
New Zealand spinach

➢ Competes with natives
➢ Behaves perennially
New Zealand spinach

➢ Abundant seed bank
Malva species

➢ *M. neglecta* and *M. parviflora*
Plantago coronopus

- Competes with natives
**Plantago coronopus**

➢ Potential impacts to seabird burrow nesting habitat
**Ehrharta erecta**

- Recent invasion
- Potential to spread

**Description:** Stems: culms erect or ascending from a base along the ground, branching, 12-24 in (30-60 cm) tall. Leaves are flat blades 2-5 in (5-12 cm) long, 0.2-0.4 in (4-9 mm) wide. Inflorescence (grass flower): 2-6 in (6-15 cm) long, contracted to open panicle. Laterally compressed attached directed to flower stem or with small stalk, 0.1 in (3-3.5 mm), falling as one unit. Glumes 0.06-0.1 in (1.5-3 mm), about equal, longer than sterile florets. Three florets per spikelet, lower two sterile and without palea; upper floret fertile with palea. Sterile lemmas awnless, glabrous (Hickman 1993).

Ehrharta (Ehrharta erecta) is a perennial grass, with a crabgrass-like habit with decumbent as well as ascending jointed stems. The sterile lemmas of E. erecta are without awns. Ehrharta grass is a **very invasive** plant on SEFI. If you see it take care to remove it along with its roots.

**Last seen:** on South slope on trail to lighthouse. If you see this species please remove it and please report it to Refuge Manager.

Holzma et al. 2016
Annual grasses

➢ Concern over impacts but no resources to address at this time
Research and Monitoring


- 2012, Barbara A. Holzman and Point Blue established vegetation monitoring plots to develop baseline data prior to a proposed mouse eradication.

- 2015, Jamie Hawk, San Francisco State University thesis showed high proportion of non-native (80%) and Cal-IPC ranked (25%) invasive plant species.

- 2016, Richard Chasey, (SFSU) Seed Bank Characterization showed native seeds in >92% of samples.

- 2016, Barbara A. Holzman and Quentin Clark (SFSU), Invasive Plant Inventory report and Clark et al. thesis 2017 (Modeling the Spatial Distribution of Invasive Plant Species).

- 2018 - Planning for the development of a protocol to detect changes in invasive and native plant composition and distribution over time, with Barbara A. Holzman, Santa Barbara Botanic Garden.
Research and Monitoring

- 2012-2014 Control plots
Research and Monitoring Products

- Reports, theses, and maps
- Hawk 2015
Research and Monitoring Products

- Reports, theses, and maps
- Hawk 2015

Total vegetative cover*

Native - Exotic

- Lasthenia maritima type
- Spergularia macrotheca type
- Tetragonia tetragonioides type
- Plantago coronopus type
- Mixed vegetation type, annual grassland
- Mixed vegetation type, herbaceous
- Anthropogenic feature

*Excludes substrate
Research and Monitoring Products

- Holzman and Clark 2016

Southeast Farallon Island Non-Native Plant Inventory
Tetragonia tetragonioides
Southeast Farallon Island Non-Native Plant Inventory
Ehrhartia erecta

Feature Type
- Patch Feature
- Linear Feature
- Polygon Feature

Canopy Cover
- 1: <1%
- 2: 1-10%
- 3: 10-25%
- 4: 25-60%
- 5: >60%

Patch Radius
- 15 Meters
- 7.5 Meters
- 1 Meter

Trails
Contours at 10 Meter Intervals

Research and Monitoring Products
- Holzman and Clark 2016
Invasive Plant Management
Herbicide Application

➢ Treat the entire island in ~8 days (weather and staffing permitted)

➢ Labor is mostly volunteers (~800 hours per year)

➢ 2-3 treatments per year

➢ Primary herbicide is glyphosate (RoundUp Custom)
Invasive Plant Management
Herbicide Application

➢ Steep terrain
Invasive Plant Management
Herbicide Application

➢ Extension wands for inaccessible plants
Invasive Plant Management

➢ Challenging logistics (supplies for the week)
Invasive Plant Management

➢ Preventing spread, boot brushes around island
Biosecurity and Prevention Plan

- 2013 Draft Biosecurity plan in Revised Draft Environmental Impact Statement for the South Farallon Islands Invasive House Mouse Eradication Project.

- Plan to incorporate plants and complete final version in 2018

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**BIOSECURITY MEASURES**

<table>
<thead>
<tr>
<th>PATHWAY</th>
<th>BIOSECURITY MEASURE</th>
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<tbody>
<tr>
<td>CARGO TRANSPORTED ON VESSELS OR HELICOPTERS (PRBO Farallon Patrol and charters; FWS charters and contractors; NOAA and NOAA charters; Special Use Permit or cooperator charters; fishing and sightseeing charters; U.S. Coast Guard or other military; Other not listed)</td>
<td>PRE-DEPARTURE QUARANTINE:</td>
</tr>
<tr>
<td></td>
<td>a) Requirement for everyone coming ashore to reduce off-the-shelf packaging and re-pack in thoroughly cleaned rodent-proof containers.</td>
</tr>
<tr>
<td></td>
<td>• All cargo must be in sealed duffel bags, suitcases or other sealed containers.</td>
</tr>
<tr>
<td></td>
<td>• Bulky items that cannot be packed in containers, such as pipes or other items with hollow portions will need to be assessed, and if possible sealed to prevent rodent entry.</td>
</tr>
<tr>
<td></td>
<td>b) Visually assess all cargo for signs of rodents or potential rodent entry points, especially containers of foodstuffs and large equipment before loading onto to long-haul vessel or aircraft.</td>
</tr>
<tr>
<td></td>
<td>• Recommend that all items loaded onto vessels or aircraft be self-inspected for holes, cracks or other signs of potential rodent entryways.</td>
</tr>
<tr>
<td></td>
<td>• If any deficiency is found, cargo must be re-packed prior to arrival or it will not be permitted on the island.</td>
</tr>
</tbody>
</table>

| | POST-ARRIVAL QUARANTINE: |
| | a) Visually assess all cargo as it is being loaded on to landing vessel or unloaded off of aircraft. |
| | • Island staff supervisor and/or assistant will visually assess all cargo to ascertain if it is packaged in required manner. |
Challenges

➢ Annual grasses

➢ Developing and implementing new techniques (technical climbing and herbicide ballistic technology)

➢ Facilities management

➢ Logistics on accessing an off-shore island

➢ Safety of personnel

➢ Invasive house mouse (proposed eradication project is controversial)

➢ Property transfer from U.S. Coast Guard (contaminants issues)
Acknowledgements and References

➢ Barbara A. Holzman, PhD

➢ San Francisco State University, Department of Geography & Environment

➢ Giselle Block, U.S. Fish and Wildlife Service, Inventory and Monitoring


➢ Too many volunteers to name!
THANK YOU!!! Questions?

Farallon Islands
National Wildlife Refuge

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