**Limonium ramosissimum** distribution models and effective treatment types in the Upper Newport Bay Ecological Reserve of Orange County, California

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Outline

• Theoretical Framework and Background
• Current Removal Effort/Treatment Results
• Habitable Range of Invasive *Limonium* (current and future trends)
• Impacts of invasive *Limonium* on rare plants like Salt marsh bird’s beak
Theoretical Framework

- With limited resources and time, Geographic Information Systems (GIS) can help:
  - monitor ecosystems
  - manage invasive plant species
  - restore native plants more efficiently and effectively

- GIS works with large datasets to predict where (and when) resources should be allocated to effectively manage conserved lands.

Example overlay of soil type and elevation to obtain the ideal niche for a rare plant:

More complicated analyses can include any range and number of factors to determine ideal habitable ranges.
Background: *Limonium ramosissimum* (Algerian Sea Lavender) in UNBER

- Upper Newport Bay Ecological Reserve (UNBER) 752-acre area owned by the CA Dept of Fish and Wildlife (CDFW) consisting predominantly of marine, mudflat and salt marsh habitats


- Outcompetes native vegetation, including endangered *Chloropyron maritimum maritimum* (Salt marsh bird’s beak)

- Provides unsuitable nesting and foraging habitat for multiple endangered birds
Our study goals:

1. Determine how effective have past treatments been on reducing invasive Limonium populations in UNBER.
2. Consider how Newport Bay Conservancy and CDFW can maximize removal efforts for invasive Limonium with limited resources and person-power.
3. Produce an optimal habitat distribution model for invasive Limonium, and assess how this potential range compares to endangered plant species.
4. Evaluate the impacts of invasive Limonium on an endangered plant, Salt marsh bird’s beak, in UNBER now and with future sea level rise.
Current Management of invasive *Limonium* in UNBER

- In 2019, UNBER was surveyed for invasive *Limonium*
- 6.1 acres of invasive *Limonium* were discovered and mapped
- Treatments between 09/2019-03/2020:
  - Hand-pulling (3.6 acres): removed whole plant and taproot
  - Solarization (0.1 acres): applied where % cover greater than 40%. Plastic tarps left in place for 4-5 months.
- Data obtained 7 days and 6 months post-treatment, effectiveness of treatment types assessed
**Treatment Results**

**Solarization**

Solarization may be more effective than hand pulling where invasive Limonium densities are greater than 40%.

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**Species Richness Post-Solarization, February-September 2020**

- **7 days Post-Treatment**:
  - Native: 2 species
  - Invasive: 1 species

- **6 months Post-Treatment**:
  - Native: 5 species
  - Invasive: 2 species

**Percent Cover Post-Solarization, February-September 2020**

- **7 days Post-Treatment**:
  - Native: 10%
  - Invasive: 2%

- **6 months Post-Treatment**:
  - Native: 50%
  - Invasive: 20%

N=21, error bars show SD
What are the optimal growing conditions for invasive Limonium and where should efforts be prioritized?

- Used GIS models with vegetation alliance and elevation ranges (LiDAR data) to determine the optimal growing conditions for invasive Limonium in UNBER
- Obtained a habitat distribution model for L. ramosissimum (i.e. optimal potential range)
Invasive *Limonium*: Preferred Vegetation Alliance

<table>
<thead>
<tr>
<th>NVCS ALLIANCE TYPE</th>
<th>COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>North American Pacific Coastal Salt Marsh</td>
<td>64</td>
</tr>
<tr>
<td>California Coastal Scrub</td>
<td>10</td>
</tr>
<tr>
<td>Barren</td>
<td>8</td>
</tr>
<tr>
<td>Western North American Freshwater Marsh</td>
<td>5</td>
</tr>
<tr>
<td>Coastal Annual and Perennial Grassland</td>
<td>5</td>
</tr>
<tr>
<td>Southwestern North American Riparian, Flooded and Swamp Forest/Scrubland</td>
<td>4</td>
</tr>
<tr>
<td>Urban</td>
<td>3</td>
</tr>
<tr>
<td>Estuarine, Lacustrine, Riverine</td>
<td>2</td>
</tr>
</tbody>
</table>

Vegetation Alliance Current Area Cover (acres)
Invasive *Limonium*: Preferred Vegetation Alliance

When normalized to area, there is no true alliance preference for *Limonium* in UNBER.
Invasive *Limonium*: Preferred elevation range

- Minimum: 0.36m (1.18 ft)
- Maximum: 2.05m (6.72 ft)
- Mean: 0.72m (2.35 ft)
- Median: 0.6m (2.05 ft)
Results: Current *Limonium* Distribution Model

- Invasive *Limonium* has potential to establish in a wide range of habitats throughout UNBER
  - Makes it difficult to use distribution models alone to predict its spread

- Prioritize regions at the mean/median elevation for *Limonium* distribution in UNBER (less than 1m)
  - Where the highest densities are observed

- Can further identify areas that are most likely to harbor other high priority native species, like Salt marsh bird’s beak
How does the potential range of invasive *Limonium* impact the distribution of Salt marsh bird’s beak?

- Used occurrence data for Salt marsh bird’s beak (*Chloropyron maritimum maritimum*; SMBB)
- SMBB is classified as endangered (federal and state)
- Located only in southern and central CA and Baja
- Completed the same analyses (vegetation alliance and elevation overlays)
Current Salt marsh bird’s beak Species Distribution Model

- Nearly 100% of occurrences in North American Pacific Salt Marsh vegetation alliance
- Elevation range of 0.35-0.69m (1.16-2.25 ft) above sea level
- SMBB has a much narrower niche than invasive *Limonium*
  - Some of the highest densities of invasive *Limonium* are found where SMBB populations exist
  - Habitable area approximately 0.57mi² (vs. *Limonium* range of 1.24mi²)
Sea level rise (SLR) is expected to dramatically increase within the next 100 years.

<table>
<thead>
<tr>
<th>Sea Level Rise Scenario</th>
<th>2050</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate Low</td>
<td>0.75</td>
<td>1.57</td>
</tr>
<tr>
<td>Intermediate</td>
<td>1.18</td>
<td>3.44</td>
</tr>
<tr>
<td>Intermediate High</td>
<td>1.71</td>
<td>5.71</td>
</tr>
<tr>
<td>High</td>
<td>2.3</td>
<td>8.17</td>
</tr>
<tr>
<td>Extreme</td>
<td>2.72</td>
<td>10.14</td>
</tr>
</tbody>
</table>
How might SMBB distributions change with sea level rise?

• With rising sea levels, potential habitat for SMBB is slowly pushed outward toward the margins of UNBER boundary

• Acreage of potential suitable habitat is greatly reduced with SLR by 2100
How might invasive *Limonium* distributions impact SMBB with SLR?

- By 2100 under Extreme SLR, invasive Limonium has ~400% larger range than SMBB.
- ~99% of SMBB habitable range is shared with potential range of invasive *Limonium*.
- Invasive *Limonium* can exist in a wider array of habitat types while SMBB is more restricted to salt marsh.
Conclusions

• Treatments
  • Solarization is effective and should be considered strategically with hand pulling and herbicide
  • But more trials necessary to maximize use of the various treatment types depending on high priority areas or native species present
Conclusions

• Potential habitat for SMBB will likely be greatly reduced with sea level rise

• Invasive *Limonium* has much broader potential range than SMBB
  • Greater competitive edge currently and with future sea level rise projections

• Prioritizing treatments of sites where SMBB populations exist now and in future may be important for persistence of the species in the future
Thank You!