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

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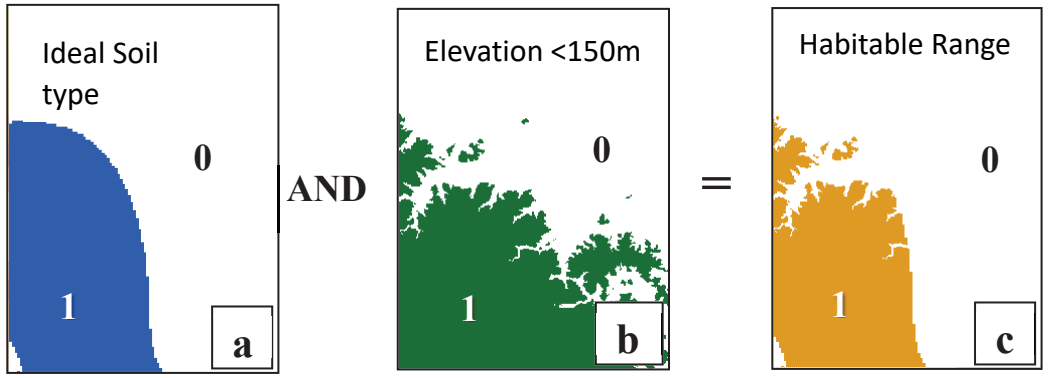
Theoretical Framework

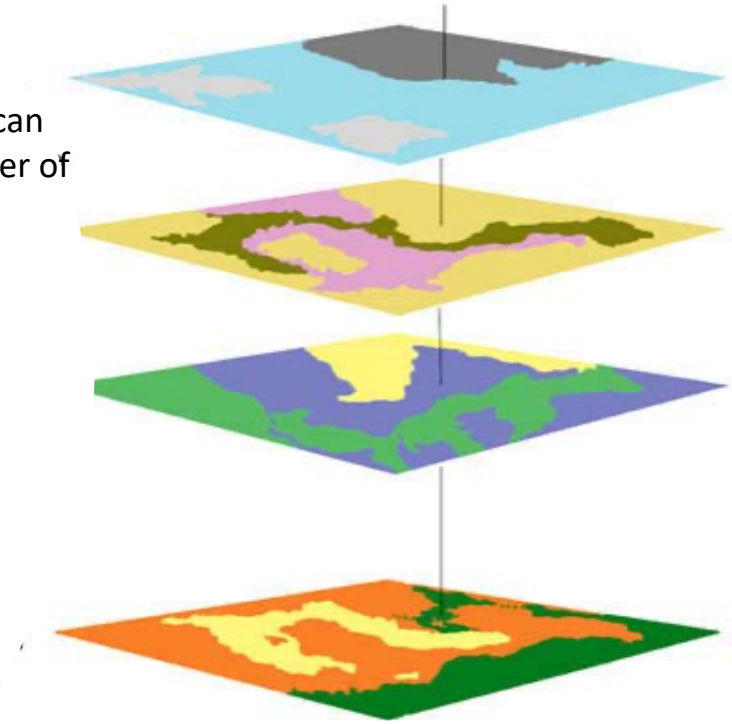
- With limited resources and time, Geographic Information Systems (GIS) can help:
  - monitor ecosystems
  - manage invasive plant species
  - restore native plants more efficiently and effectively

- 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
- *Limonium ramosissimum* (Algerian Sea Lavender; invasive *Limonium*) first identified in Upper Newport Bay Ecological Reserve (UNBER) in 2002.
- 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

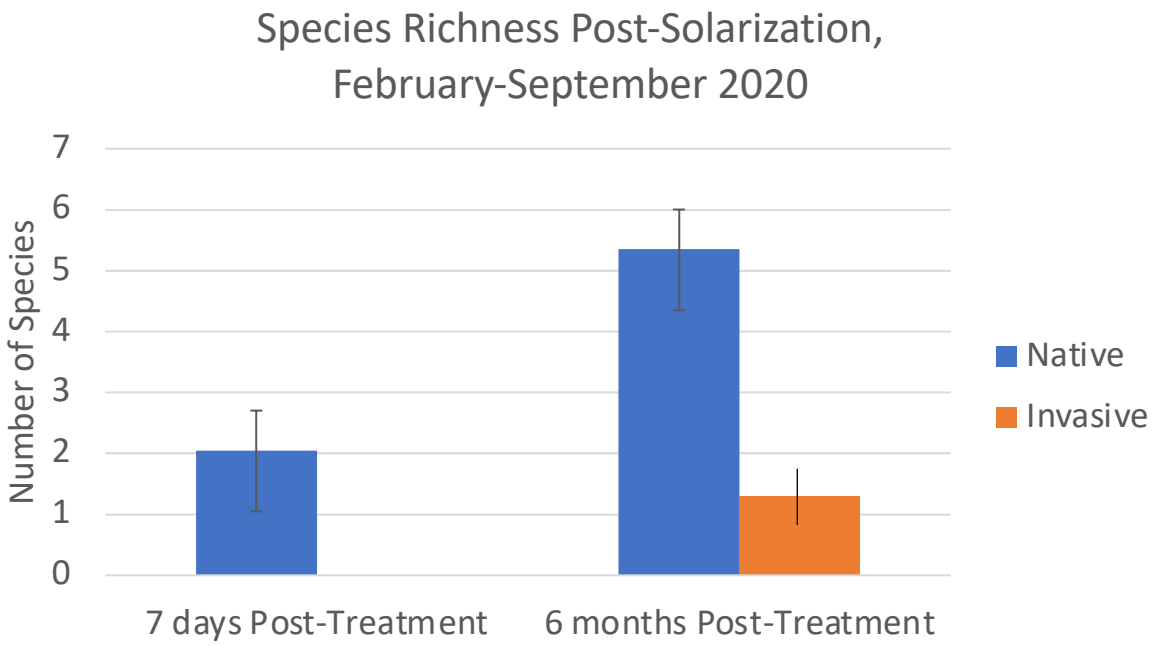
- In 2019, UNBER was surveyed for invasive *Limonium*
- 6.1 acres of invasive *Limonium* were discovered and mapped
- Treatments between 09/2019-03/2020:
  - Hand-pulling (3.6 acres): removed whole plant and taproot
  - Solarization (0.1 acres): applied where % cover greater than 40%. Plastic tarps left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

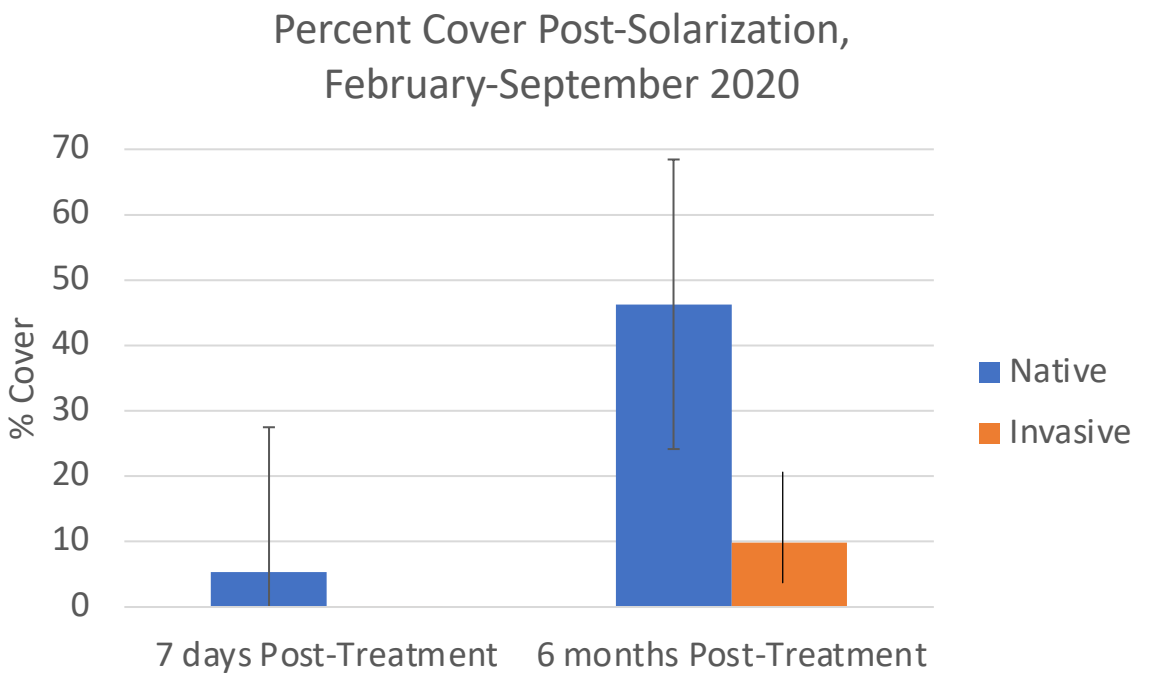
Treatment Results

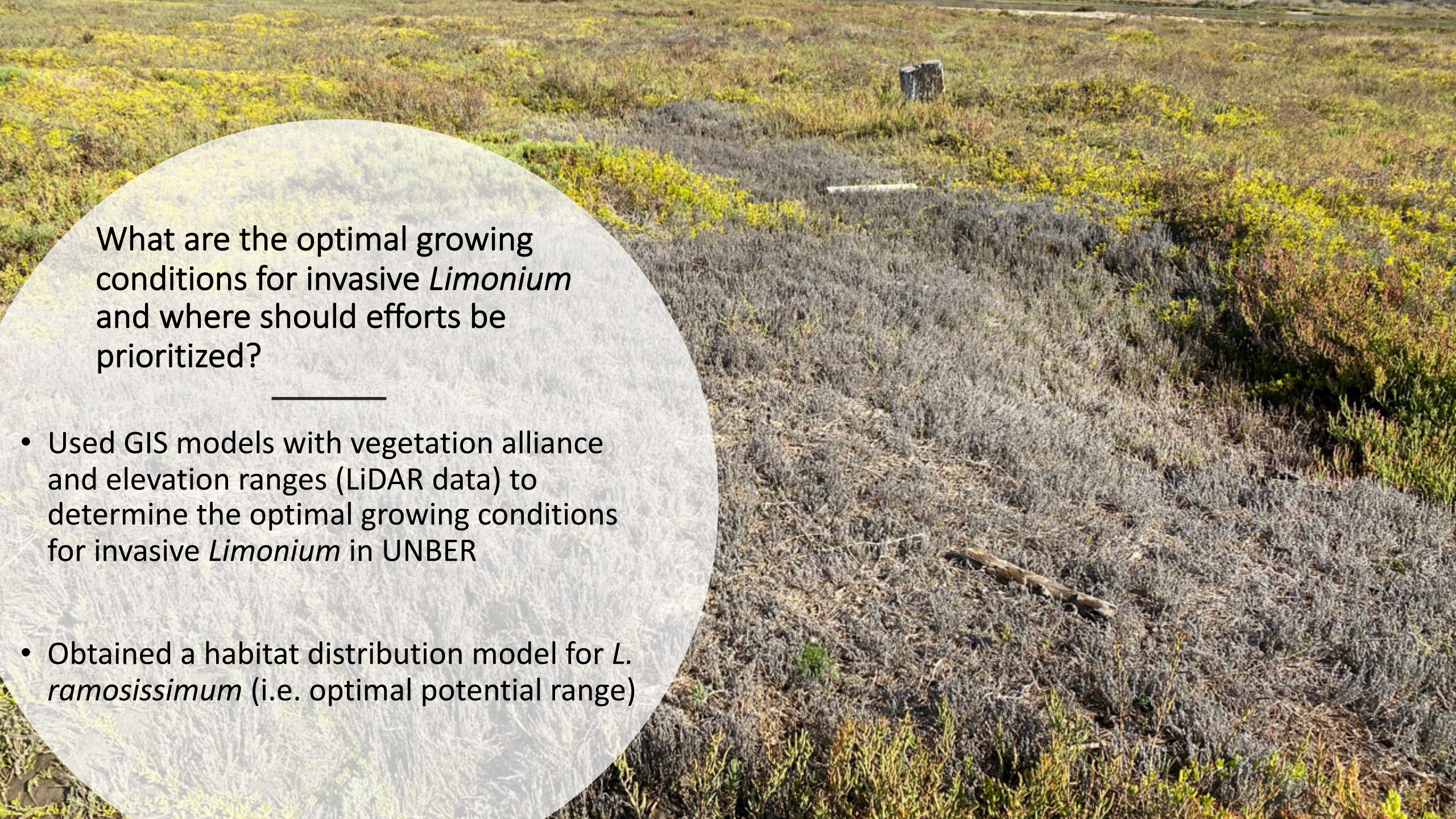
Solarization

N=21, error bars show SD

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





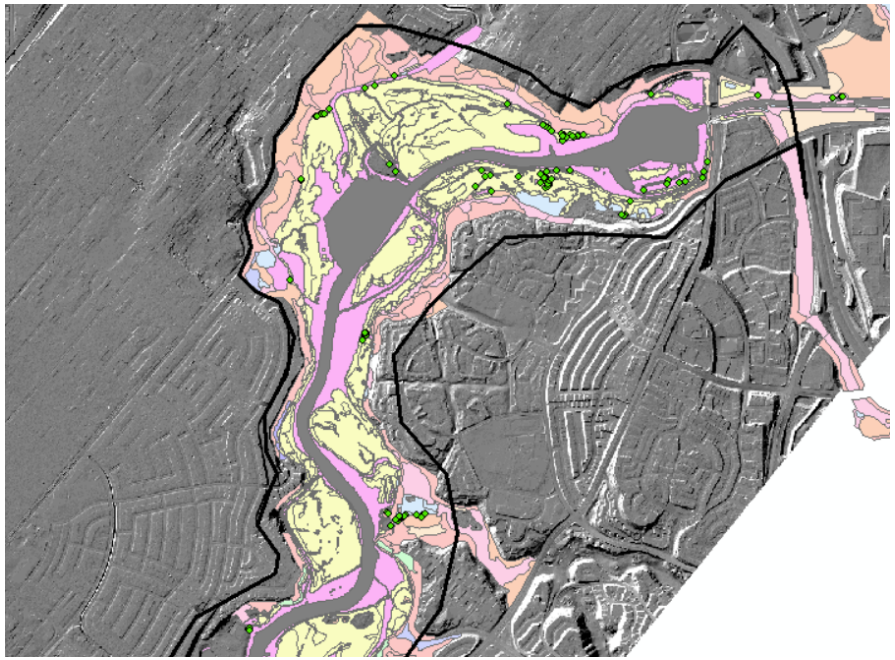


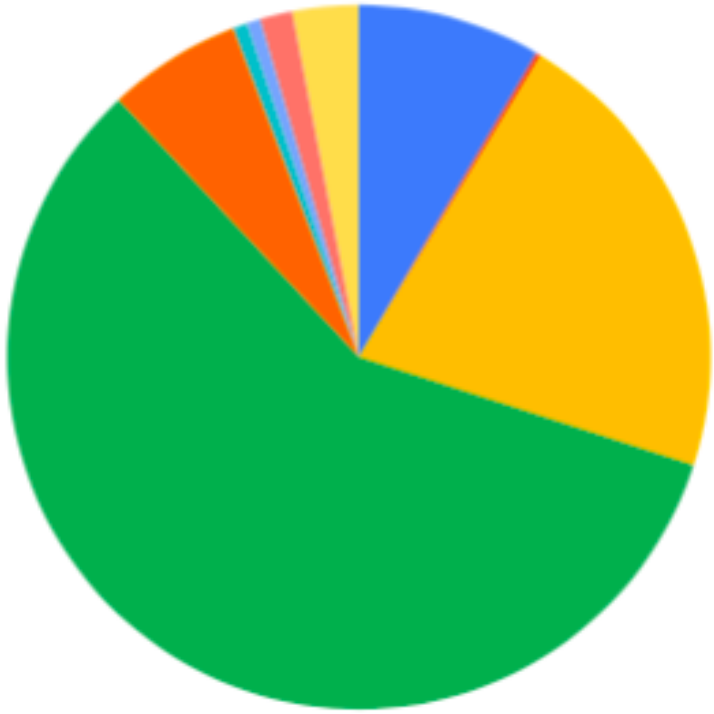
What are the optimal growing conditions for invasive *Limonium* and where should efforts be prioritized?

- 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)

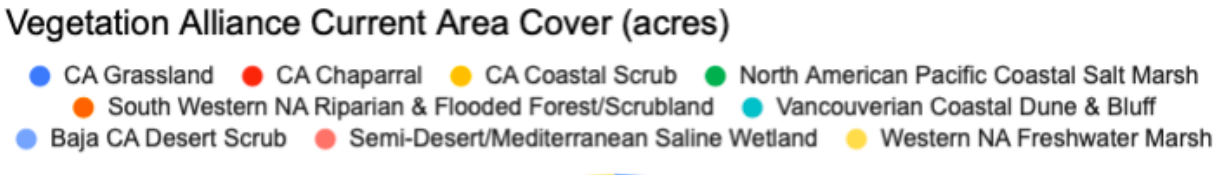
Invasive *Limonium*: Preferred Vegetation Alliance





Algerian Sea Lavender in Each Alliance Type

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



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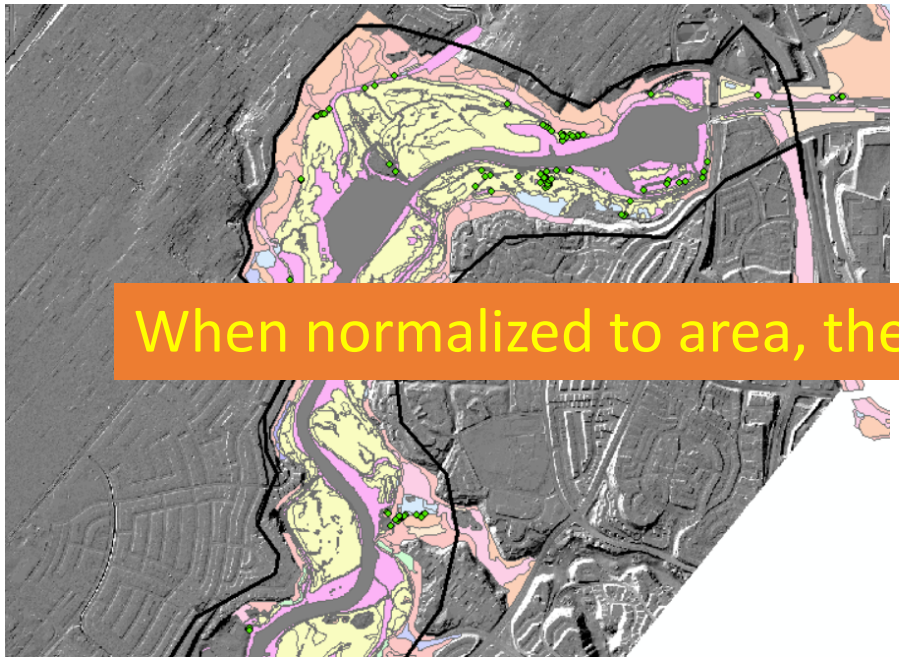
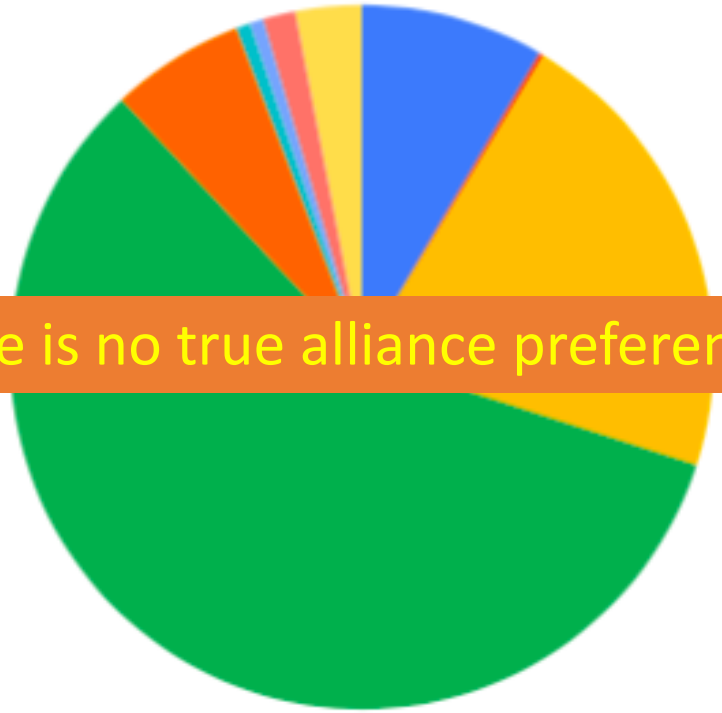


When normalized to area, there is no true alliance preference for *Limonium* in UNBER



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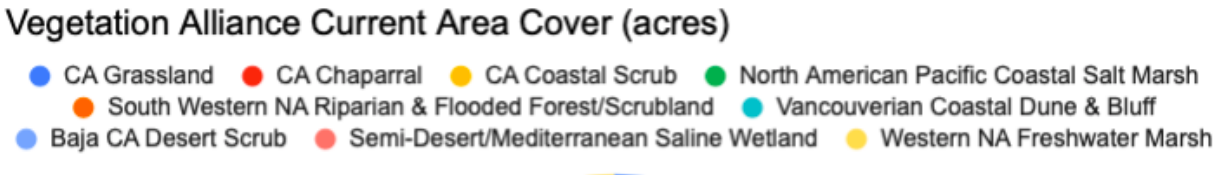
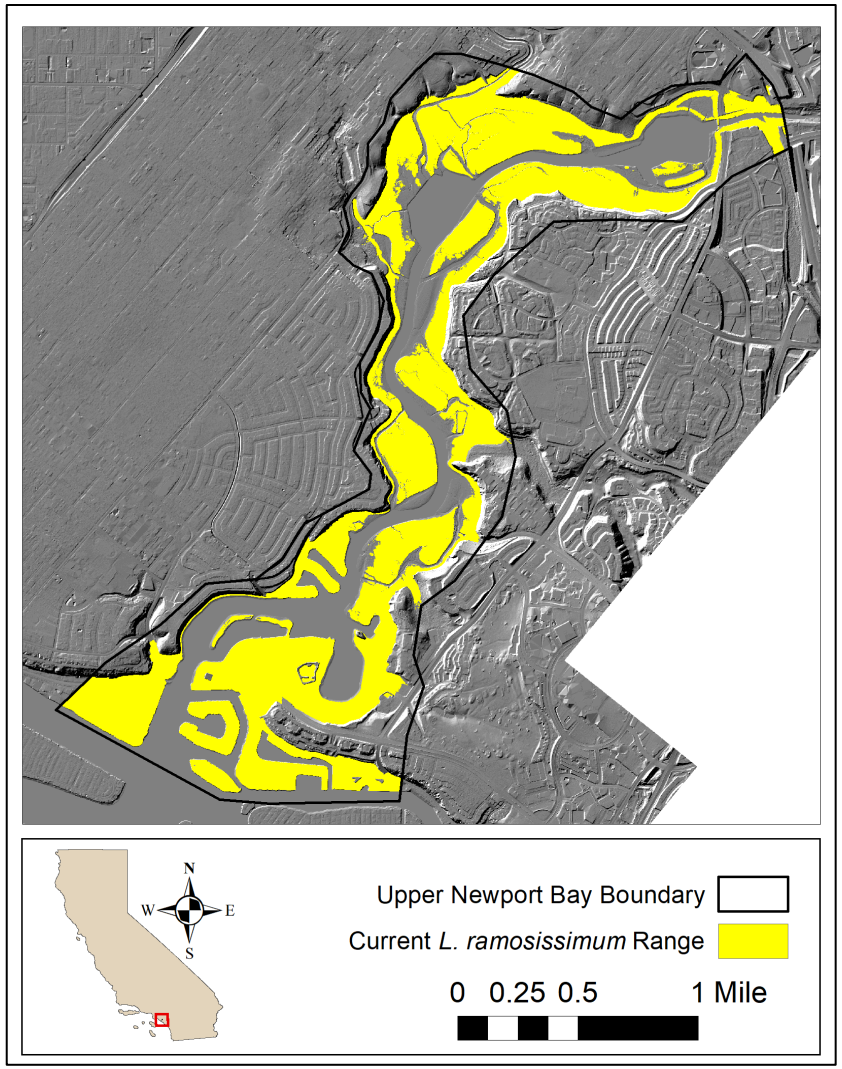
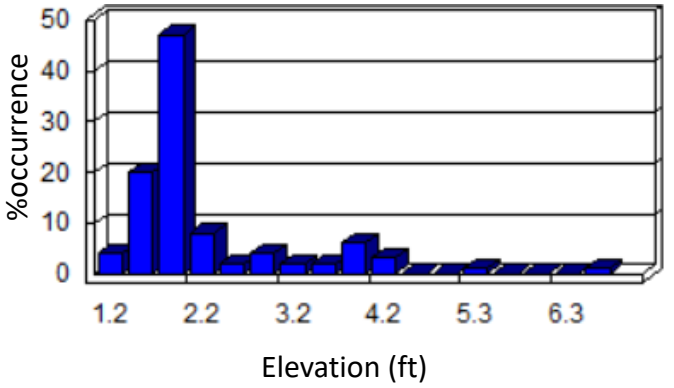
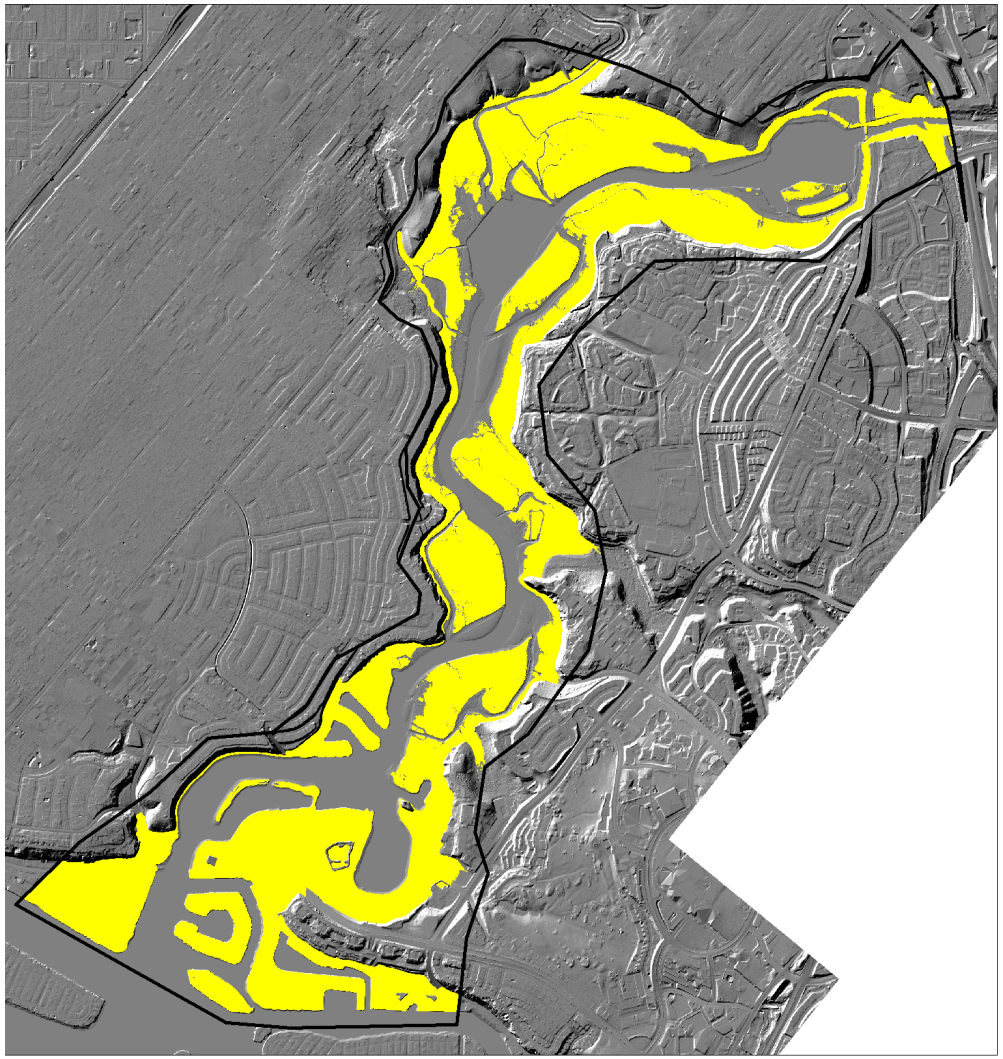


Invasive *Limonium*: Preferred elevation range





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

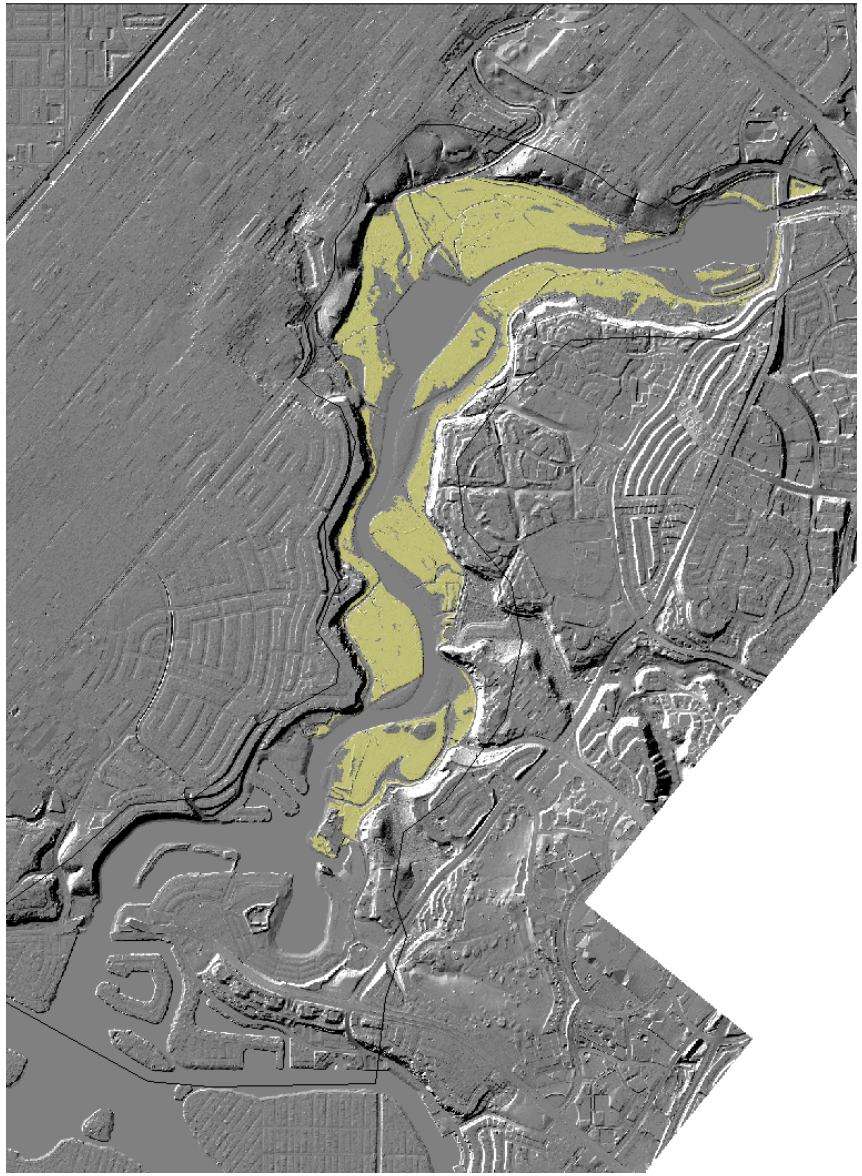
- Invasive *Limonium* has potential to establish in a wide range of habitats throughout UNBER
  - Makes it difficult to use distribution models alone to predict its spread
- Prioritize regions at the mean/median elevation for *Limonium* distribution in UNBER (less than 1m)
  - Where the highest densities 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 0.57mi^2 (vs. *Limonium* range of 1.24mi^2)



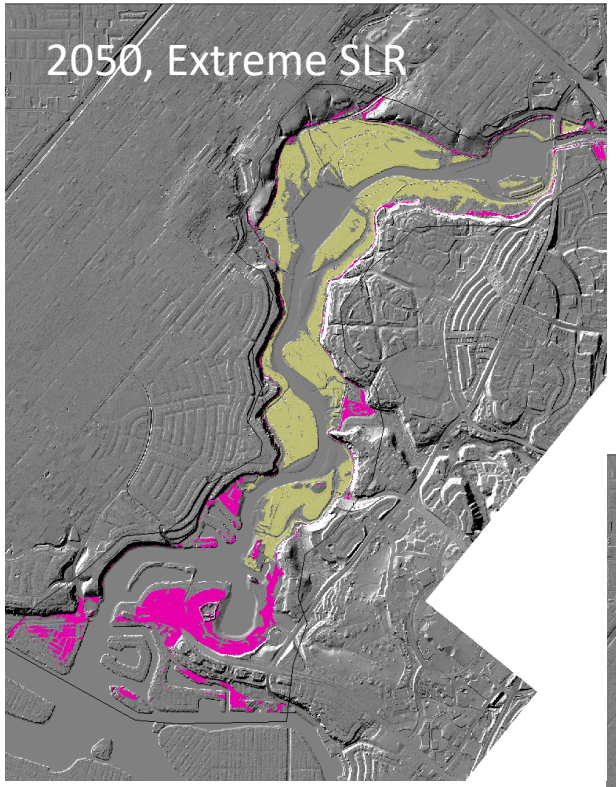
Salt marsh bird's beak current potential habitable range

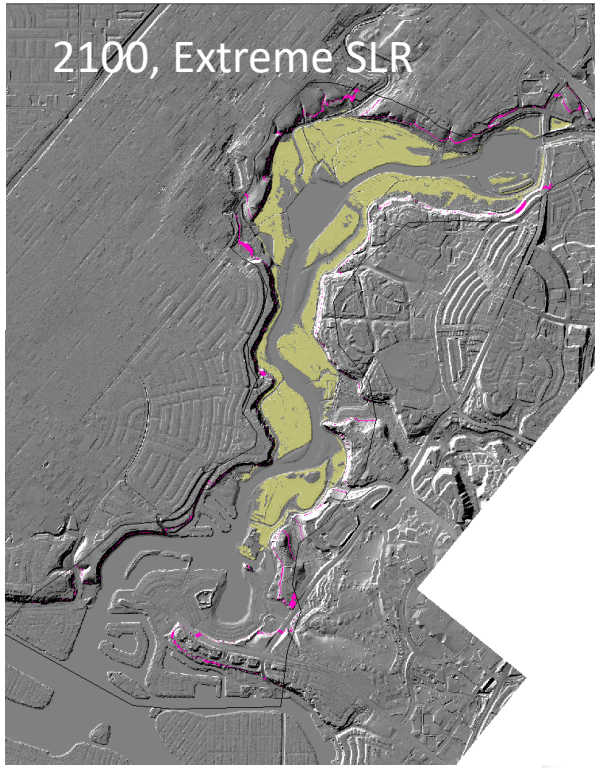
Sea level rise (SLR) is expected to dramatically increase within the next 100 years

SEA LEVEL RISE PROJECTIONS FOR UPPER NEWPORT BAY (FEET)		
Sea Level Rise Scenario	**2050**	**2100**
Intermediate Low	0.75	1.57
Intermediate	1.18	3.44
Intermediate High	1.71	5.71
High	2.3	8.17
Extreme	2.72	10.14

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

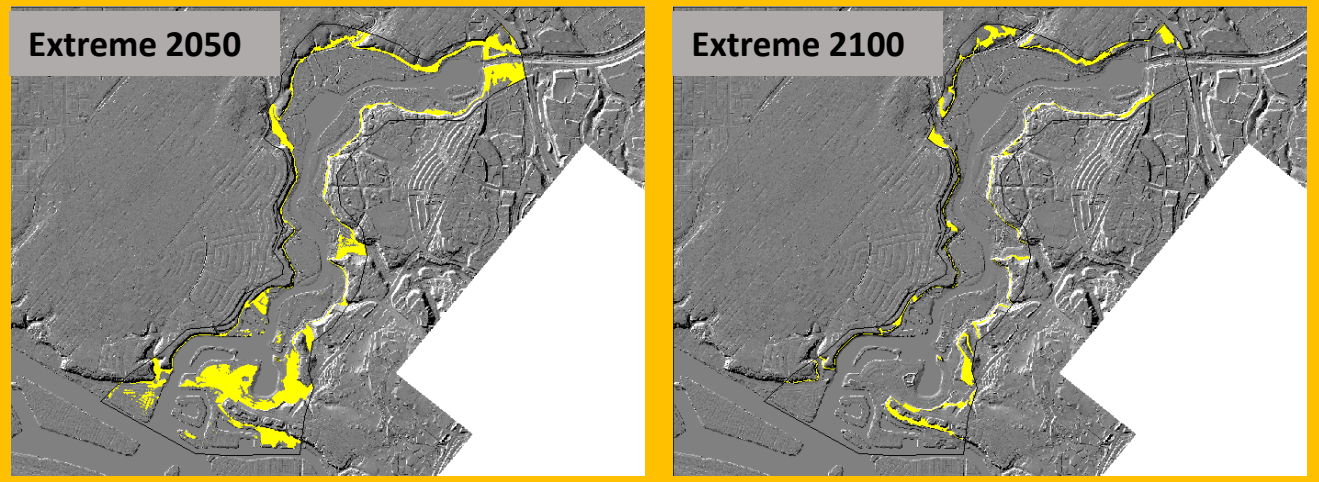




SMBB Ranges, current (yellow) and future (pink)

How might invasive *Limonium* distributions impact SMBB with SLR?

Invasive *Limonium* distributions, 2050 and 2100, Extreme SLR



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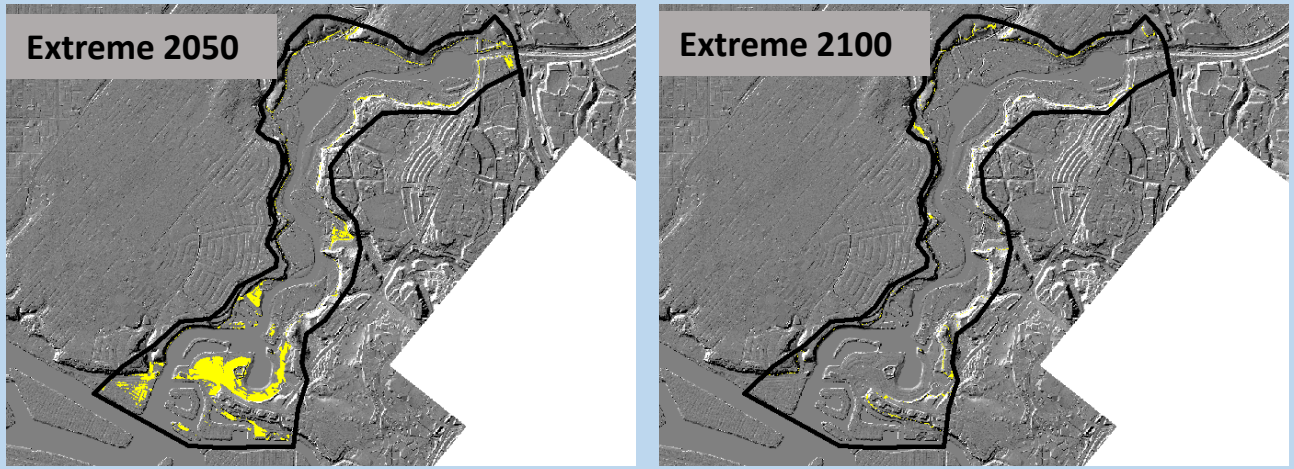

- By 2100 under Extreme SLR, invasive Limonium has ~400% larger range than SMBB.
- ~99% of SMBB habitable range is shared with potential range of invasive *Limonium*
- Invasive *Limonium* can exist in a wider array of habitat types while SMBB is more restricted to salt marsh

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!