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# How Nebraska's Eastern Saline Wetland Native Plant Species Grow in Response to Restoration Methods: Application of Different Salinity Level Groundwater

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# How Nebraska's Eastern Saline Wetland Native Plant Species Grow in Response to Restoration Methods: Application of Different Salinity Level Groundwater

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## Introduction

- Nebraska's Eastern Saline Wetlands are unique ecosystems endemic to the Salt and Rock Creek waters in Lancaster and Saunders County.
- They provide an ecosystem services as well as habitat for endangered species such as the state endangered saltwort (*Salicornia rubra*) and federally endangered Salt Creek tiger beetle *(Cicindela nevadica lincolniana)*.
- Over 80 % of the saline wetlands are highly degraded and in recent years, the Saline Wetland Conservation Partnership has formed to conserve and restore the remaining saline wetland fragments, but there is limited information about inland saline wetland restoration.

**Purpose:**

Investigate techniques to better conserve these saline wetlands and native saline vegetation communities through habitat restoration and plant growth and diversity.

**Research Question/ Objectives:**

- How plant growth responds to saline wetland restoration techniques, specifically water application of different salinity levels and seeding time to find optimal restoration conditions
- Understanding how soil and water salinity effect plant germination, growth and diversity so restoration methods can be improved

## Methods

- Seven native saline wetland plant species chosen as indicators of wetland health: foxtail barley, marshelder (IVAN), saltmarsh aster (ASSB), saltgrass (DISP), saltwort (SARU), seablite (SUCA) and spearscale (ATSU).
- **Germination tests** conducted in lab setting
  - Three temperature treatments represented March (5-10°C), April (5-20°C) and May (10-20°C) in NE to determine optimal seeding time
  - Three salinity treatments: low (2.7 ppt), medium(19.2 ppt), and high(28.0 ppt) from wells at experimental site with a control of freshwater
  - Seeds collected, separated and placed in petri dished with wetted filter paper and then placed in incubation chambers
  - Germinated seeds counted and recorded every other day for 20 days
  - Calculated germination rates


Left to right: Germination tests, Incubation chambers

- **Field Survey**: Ecosystem scale experiment conducted at research site located near 27th and Arbor Road in Lincoln, NE
  - 34 plots receiving treatments of low, medium or high salinity water, and drip or flood water application methods, or control of fresh water
  - Seeds collected, separated, weighed, divided and planted in March 2015
  - Presence and growth of each species found was recorded for each plot in the following fall
  - 1mx1m quadrat used and all plants inside were measured for height and amount of branches
  - Biomass samples were also taken for further growth measurement
  - Calculated relative abundance for each plot and treatment using Shannon Diversity Index

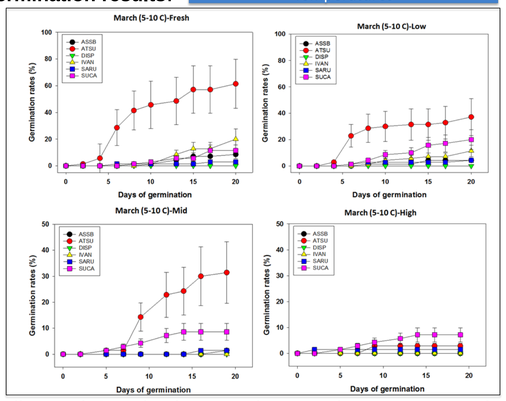


From left to right: Field experiment site, Plant identification, Quadrat used for sampling

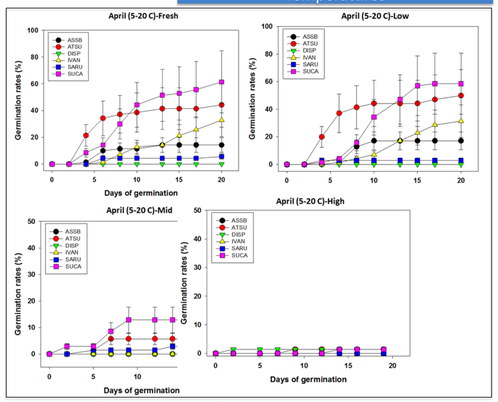
## Results

**Germination results:**

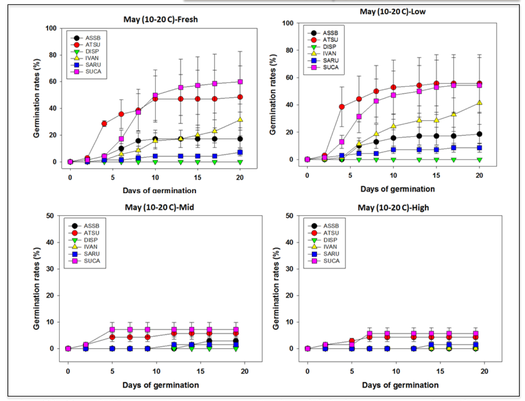
Germination for Salinity Levels in March Temperatures




Germination for Salinity Levels in April Temperatures




Germination for Salinity Levels in May temperatures



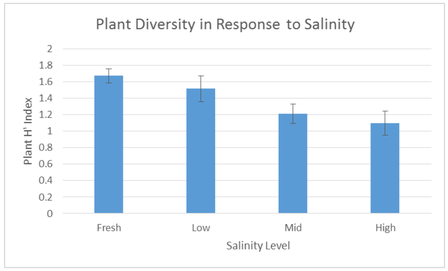

Findings : 1) Germination rates increased as temperature increased. 2) Germination rates decreased as salinity increased. 3) Seablite and spearscale had highest germination rates across all temperatures.

**Field Survey:**

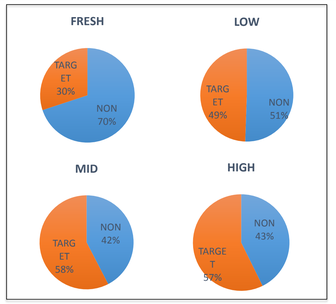
**Species identification/ Richness:**

| Salinity | # of species | Species |
|---|---|---|
| Fresh | 20 | Aster, Saltbush, **Spearscale**, Bushy Knotweed, Common Ragweed, Curly Dock, Dead Grass, Fall Panicum , **Foxtail Barley**, Giant Foxtail, Goldenrod, Kochia, **Marshelder**, Plantain, **Salt Grass, Seablite**, Tall Thistle, Thistle, Western Ragweed, Witchgrass |
| Low | 18 | Aster, Saltbush, **Spearscale**, Bushy Knotweed, Common Ragweed , Common Sunflower , Curly Dock, Dead Grass, **Foxtail Barley**, Kochia , **Marshelder**, Plantain, **Saltmarsh Aster, Seablite**, Thistle, West Rag, Western Ragweed, Witchgrass |
| Mid | 13 | Aster , Saltbush, **Spearscale**, Bushy Knotweed, Common Ragweed, Common Sunflower, **Foxtail Barley**, Kochia, **Marshelder, Saltgrass , Saltwort , Seablite** |
| High | 6 | Saltbush, **Atriplex Spicata**, **Foxtail Barley**, Kochia, **Seablite**, Western Ragweed |

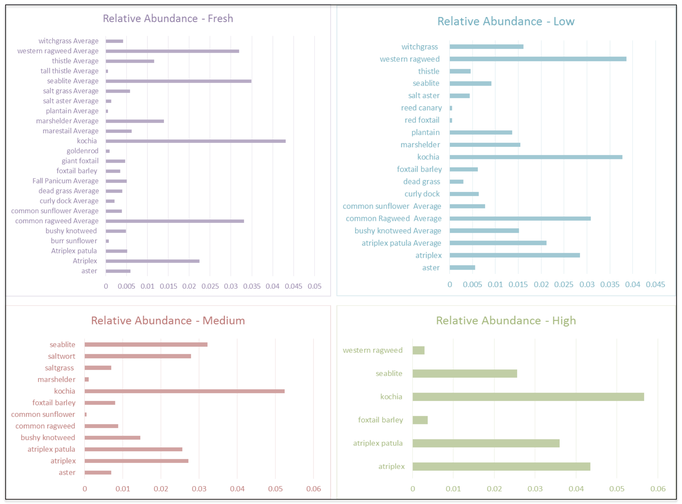
**Diversity:**




Plant diversity decreases as salinity increases




The abundance of targeted species increased with salinity from fresh to high as indicated in the figure.




Species diversity decreased with increase in salinity from fresh water to high salinity level water indicated in the figures, while abundance of targeted saline species increased with increase in salinity.

## Conclusions and Implications

- Performed germination tests and field experiments to study saline wetland plant response to salinity and restoration methods
- As salinity increased, germination rates decreased for all six species tested
- Warmer month temperature simulations had highest germination rates
- As salinity increased at the experimental site, plant species richness decreased.
- Freshwater plant species decreased as salinity increased; over 50% of plant abundance of medium/ high salinity level plots consisted of seven targeted species
- Seablite and spearscale had highest germination rates and were most abundant at all saline plots of experimental field site
- These findings are useful in suggesting restoration methods most suitable for plant growth, such as medium salinity levels to promote native saline plant species growth while inhibiting freshwater wetland weeds, and April seeding times to increase germination