Innovative reclamation for energy projects: harnessing the power of native species on salt-impacted sites

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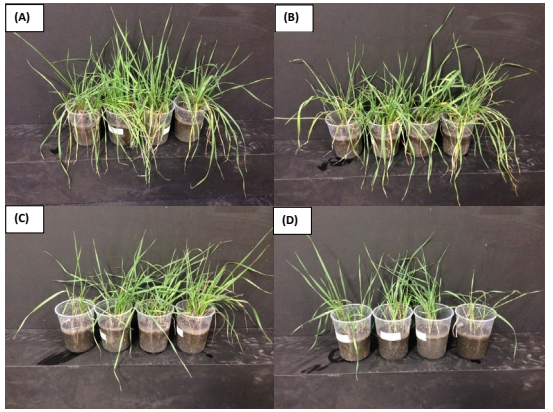
Salt impacts in Alberta

- Anthropogenic and natural sources
- Degradation of soil properties, impaired vegetation growth, plant mortality
- Salt-impacted soils can be a particular problem in grasslands
  - Sensitive to disturbance
  - Difficult to reclaim
- Reclamation:
  - Tier 1 Guidelines
  - Native Prairie Protocol (Alberta Environment and Parks, 2019)

https://www.src.sk.ca/blog/understanding-oil-and-gas-methane-emissions-and-mitigation-opportunities-part-1

https://www.src.sk.ca/blog/pipelines-101-history-pipelines-and-how-they-are-used-modern-living

https://www.swiftcurrentonline.com/ag-news/soil-salinity-and-seeding-options-focus-of-forage-agronomy-workshop



Innovation and native vegetation

- Native vegetation communities have evolved to changes in edaphic conditions of saline soils (i.e., *Puccinellia nuttalliana*)
- Can we harness the natural tolerance of native species in reclamation of salinity impacted to increase success?
  - Interim revegetation
  - Erosion control
  - Weed control
  - Avoid further disturbance if possible
- Prioritize the use of certain species under different conditions

Evaluating the natural tolerance of native grasses to salt-impacted soil

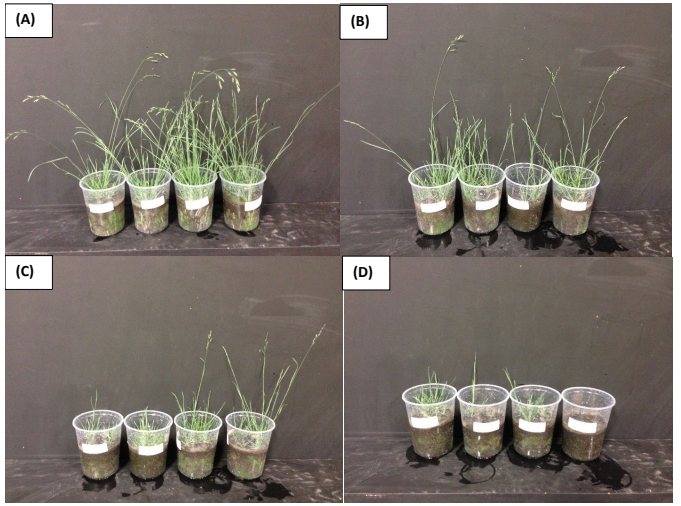
1. Natural tolerance of native grass species to anthropogenic salinity (NaCl)
2. Toxicity effects of NaCl and Na_2SO_4 on native grass species
   - Anthropogenic vs naturally occurring salinity

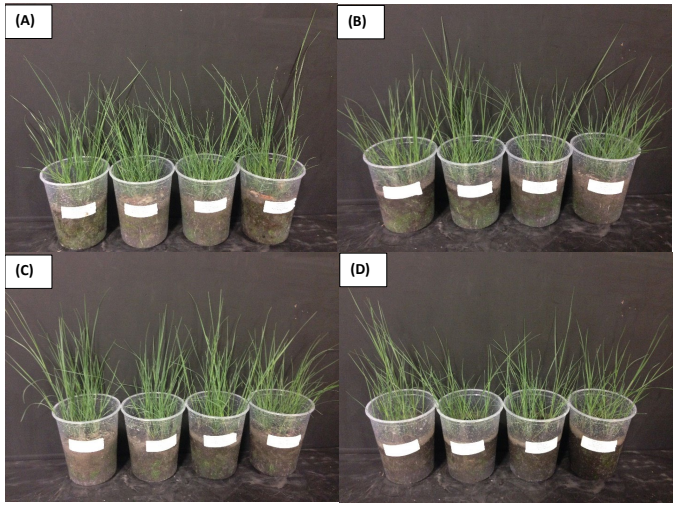
This is part of a larger report, funded through a Creative Sentencing project, available on the AER's Compliance Dashboard.

- Reference #201609-01

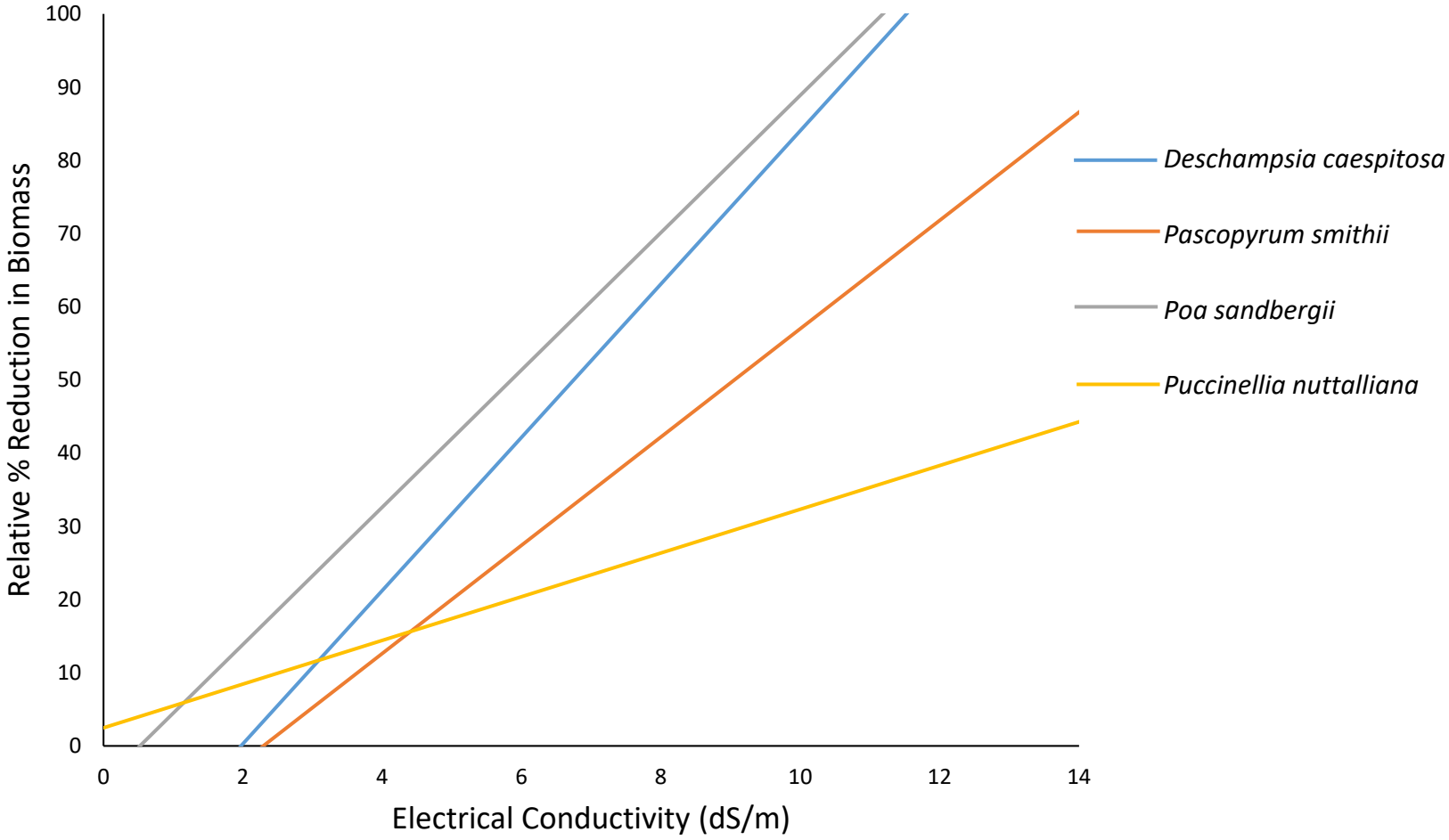
Natural tolerance of native grass species to anthropogenic salinity

- Four species:
  - *Deschampsia caespitosa* (tufted hair grass)
  - *Pascopyrum smithii* (western wheatgrass)
  - *Puccinelia nuttalliana* (Nuttall's alkali grass)
  - *Poa sandbergii* (Sandberg's bluegrass)
- Four salinities: 1.5 (control), 4, 6, 11 dS/m
  - Spiked with NaCl
- 6-week growth period





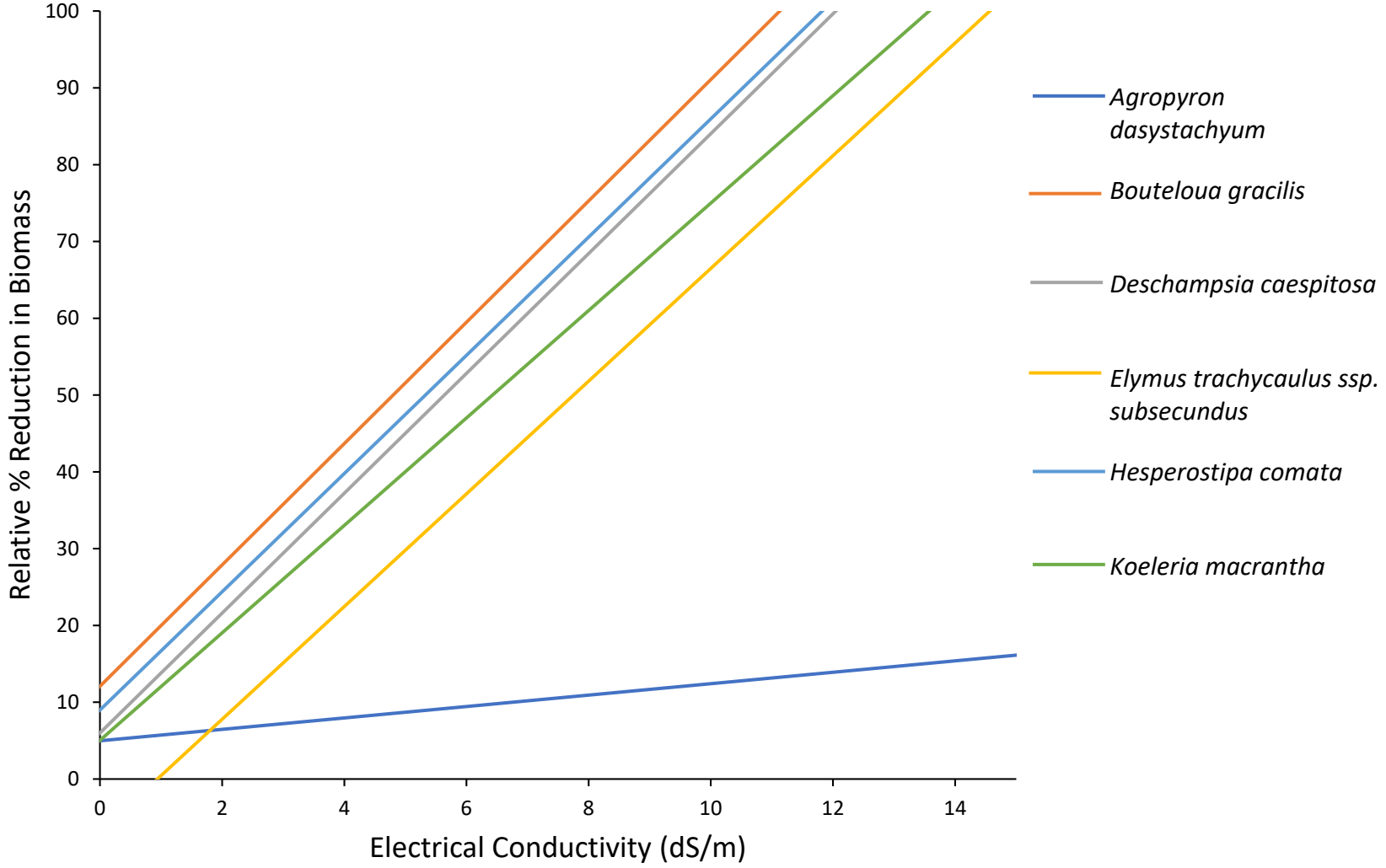
Natural tolerance of native grass species to anthropogenic salinity



Natural tolerance of native grass species to anthropogenic salinity

- Six species:
  - *Koeleria macrantha* (junegrass)
  - *Elymus trachycaulus ssp. subsecundus* (awned wheatgrass)
  - *Agropyron dasystachyum* (northern wheatgrass)
  - *Deschampsia caespitosa* (tufted hair grass)
  - *Hesperostipa comata* (needle and thread)
  - *Bouteloua gracilis* (blue grama)
- Four salinities: 1.61 dS/m (control), 4.63 dS/m, 6.07 dS/m, 12.54 dS/m
- 10-week growth period

Natural tolerance of native grass species to anthropogenic salinity



Natural tolerance – summary

- Species thought to be salt tolerant showed impacts with increasing salinity; *P. nuttalliana* most tolerant.
- *A. dasystachyum* would be the best choice for fast, vigorous growth in soils with fair/poor salinity rating, given the results.
- Alternative establishment methods may be a more effective means of establishment than seeding in salt-impacted soils.

Toxicity effects of NaCl and Na_2SO_4 on native grass species

- Objective: Evaluate the toxicity of anthropogenic and naturally occurring salts on native grass species
- Followed a modified Environment Canada (2007) method
- Three species:
  - *Pascopyrum smithii* (Western wheatgrass)
  - *Nassella viridula* (green needle grass)
  - *Deschampsia caespitosa* (tufted hair grass)
- Soil spiked to a range of salinities:
    - NaCl: 2.5 – 27.1 dS/m
    - Na_2SO_4: 2.5 – 24.4 dS/m
- Determine effective concentration (EC_p)/inhibition concentration (IC_p)

Toxicity effects of NaCl and Na_2SO_4 on native grass species

Species	Salt	Parameter	IC_{50} (dS/m)
Pascopyrum smithii	NaCl	Shoot length (mm)	13.78 (0.75)
	Na_2SO_4		15.48 (0.82)
Nassella viridula	NaCl		12.25 (0.62)
	Na_2SO_4		14.28 (0.65)
Deschampsia caespitosa	NaCl		13.91 (2.84)
	Na_2SO_4		24.79 (17.14)

Species	Salt	Parameter	IC_{50} (dS/m)
Pascopyrum smithii	NaCl	Root length (mm)	7.18 (2.70)
	Na_2SO_4		12.68 (0.87)
Nassella viridula	NaCl		9.60 (0.59)
	Na_2SO_4		10.64 (0.70)
Deschampsia caespitosa	NaCl		10.74 (3.03)
	Na_2SO_4		10.05 (1.90)

Toxicity effects – summary

- Na_2SO_4 was less toxic than NaCl, in terms of **shoot length**, at the same EC
- Roots tended to be impacted similarly by both NaCl and Na_2SO_4
- Species-specific effects of salinity were observed
- If seeding a salt-impacted site, *N. viridula* and *P. smithii* would be good candidates as they are able to germinate in soils with relatively high ECs

Conclusions

- Wheatgrass species tested may be ideal for interim reclamation of salt-impacted site (moderate-high tolerance, fast growth).
- Consideration should be made regarding establishment techniques. Traditional seeding may be appropriate for some of the species tested (i.e., *N. viridula*), but not for others (i.e., *A. dasystachyum*).
- If aboveground growth is the main concern, it may be helpful to consider the type of salt contamination present on site (Cl^- vs SO_4^{2-}).

Thank you!!

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Check out the report and technology transfer documents:

AER Compliance Dashboard – Noncompliance and Enforcement

http://www1.aer.ca/compliancedashboard/enforcement.html?searchcol=1&searchstr=201609-01

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