# The corms of *Eriophorum vaginatum* thriving in metal contaminated wetlands in Sudbury, ON, do not accumulate industrial metals

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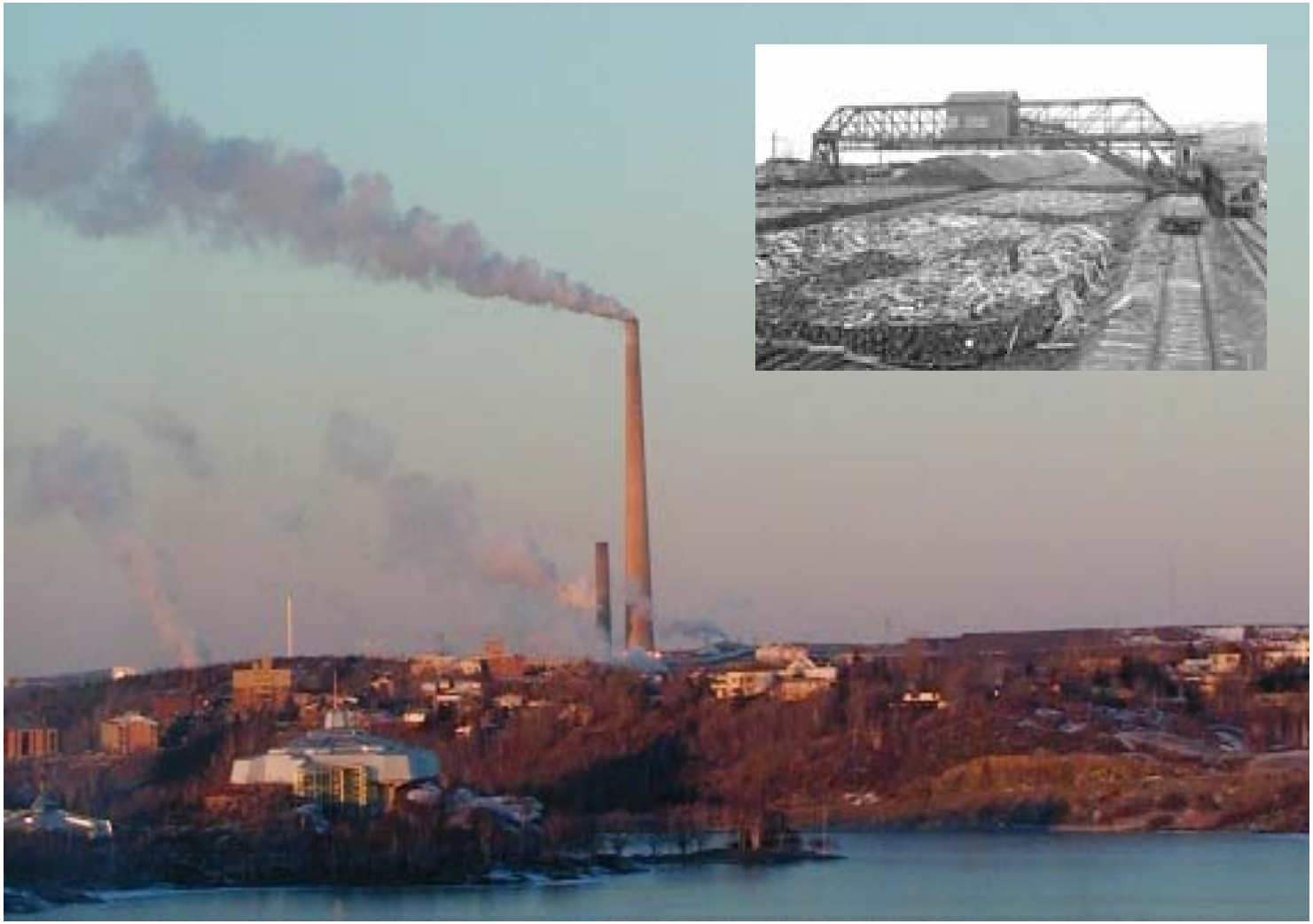
# THE BIG PICTURE

*Sudbury, ON, Canada*



# TOUGH PERENNIAL

## *Eriophorum vaginatum* L.

Well adapted to cold, nutrient-poor bogs and tundra in the arctic and boreal regions

Can accumulate and retranslocate radioactive cesium ($^{137}Cs$) in its shoots

Accommodates substrate pH of ~3 to 8

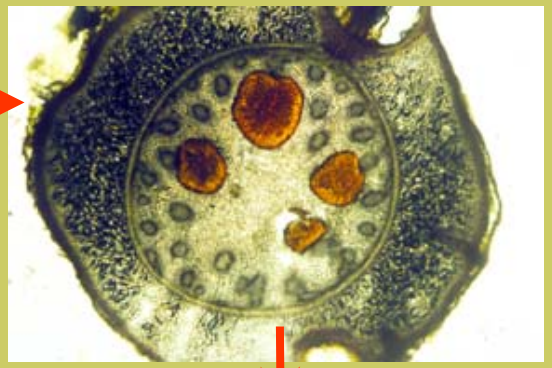
Only species to survive even 15 yrs after crude oil spills on Alaskan tundra

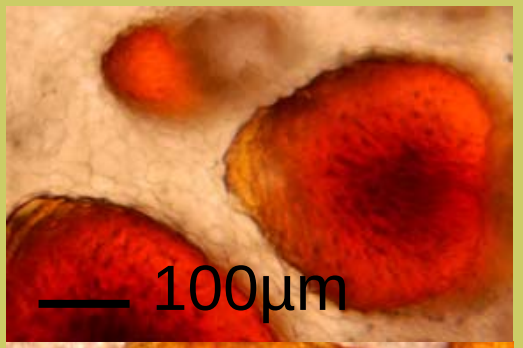
Growing in Sudbury wetlands of which the surrounding soils contain high levels of potentially toxic, industrially borne metals

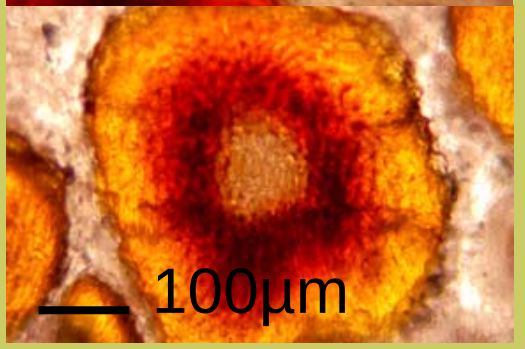
Persists through periodic drought and repeated total-defoliation

# *E. vaginatum*
## Corms & sclereid clusters







# THE BIG QUESTION

## *Eriophorum vaginatum*

- Is there a link between its unique internal anatomy and its survival in nutrient limited and contaminated environments?

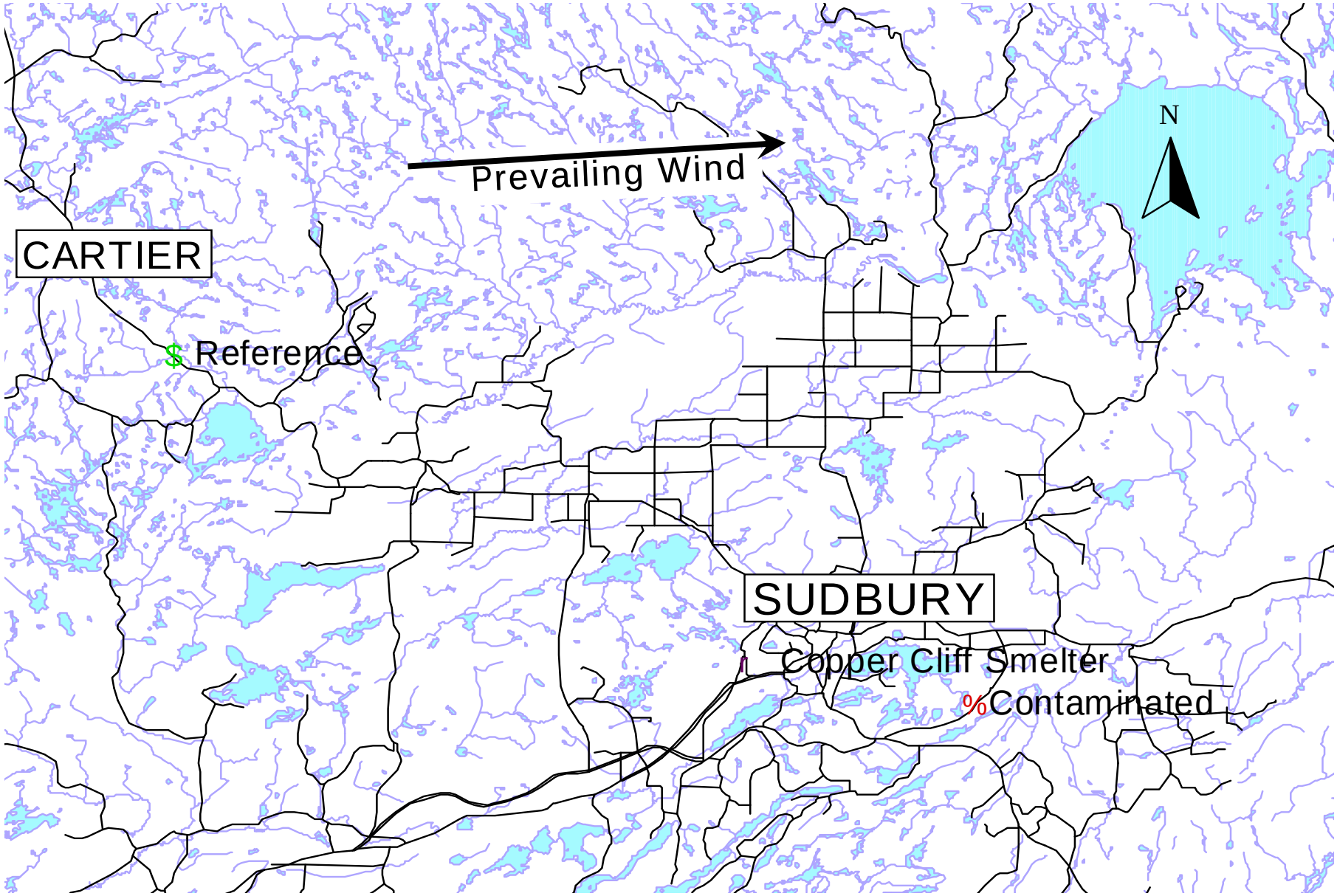
+ ?? =

# Objectives

- Do the overwintering corms bioaccumulate industrial metals persistent in Sudbury's environment?
- Can sclereid clusters within the corm accrue these metals from the surrounding tissues?

■Contaminated Site 12km ESE of Copper Cliff Smelter

▲Reference Site 40km NW of Copper Cliff Smelter



# Sample Preparation & Analysis

- Sampling date: 23 Sep 2005 for both representative sites
- Vegetation
  - 3 tussocks of *E. vaginatum* randomly selected per site
  - Corm analysis → 15 homogenized per tussock
  - Sclereid analysis → 20 dissected corms per tussock
- Substrate
  - Adjacent to the root zone of each tussock
  - 1 random grab per tussock (2-16 cm depth)
  - pH 1:10 w/v soil:deionized water
- 5:1 $HNO_3$:HCl open digestion
- Metals quantified by ICP-MS
  - Al, Fe, Co, Ni, Cu, Zn, As, Cd, and Pb
- Principle Component Analysis (PCA)
  - To illuminate any linear, multivariate relationships between metal contamination of the sites and those of the samples

**Selected 'near total' metal concentrations (µg/g, dry wt., n=3)**

| | ▲ Reference | | ■ Contaminated | |
|---|---|---|---|---|
| | Mean | SEM | Mean | SEM |
| *Soil* | | | | |
| Al | 1520 | 76 | **14300** | 698 |
| Fe | 3440 | 82 | 3570 | 665 |
| Ni | 38.4 | 2.2 | **842** | 104 |
| Cu | 58.8 | 5.8 | **566** | 149 |
| *Corms* | | | | |
| Al | 28.3 | 6.5 | **59.0** | 11.2 |
| Fe | 67.2 | 13.7 | 76.3 | 12.1 |
| Ni | 7.41 | 1.10 | **84.1** | 10.4 |
| Cu | 38.9 | 6.4 | **67.7** | 5.8 |
| | Median | Range | Median | Range |
| *Soil pH* | 3.38 | 3.31 - 3.48 | 3.72 | 3.59 - 4.02 |

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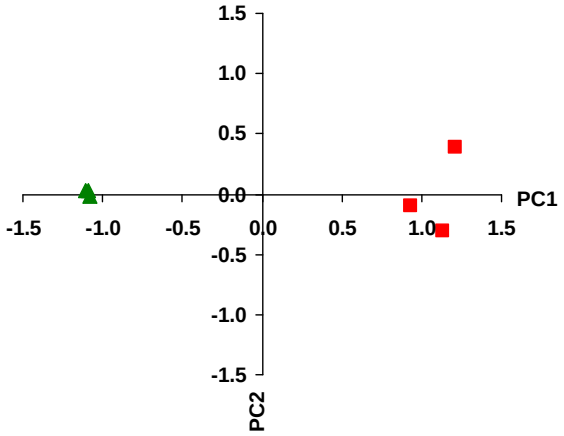
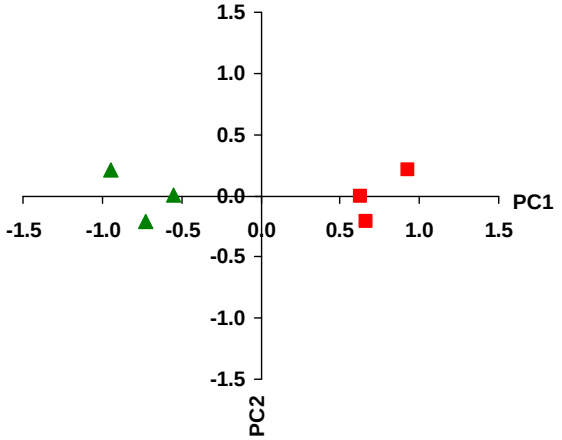
| *Sclereid clusters* | | | | |
| Al | 40.9 | 14.7 | 41.2 | 15.3 |
| Fe | 49.6 | 8.0 | 35.9 | 16.5 |
| Ni | 1.11 | 0.48 | 2.79 | 0.55 |
| Cu | 22.2 | 11.8 | 5.38 | 0.85 |

# Principle Component Analysis (PCA): Preliminary Relationships Confirmed



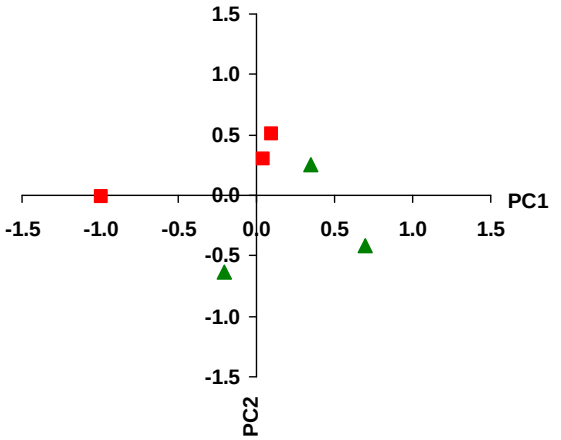

97.1% variance explained

Soil




96.7% variance explained

Corms




90.9% variance explained

Sclereid clusters

- Interestingly, the magnitude of difference in the metal content between sites followed similar relationship as observed in the raw data
- Despite the magnitude of environmental metal pollution sclereid metal content was very similar in all samples

# Conclusions and Implications

- Substrate metal content > corm metal content > sclereid metal content
- Soil Cu-Ni content at the contaminated site exceeded Canadian environmental quality guidelines suggesting continued potential toxic action on biota
- Corms did not accumulate industrial metals persistent in Sudbury's environment despite similar low pH in both sites
- Sclereid clusters seemingly do not act as metal detoxification centres within the corm of *E. vaginatum*

# Conclusions and Implications

- The natural, red-orange colour of sclereid clusters may be due to an Fe-complex
- This study suggests *E. vaginatum* can survive in metal contaminated wetlands with low pH because metals are largely excluded from the corm
- Results of this study may lead to the use of *E. vaginatum* in northern wetland phytostabilization or reclamation throughout circumpolar and boreal regions
- Future study will focus on the role of Fe and Al within *E. vaginatum* and the role of metal exclusion for its survival

# Acknowledgements

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xstrata

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