A Potential Remediation Strategy using Wetland Vegetation and Aquatic Macrophytes in Kelley Lake, Sudbury, Ontario.

By:

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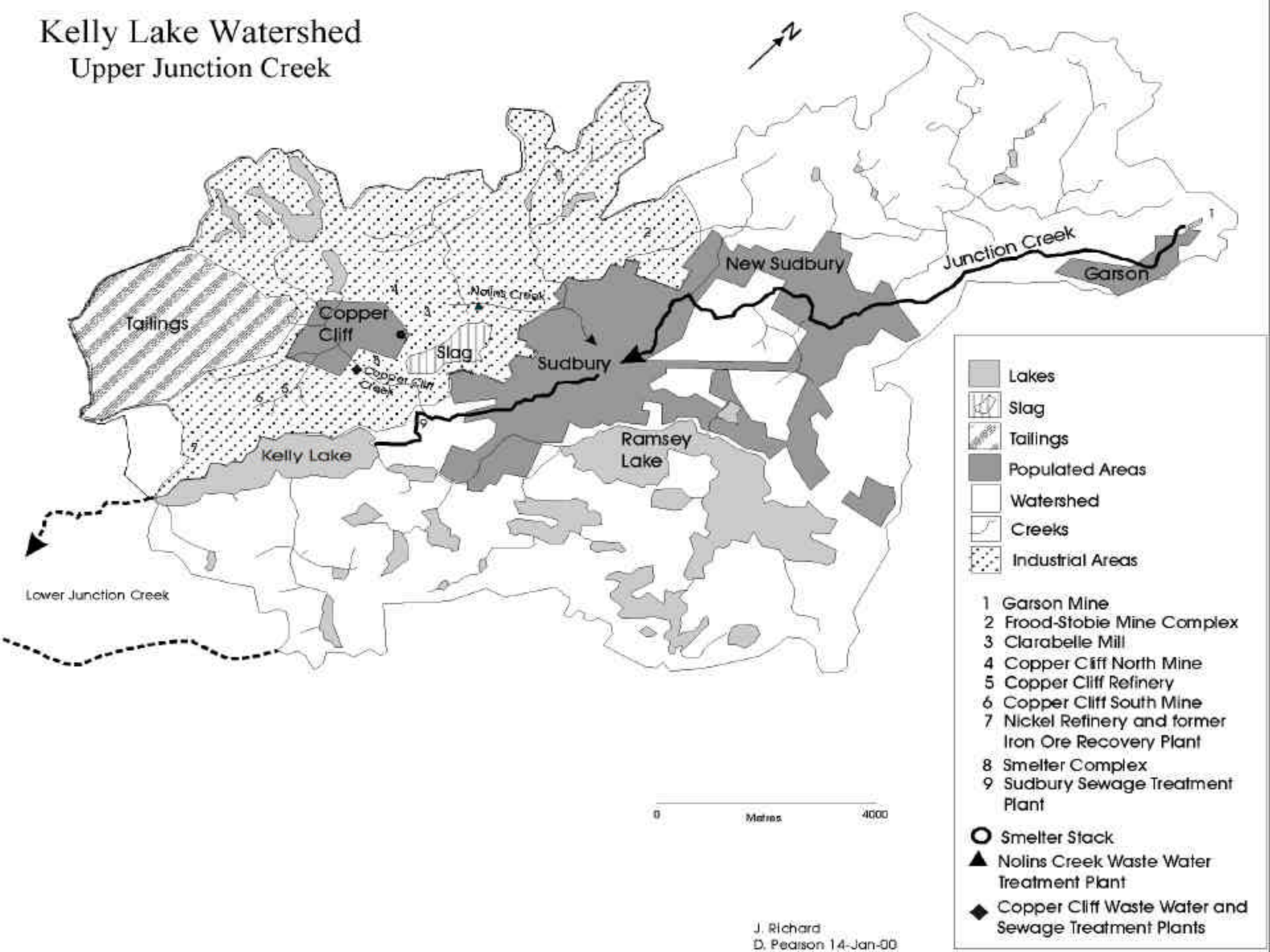
Kelly Lake Watershed
Upper Junction Creek

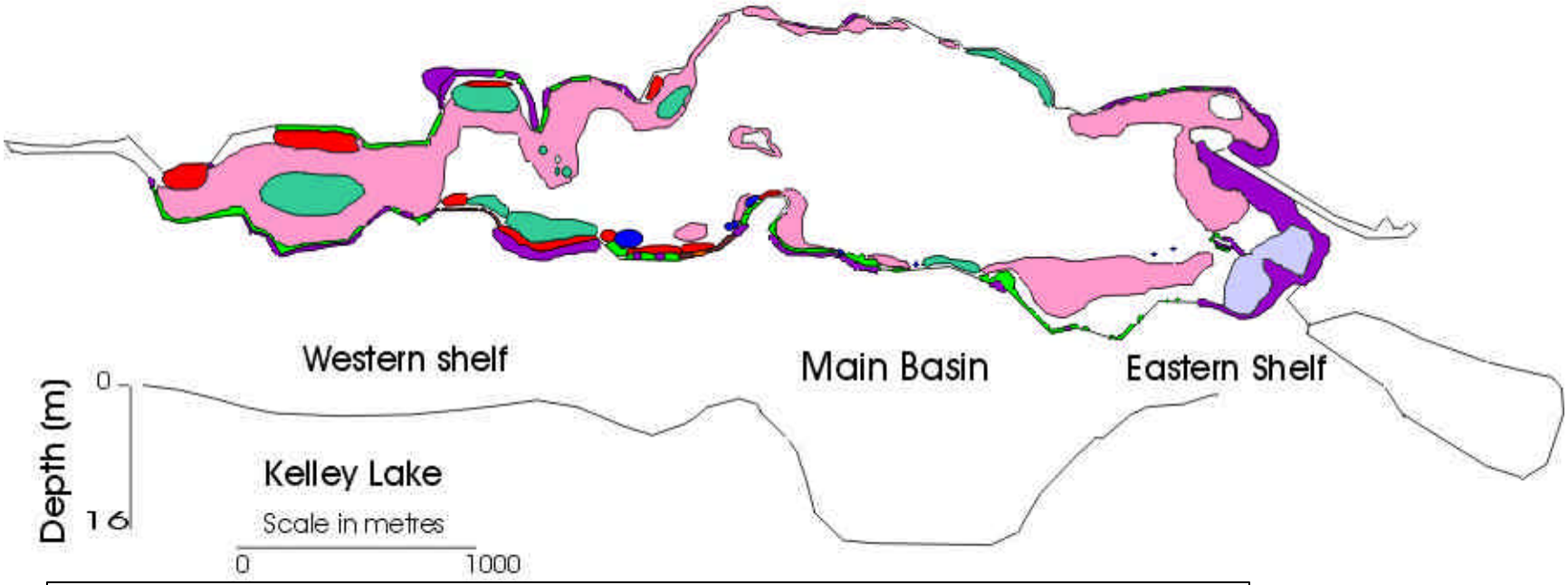


J. Richard
D. Pearson 14-Jan-00

Objectives:

- to determine the distribution and abundance of vegetation species in the lake.
- to quantify the metal and nutrient loading in the vegetation and soil, in both the wetlands and littoral regions.
- assess the use of wetland and aquatic species in a harvest regime.

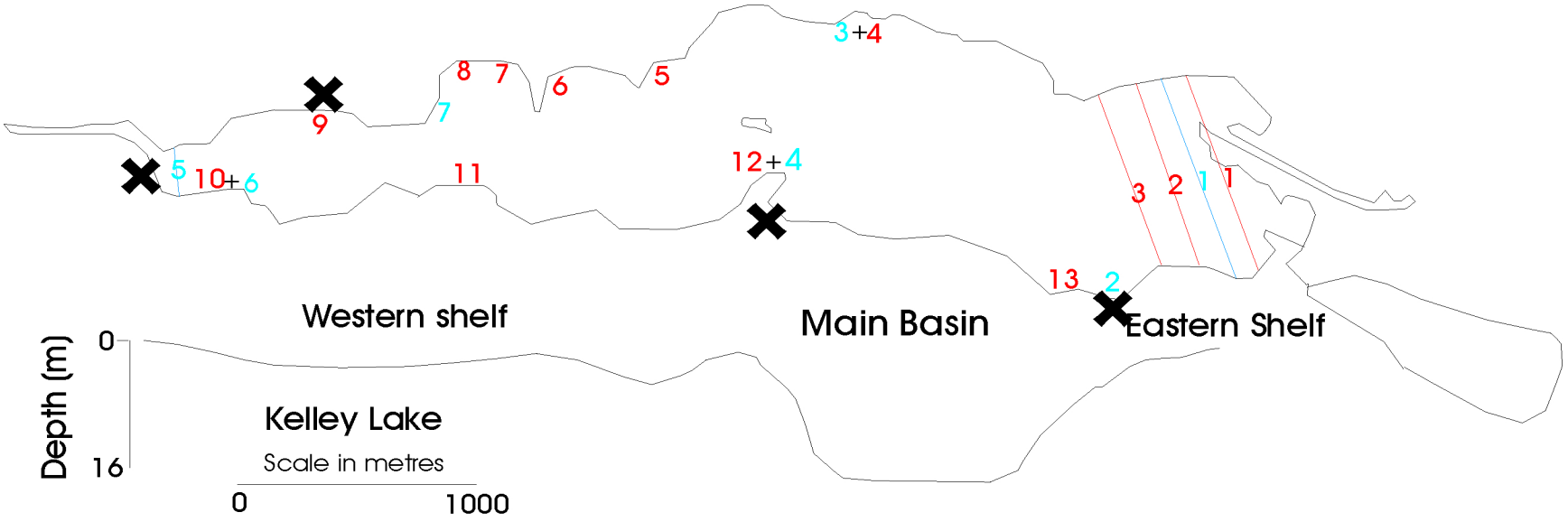
Survey of Wetland Vegetation and Submerged Macrophytes in Kelley Lake. (Field Season 2000)



- *Myriophyllum spicatum*
- *Potamogeton pusillus*
- *Myriophyllum spicatum + Potamogeton richardsonii*
- *Potamogeton richardsonii*
- *Typha latifolia*
- *Scirpus acutus*

Digitized outline by: Jackie Richard

Sampling Points for 1999 and 2000 Field Seasons



1999 sampling points

2000 sampling points

Emergent Wetlands Sampled in 2000

Outline digitized by J. Richards

Sampling

- *Vegetation*

-measurements of %cover and biomass taken in all plots.
-the vegetation collected for biomass was used for analysis (XRF-EMMA).

- *Water*

-surface samples were collected weekly, at the inlet, main basin and outlet
-water analyzed by ICP-MS.

- *Soil*

-*shoreline marshes*-soil was collected at every plot in 5cm increments up to a depth of 20cm.
-*Littoral zone*-the top 2cm (rooting zone) of soil was collected at the first, middle and last plot on every transect.
-analysis included; pH, redox, conductivity, organic matter, sequential analysis, total metals (XRF) and water extractable (ICP-AES).

Table 1. The average concentration of metals and nutrients in water entering and leaving the lake, in 1999.

	Inlet	Lake Basin	Outlet	PWQO
pH		7.22		
	ppm	ppm	ppm	ppm
PO_4	237	130	128	no set limit
Total-P	59	6	12	10-30
Cu	85	30	33	5
Ni	546	639	645	25
Fe	1619	980	1027	300

General Soil Characteristics

(Shoreline marshes and littoral regions)

- total metal concentrations reaching; Ni (max=5023 ppm), Cu (max=2418 ppm), Fe (max=47500 ppm)

- organic matter content < 10% (mineral soil)-fine grained silty - clay

- negative redox potential < -100 mv (reducing state)

- pH ranging from 6-7 (near neutral)

Table 2. Sequential extraction of a sediment profile (modified from Tessier's,1993).

	(ppm)	Carbonate	FeMn oxide	Organic	Sulfide	Residual	Total
Phosphorus	%	2.6	11.39	22.74	58.44	4.73	100%
Copper	%	1.27	0.78	90.1	6.56	0.42	100%
Nickel	%	4.51	56.05	32.54	4.52	0.52	100%
Iron	%	0.2	39.21	13.61	38.39	8.16	100%

Table 3. Average concentrations of “bioavailable” elements from sediments collected from wetlands and the littoral zone (water extractable).

Depth (cm)	Ni (ppm)	Cu (ppm)	Fe (ppm)	Total-P (ppm)
0-5	239.7	62.6	49.2	0.4
5-10	181.6	72.2	164.6	0.7
10-15	90.3	26.8	133.1	0.5
15-20	84.2	22.1	20.8	0.4
Littoral (0-2)	166.8	80.5	11.6	0.5

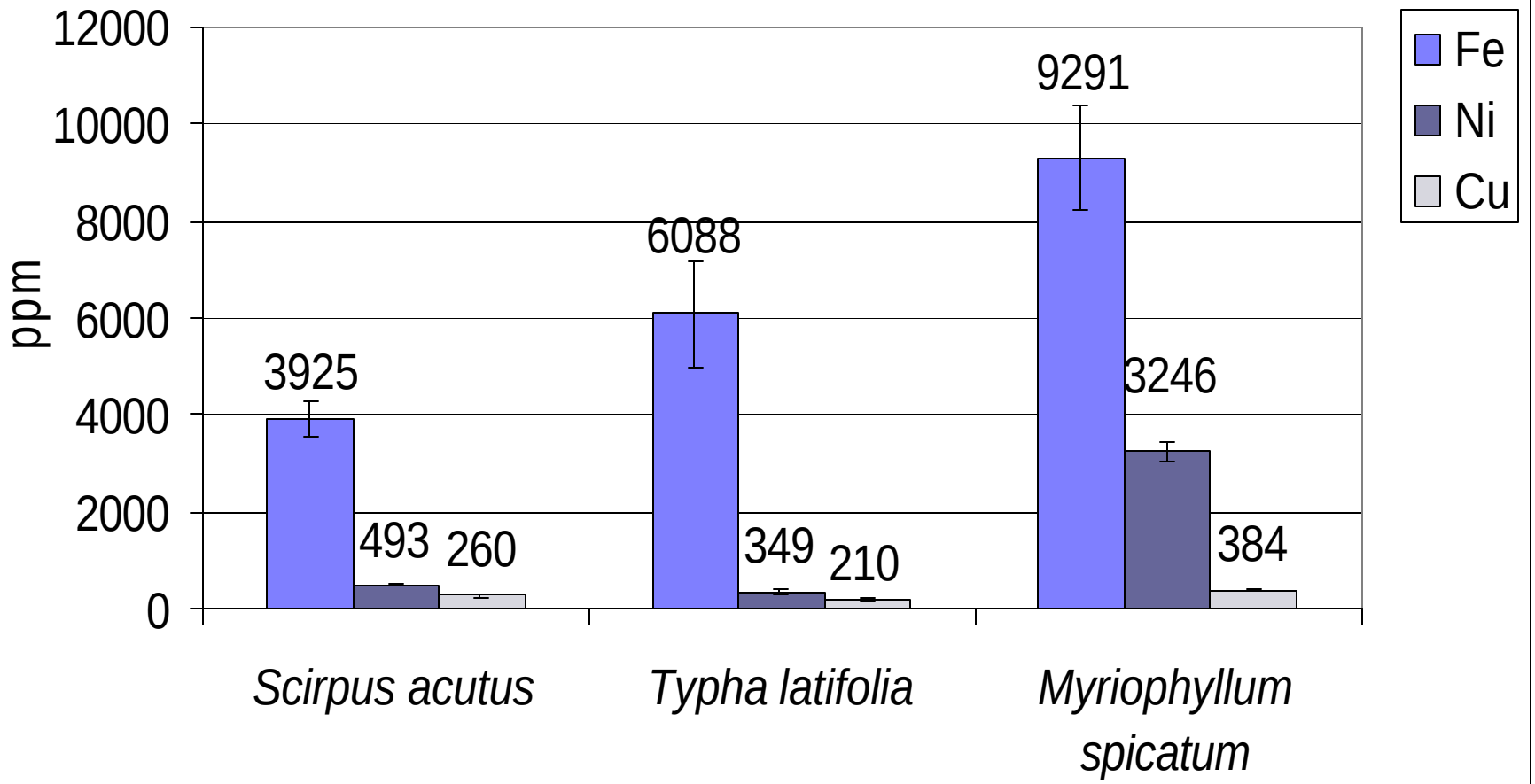


Figure 1. Average concentration (±s.e.) of heavy metal accumulation in three dominant species in Kelley Lake.

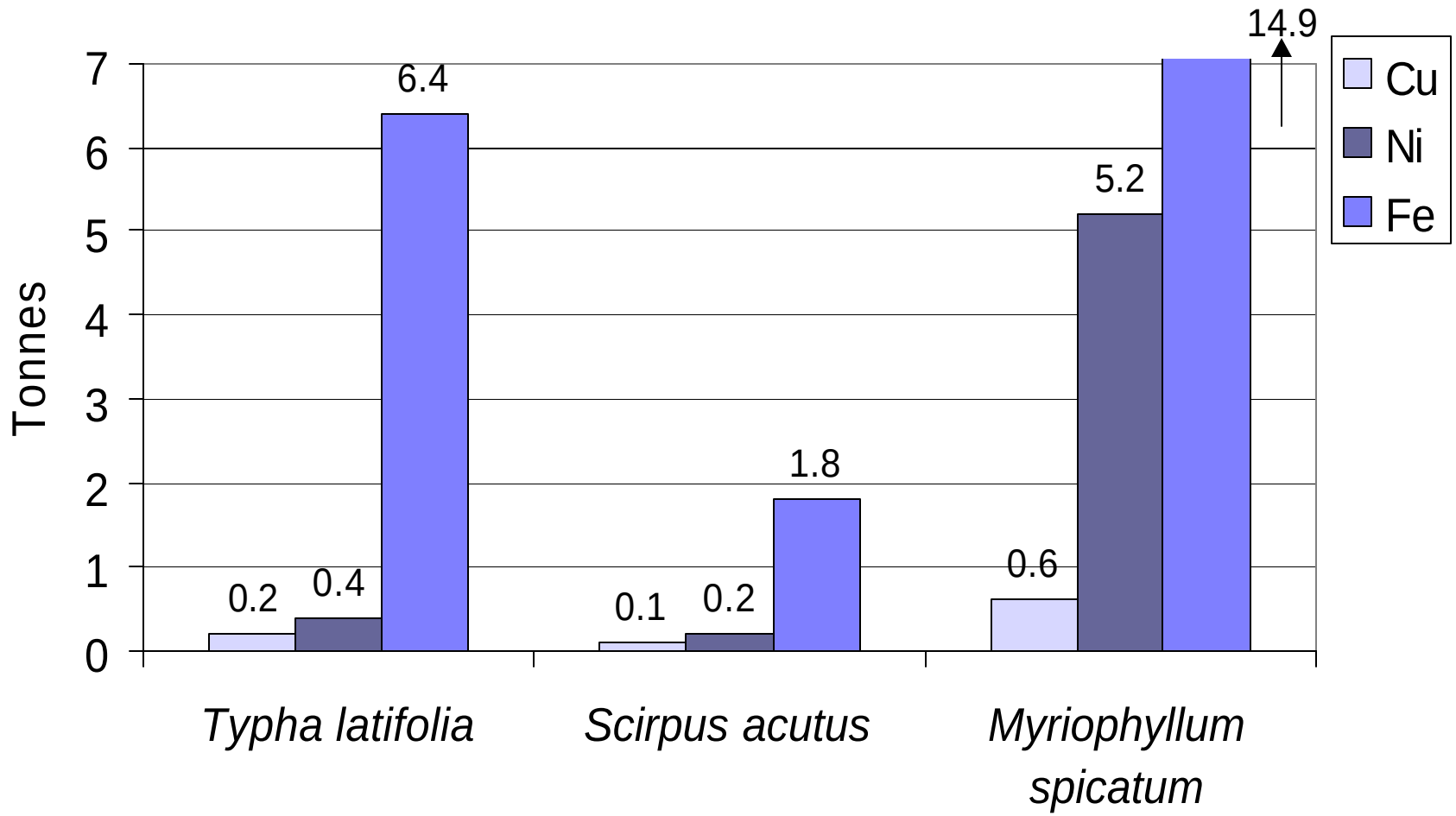


Figure 2. Estimates of standing crop for metals in the entire plant population for three species.

Harvest Regime

Macrophyte (*Mriophyllum spicatum*)

- hyperaccumulator of heavy metals
- highly competitive, populations regenerate quickly after disturbance
- easy access
- deter recycling of metals back into the system following senescence.

Wetland Species (*Typha latifolia*, *Scirpus acutus*)

- not as adept to sequestering metals
- shoreline marshes are too small
- not easily accessible
- slower decomposition

Conclusions

- Kelley Lake is acting as a sink for nutrients and metals.
- toxic amounts of metals are being taken up in the plants.
- Myriophyllum spicatum sequestered the largest amount of Cu, Ni and Fe.
- metals could be recycled back into the system.
- harvesting plants

Acknowledgements

I would like to thank INCO (Glen Watson), The City of Greater Sudbury (Paul Graham), Mirarco (Centre for Environmental Monitoring), Geoscience labs, ELRFS, the Kelley Lake Research Team (Alan Lock, Jackie Richard, Francois Prevost), Jennifer Noel and Amanda Fawkes.

Table. Pearson correlation coefficients for, vegetation versus soil and water (n=12).

	Fe	Cu	Ni
shoots vs soil (total metals)	r=0.459	r=0.229	r=-0.183
shoots vs soil (water extractable)	r=0.361	r=-0.127	r=0.119
shoots vs water	r=0.55	r=-0.124	r=0.04