

Comparing relative fish density estimates from electrofishing and visual surveying methods

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Purpose

- The importance of accurate sampling of fish populations in:
 - Ascertaining ecological status (COSEWIC listing)
 - Assessing stocked and harvested populations (commercial and recreational fisheries)
 - Studying population dynamics and assessing fish distribution patterns

Sampling methods in use

Advantages

- **Electrofishing:**
 - Precise identification and measurement additional
 - Tissue collection
- **Visual surveying (snorkelling)**
 - Less invasive and harmful to fish
 - Most cost effective, least time consuming , most accessible
 - Effective for community wide sampling

Disadvantages:

- **Electrofishing:**
 - Size bias
 - Skewed fish composition
 - Difficulties sampling with higher flows and substrate complexities
- **Visual surveying (snorkelling)**
 - Misidentification and sizes are estimates
 - Biased fish composition
 - Limited information available

Comparative studies

- Visual sampling underestimates salmonid densities by 25-35% relative to electrofishing
- Estimates are highly correlated between methods ($r = 0.90-0.99$) ; length-frequency distributions are similar

(Thurrow and Schill 1996; Mullner et al. 1998; Thurrow 2006)

Comparative studies cont'd.

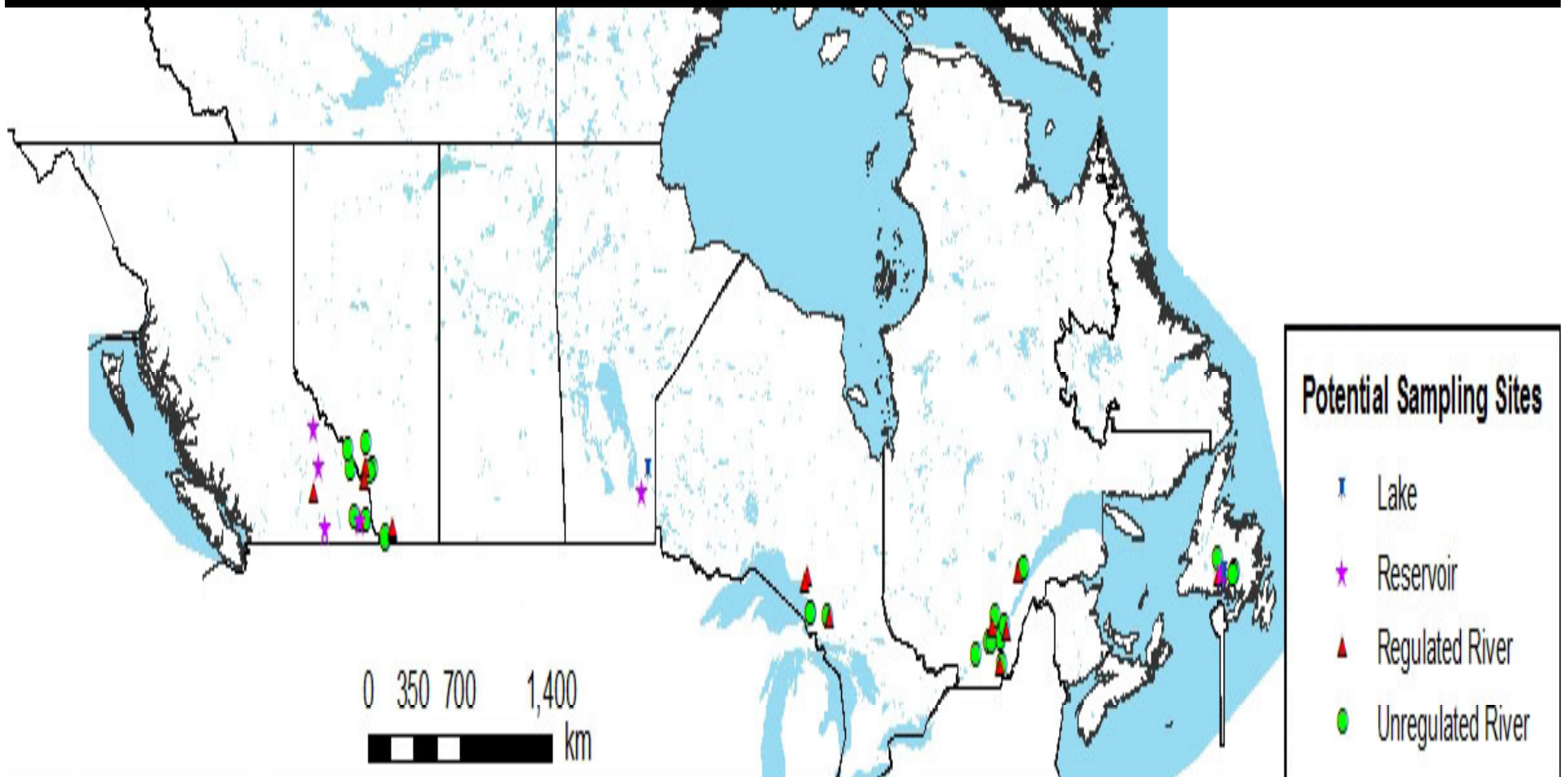
- Species composition of the fish community sampled (mostly dominated by salmonids)
- Influence of environmental conditions: water conductivity, temperature, flow, water transparency...
- Electrofishing surveys use depletion estimate models

(Reynolds 1996; Korman et al. 2009)

Objectives

- 1) Evaluate the relative performance of both methods with respect to estimating fish densities, size structure, and species richness
- 2) Assess how environmental variables may impact the potential of both sampling methods

Geographical range of the study: 22 rivers studied, sampled at 161 sites



Distribution of sampling efforts across regions in Canada

Sampling region	River sampled	Number of sites sampled by Habitat type			
		Pool	Run	Riffle	total
Alberta	Elbow River	1	5	4	10
Alberta	Kananaskis River		16		16
Alberta	St. Mary River		5	5	10
Newfoundland	Conne River		3	2	5
Newfoundland	Granite Compensation Canal	1	4	1	6
Newfoundland	Noel Paul's River		2	4	6
Newfoundland	West Salmon River	1	3	2	6
Ontario	Aubinadong	2	4		6
Ontario	Batchawana	2	6	2	10
Ontario	Magpie River	2	13	2	17
Ontario	Michipicoten River	2	4	2	8
Ontario	Mississagi River	3	2	1	6
Ontario	South River	3	1	1	5
Québec	Rivière aux saumons		4		4
Québec	Rivière Beaurivage		3		3
Québec	Rivière Bécancour		14	2	16
Québec	Rivière Etchemin		3	1	4
Québec	Rivière Petit Saguenay		3	1	4
Québec	Rivière Sainte-Marguerite		3	1	4
Québec	Rivière Ste-Anne		6	1	7
Québec	Rivière St- François		2	2	4
Québec	Rivière St-Jean		2	2	4
	total	17	108	36	161

Electrofishing sampling

- Sites (150-300m²)
- Teams: 2 netters and operator
- Single pass
- ~ 300W



Smith-Root LR-24 backpack

Visual sampling



- Pairs of snorkelers
- Swimming speed:
1.5- 2m/minute
- Size classes:
0-5, 5-15, 15+ cm



Physical variables measured (23)

- Depth (cm)
- Flow (m/s)
- Macrophyte cover (%)
- Woody debris(%)
- Canopy cover (%)
- Cloud cover (%)
- 8 substrate classes
(modified Wentworth scale)
- Water temperature(°C)
- Water transparency, visibility (m)

Additional site information:

- Number of shores within site
- Surface sampled (m²)
- Wetted stream width (m)



Marsh-McBirney flow meter

Electrofishing variables:

Shocking seconds (s), Voltage(V), Power (W)

Fish Results

	Electrofishing	Visual Sampling
Average densities (fish/ 100m²)	13	19
(for 161 sites combined)		
Species Richness	34 (35)	30 (35)
Number of species by size class observed		
	(0-5 cm) 25 (26)	(0-5 cm) 25 (26)
	(5-15 cm) 33 (33)	(5-15 cm) 26 (33)
	(15+ cm) 13 (14)	(15+ cm) 7 (14)

Correlation (N=161) $r=0.20$ $p<0.05$

Species Absent

Electrofishing survey

- Black spotted stickleback (*Gasterosteus wheatlandi*)
- Rainbow trout (+ 15cm) (*Oncorhynchus mykiss*)



Visual survey

- American brook lamprey (*Lampetra appendix*)
- American eels (*Anguilla rostrata*)



Data preparation

Densities (#/m ²)	Sp. A SC. 1	Sp. M SC. 1	...	Sp. Z SC. n
Site 1	0	0.003	...	0.007
...	...	...	...	...
Site161	0.023	0.010	...	0.151

Average % (E-V)/(E+V) *100	Sp. A SC. 1	Sp. M SC. 1	...	Sp. Z SC. n
Site 1	0	-95.83	...	25
...	...	...	...	...
Site161	100	-87.17	...	-50.01

E,V,A score (± 25%)	Sp. A SC. 1	Sp. M SC. 1	...	Sp. Z SC. n
Site 1	A	V	...	E
...	...	...	...	...
Site161	E	V	...	V



Data preparation

E,V,A score ($\pm 25\%$)	Sp. A SC. 1	Sp. M SC. 1	...	Sp. Z SC. n
Site 1	A	V	...	A
...	...	...	...	...
Site161	E	V	...	V

Rule by row:

If 100% E or A in row => **E**

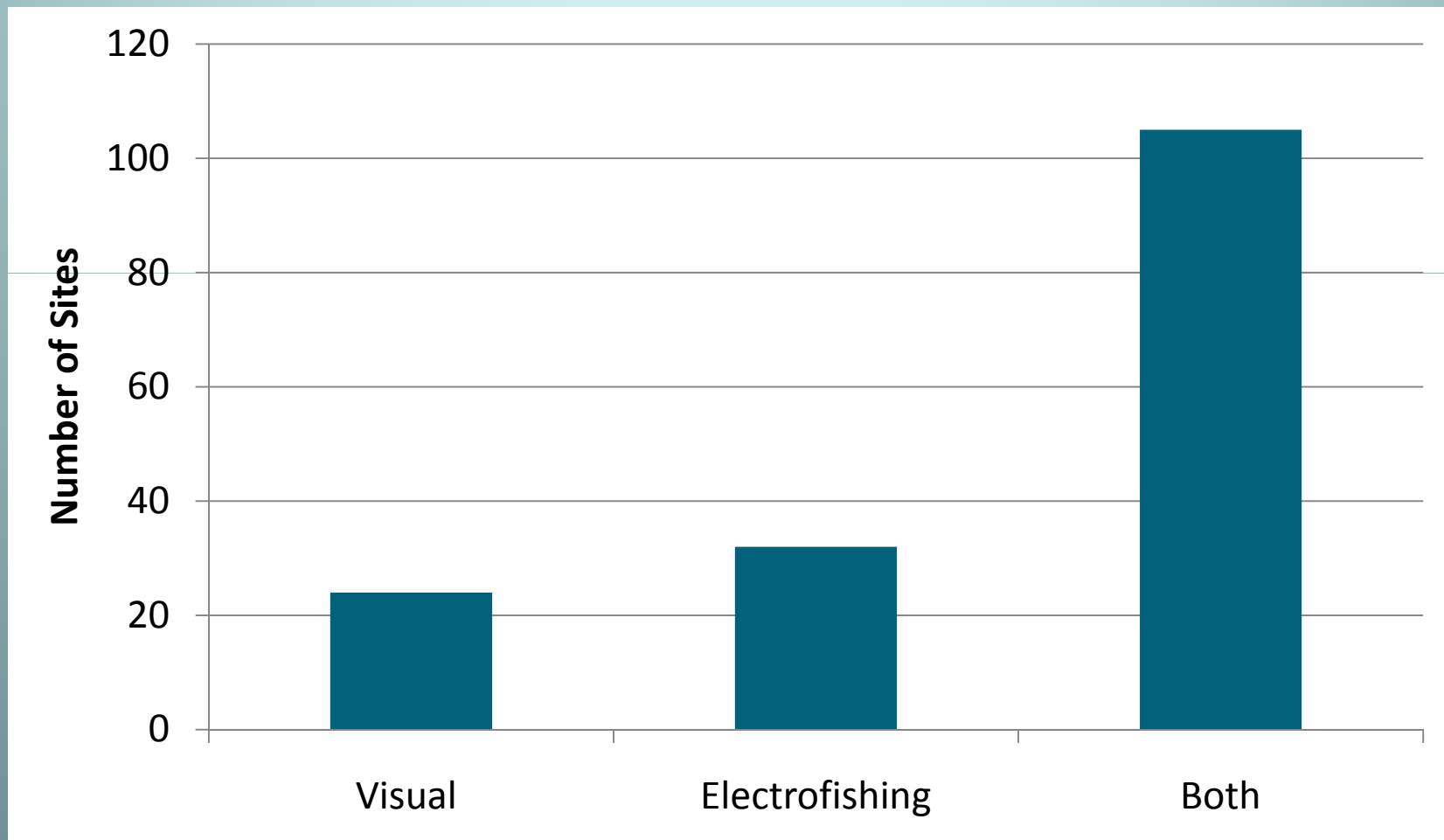
If 100% V or A in row=> **V**

If E and V or 100% A in row => **B**

Response variable E, V, B	Score
Site 1	V
...	...
Site161	A



Distribution of Groups N=161



Physical variables

Physical variables	range
Depth (cm)	18.2 – 85.7
Flow (m/s)	-0.0600 – 2.7495
Macrophyte (% cover)	0 – 67
Woody (% cover)	0 – 23
Canopy (% cover)	0 – 50
Water temperature (°C)	6.67 – 30
Transparency (m)	0.4 – 7.6
Cloud (% cover)	0 – 100
Wetted river width (m)	6 – 16
Shocking seconds (s)	246 – 1190
Voltage (V)	147 – 990
Power (W)	70 – 380
Visibility (cm)	125 – 1700

Substrate variables (% cover)	range
Silt	0 – 80
Sand	0 – 92
Gravel	0 – 89
Pebble	0 – 59
Cobble	0 – 82
Boulder	0 – 71.5
Metric boulder	0 – 19
Bedrock	0 – 100

Results of the model

Linear Discriminate Analysis (LDA)

First model with 3 groups (E,V,B)	Water temperature
Apparent correct classification rate	0.70
Cross validation rate	0.70
Jackknife correct classification rate	0.68

Final model:
EVB~ water temperature

Greater Visual sampling estimates => warmer water temperatures
Greater Electrofishing estimates => colder water temperatures

Discussion and Conclusions

- Similar fish densities observed with (E) and (V), but Species richness (E) > Species richness (V)
- Contributing Physical Variables to classifying our groups:
EVB ~ water temperature
- Water temperature is an indicator of fish community structure

Discussion cont'd

- Sampling approach efficacy
 - Observer sampling bias
 - Single pass electrofishing underestimate fish densities, but species richness is well represented (Meador et al. 2003)
- Complementary methods for estimating fish communities in the wild
- Use both methods in tandem

Future directions

- Additional statistical analysis:
incorporate fish classifications (Class and Families)
and behavioural groups
- Establish sampling guidelines that may be
applied within the academic to commercial
domains

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