Use of a River Side Flow-Through Holding System as Part of a Lake Sturgeon (*Acipenser fulvescens*) Larval Survival Study

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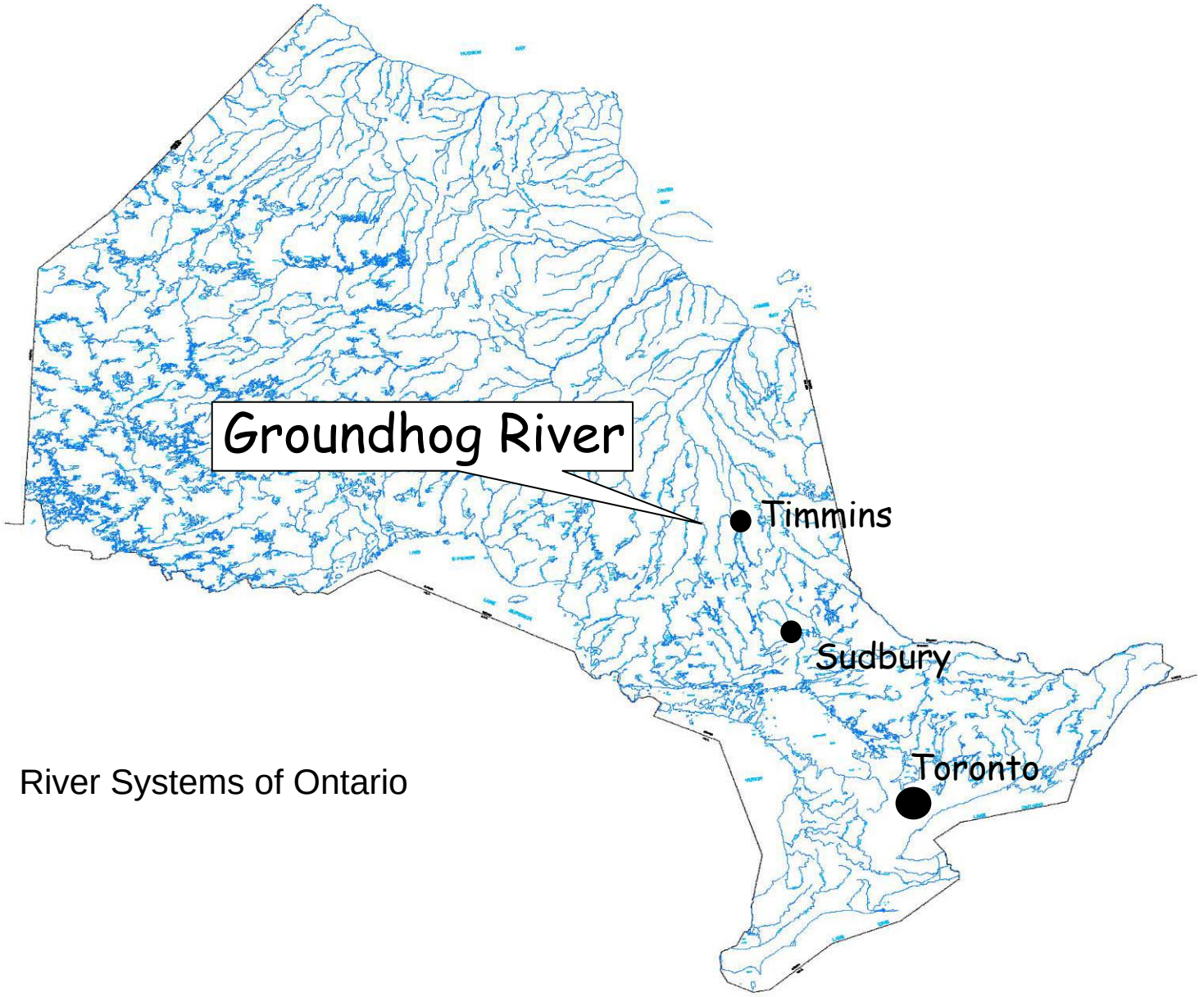
Montcalm Mine Lake Sturgeon Monitoring Program

- **Project Background**
- **River Side Flow-Through System**
- **Summary**

Project Background



River Systems of Ontario

Project Background

- Montcalm Mine (nickel/copper) is 85 km northwest of Timmins, Ontario with an anticipated 7-10 yr operation life.
- No on-site processing of ore (extraction only) but a mine water treatment system is required.
- Certificate of Approval (C of A) issued by the Ontario Ministry of the Environment to convey treated mine water via a 15 km buried pipeline to the Groundhog River.
- Pipeline outfall (diffuser) located at Six Mile Rapids, in the vicinity of a known lake sturgeon spawning area.

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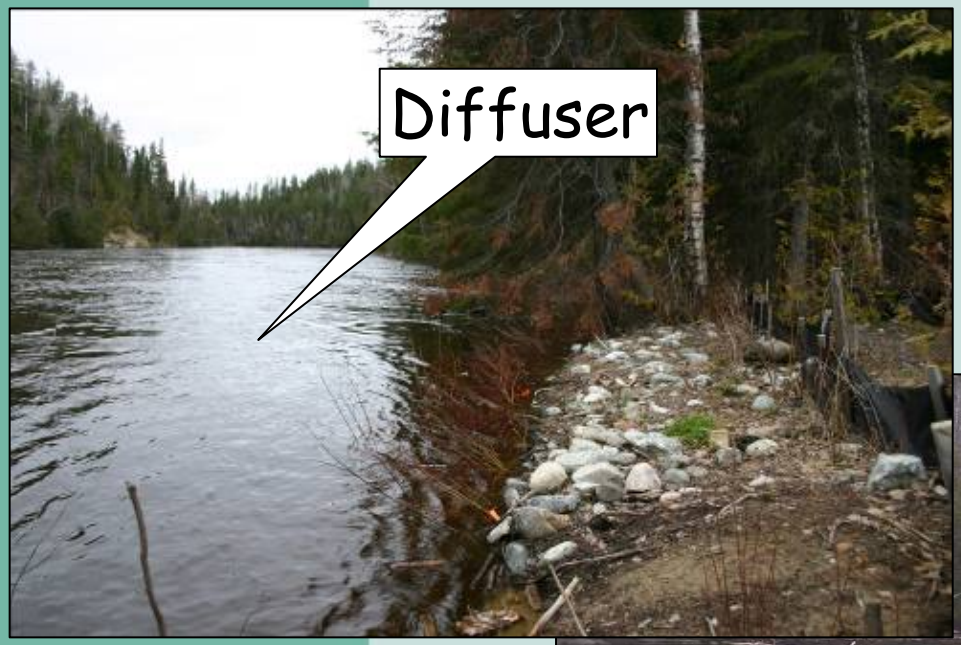
Background – Monitoring Program Trigger



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Background - Studies Completed to Date

- 2003 - Spawning census and larval drift assessment.
- 2004 - Year 1 of Detailed Study Design/Sturgeon Study (Baseline - No Effluent Discharge).
- 2005 -Year 2 of Detailed Study Design/Sturgeon Study (Baseline - Discharge suspended during spawning period).
- 2006 - Year 3 of Detailed Study Design/Sturgeon Study (Discharge flow during spawning period).

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Background –Monitoring Program

Key Study Elements

- **Population Data and Descriptive Statistics**
  - Spawning Adult Census and Tagging
  - Genetics, Size, Sex and Age Data
  - Egg Number Index
- **Quantitative Effects Assessment**
  - Habitat Use Patterns of Spawning Lake Sturgeon
  - Egg/Larval Survival and Development Study

"Is treated mine water effluent affecting the quantity of eggs, hatch success, or the size, growth, or condition of larval lake sturgeon?"

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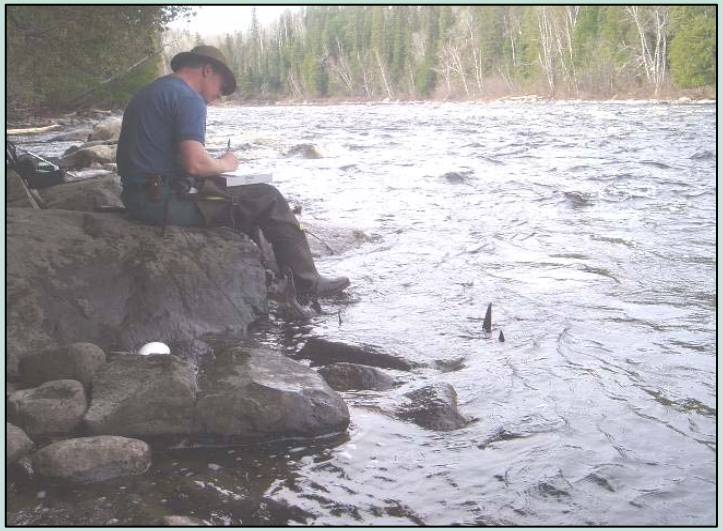
Local Study Area - Six Mile Rapids

Rocky Bend Rapids



Claim Block Rapids

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Reference Study Area – Camus Rapids/Upper Falls

Camus Rapids

Upper Falls

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Egg/Larval Survival and Development

- Past studies have confirmed that egg incubation is a viable tool for *in-situ* monitoring of lake sturgeon egg development to hatch.

- Accounts for synergistic effects of effluent and ambient conditions within RA mesohabitats.

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Highlights of Egg Development Stages

- Post fertilization (p.f.) with dark spot at apex of animal pole

- ~48 hrs p.f., late blastula, early gastrulation

- ~72 hrs p.f., early neuralation

- ~96 hrs p.f., protrusion above yolk sac surface

- ~144 hrs p.f., pre-hatch

- ~168 hrs p.f., newly hatched larva

- ~1 week post hatch

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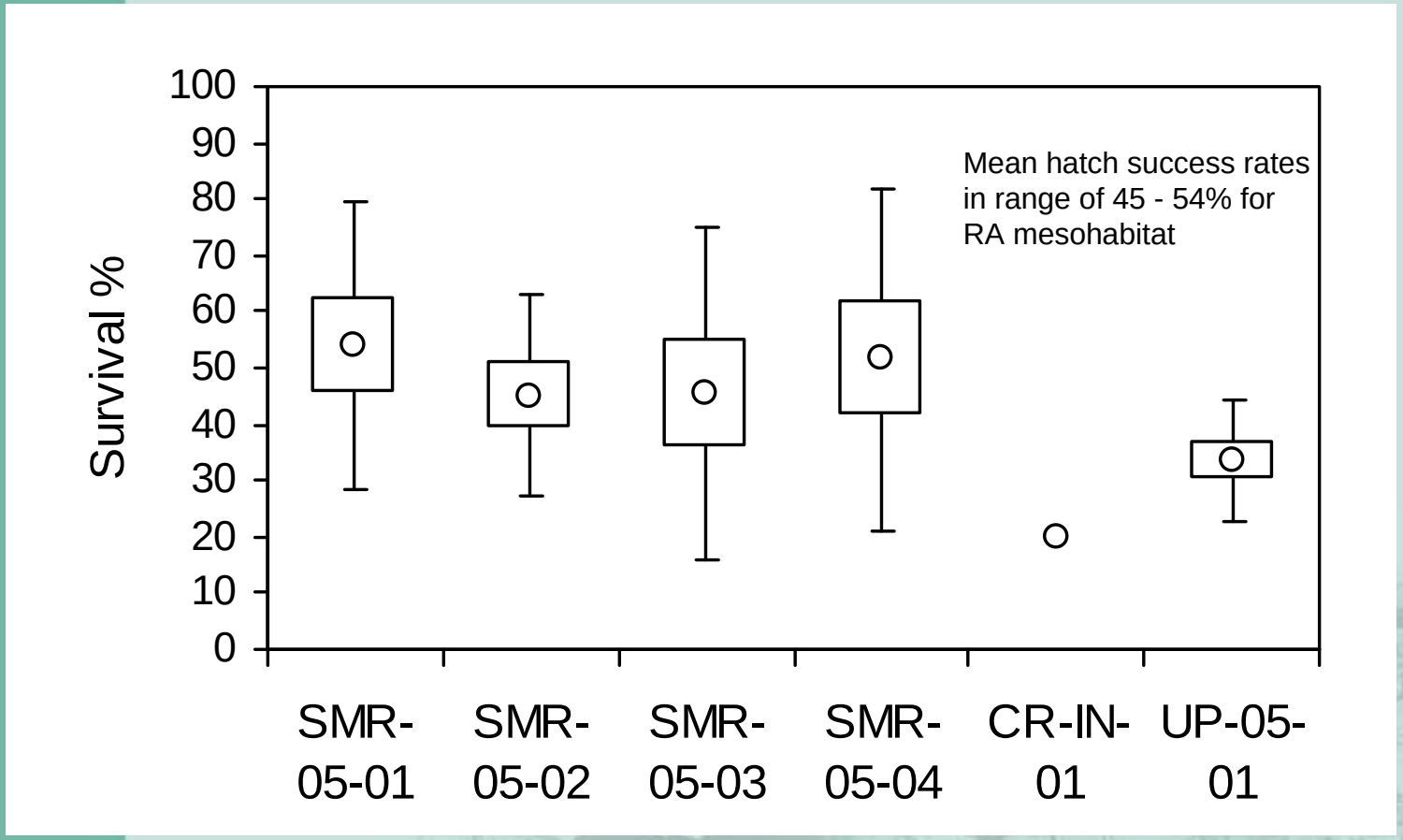
Egg/Larval Survival and Development

Mean Hatching Success for Eggs Incubated *In Situ* in Arrays at Six Mile Rapids, Camus Rapids and Upper Falls



- Open Circles = means
- Box plot range = +/- 95% confidence interval
- Error bar range = +/- S.D.
- n=5

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2006 – Egg/Larval Survival and Development

- During DSD review in 2006, additional egg incubation stations were proposed at the diffuser to account for mesohabitat variations between diffuser and SMR spawning sites (FL vs. RA).
- Request by Regulators to monitor post-hatch larvae survival at diffuser, *in-situ*.
- Purpose to evaluate the potential effluent exposure effects on post-hatch larvae prior to drift.

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2006 – Egg/Larval Survival and Development

The Problem:

- Potential for ambiguous results caused by the experimental design as opposed to effects from effluent on early stage survival resulting from:

  - Lack of literature studies relating to the field rearing of lake sturgeon larvae *in-situ*;
  - Uncertainty associated with survival after extended hold time in incubation cassettes post hatch;
  - Uncertainty associated with potential effects of extended hold time in an alternative container post hatch (*i.e.* differentiate between exposure effects); and
  - Uncertainty associated with effects of physical handling of larvae and transfer from incubator to holding container.

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2006 – Egg/Larval Survival and Development

The Solution:

- River-Side flow-through rearing system developed in conjunction with In-River larval holding containers to serve as a control.
- Allows a basis for evaluation of post-hatch survival effects attributed to exposure to effluent vs. apparatus.
- Key Features of River-Side System:
  - Easy to build in remote un-serviced location;
  - Continuous and controllable flow;
  - Large volume containers to allow free swimming;
  - Minimal handling of eggs/larvae; and
  - Cost effective.

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Methodology

- River-Side system built to operate in parallel with In-River incubators. Fertilized eggs would be incubated in McDonald jars with water flow transfer to holding tank upon hatch.
- All eggs incubated *in-situ* at diffuser reference and exposure location.
- Upon hatch larvae transferred from *in-situ* egg incubators into River-Side holding system or In-River holding system for 48 hours.

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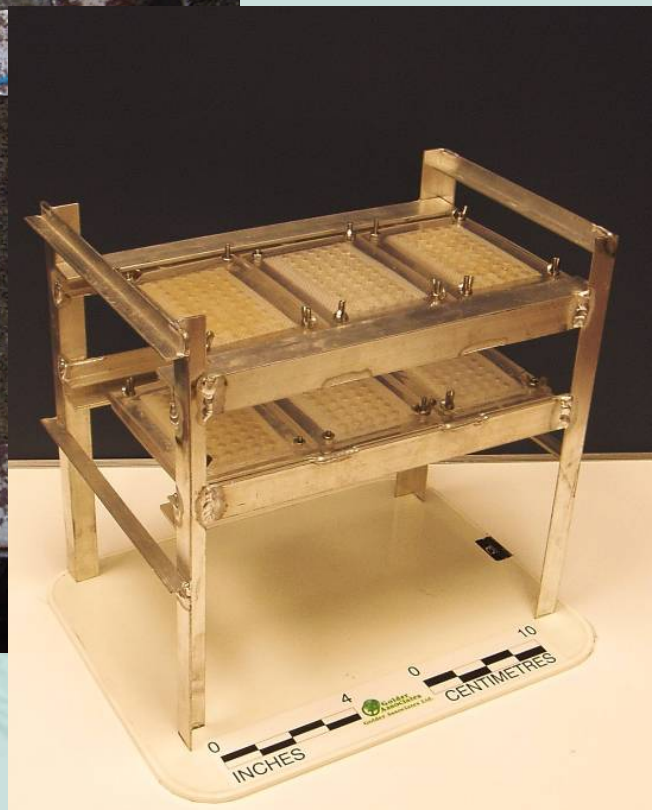
Egg Collection and Incubation



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In-River System

- In-River holding containers placed ~10 m u/s and d/s of the diffuser and suspended off the bottom using incubator array racks.
- Larvae transferred from incubators to holding containers.

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Deployment of In-River System

Diffuser

Flow Direction

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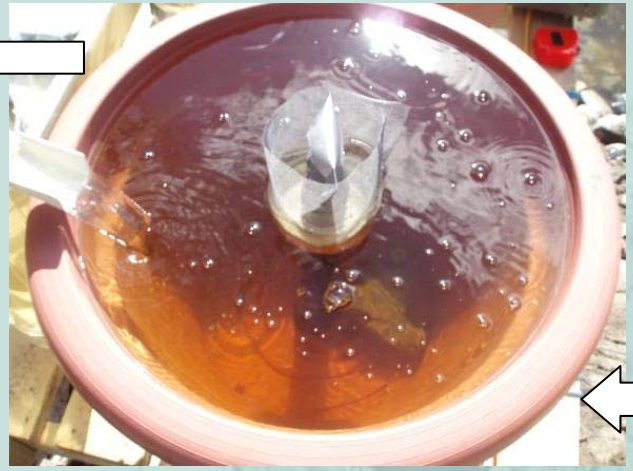
River-Side Components



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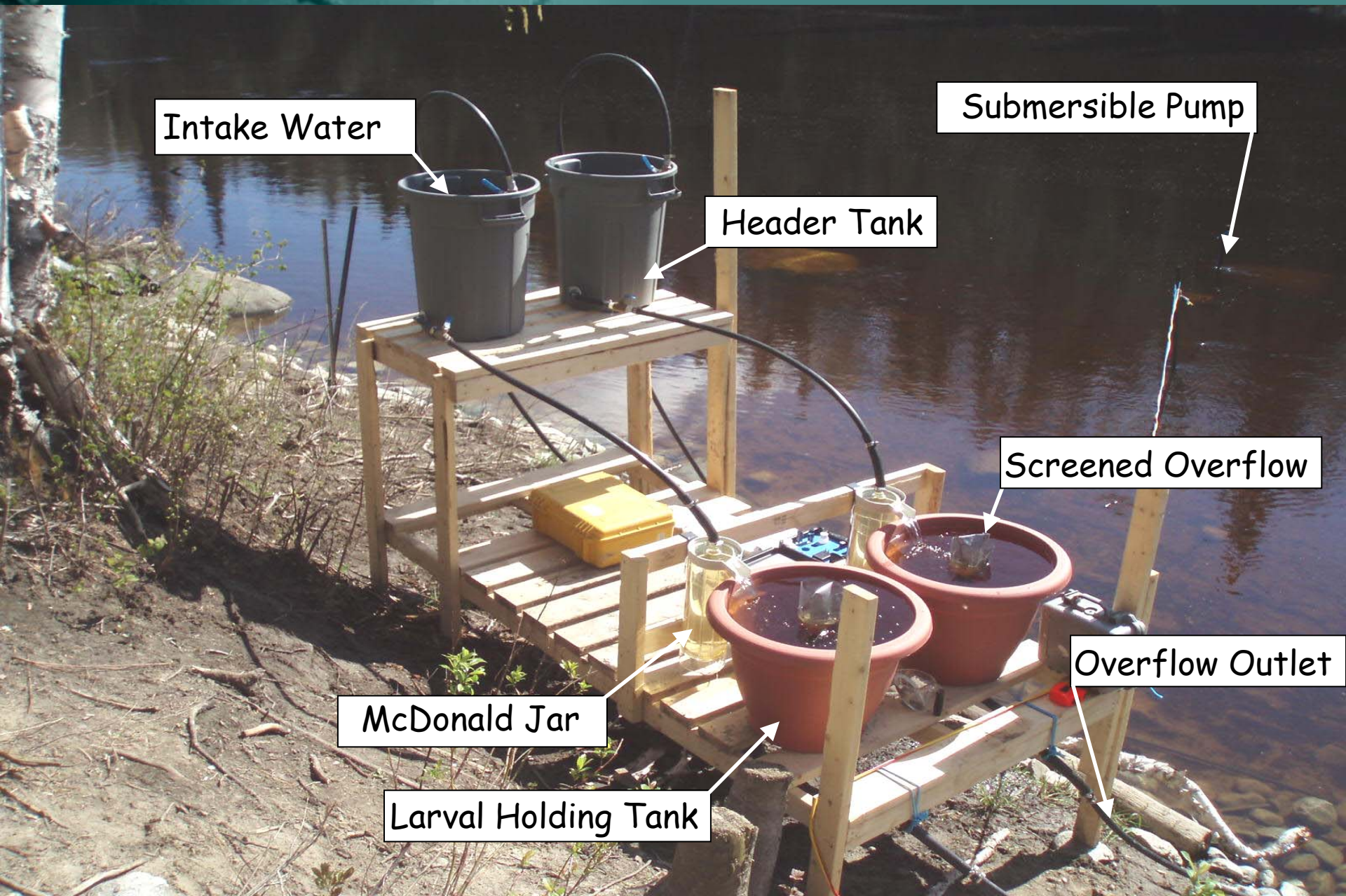
Assembled River-Side System



Results

- River-Side system:
  - Reference 95.5%
  - Exposure 93.8 %
- In-River system:
  - Reference 98.9 %
  - Exposure 97.3 %

Set Up		Number of Larvae After 48 hrs		
Location	Initial Number Larvae (0 hrs)	Number Dead	Number Escaped	Live Number After 48 hrs
In-River Reference	155	1	58	96
River-Side Reference	155	4	70	81
In-River Exposure	94	2	22	70
River-Side Exposure	94	6	4	84

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Summary

- System was an effective control for rearing purposes.
- Facilitated close monitoring of larvae through out the holding period.
- Successful in illustrating effectiveness of *in-situ* holding of larvae with out major modifications to the program or operations costs.
- Some bugs to work out in terms of escapement. Similar problems noted in other rearing studies (Allen *et al.*, 2006).
- “Low Tech” but effective technique for performing an egg/larval survival study.
- Built using “off the shelf” equipment and parts commonly available. Total costs to construct <$2K (CDN).

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and our mentor.....

Questions ?