

Mesocosms to Advance Control of Aquatic Invasive Species

J. Davies

ICAIS April 11, 2016

Mesocosms

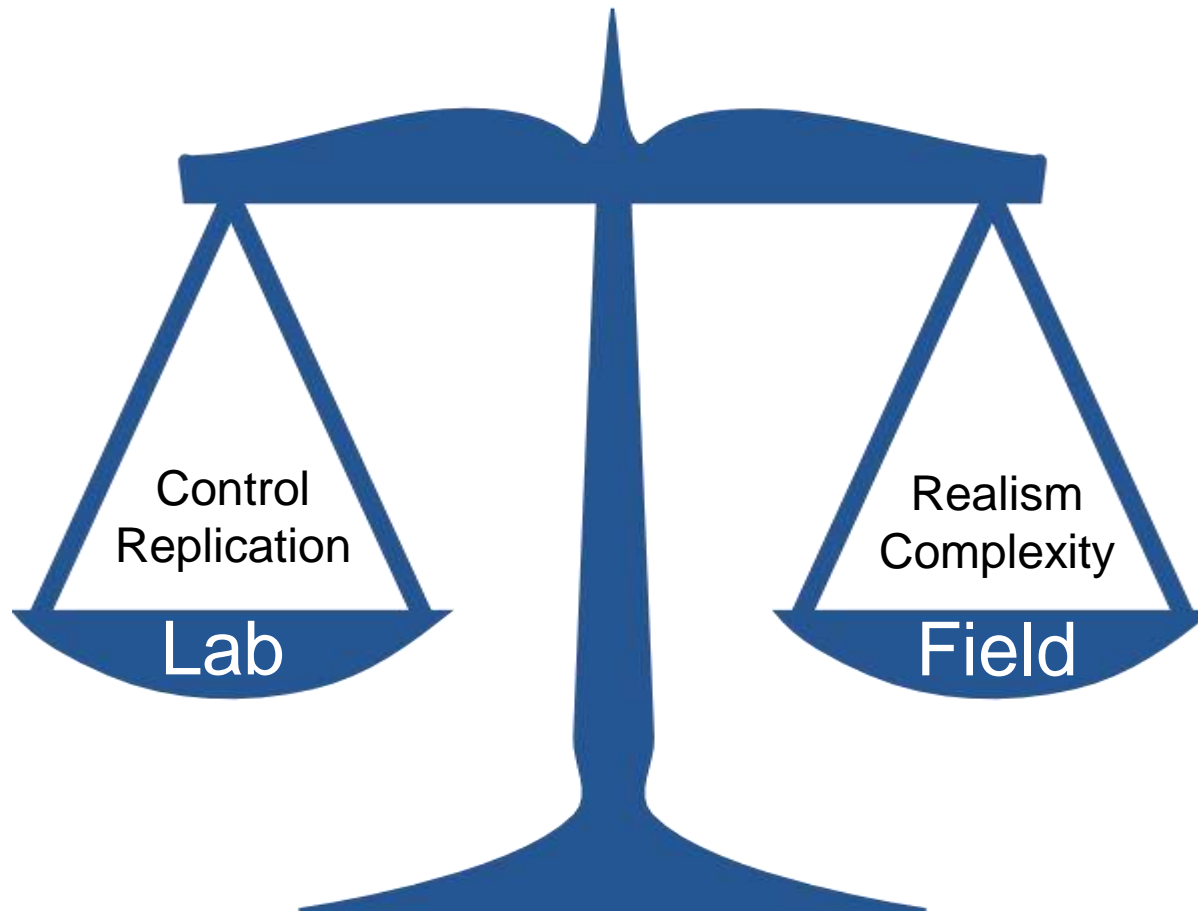


Image courtesy of K. Solomon



- Simplified and replicated experimental models of natural ecosystems
 - Structural and functional elements similar to those of natural systems
 - Should not be considered 'miniaturized' versions of real world ecosystems
- Allow experimentation at community / population levels
 - Sufficient complexity to allow observation of unexpected or emergent phenomena

Balance lab and field

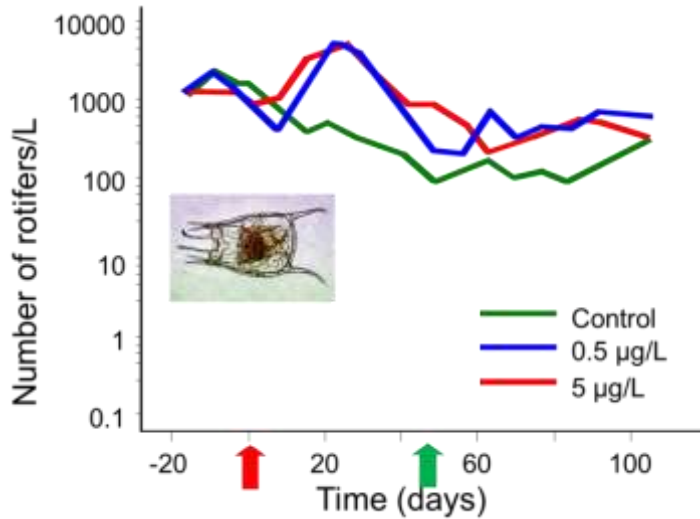
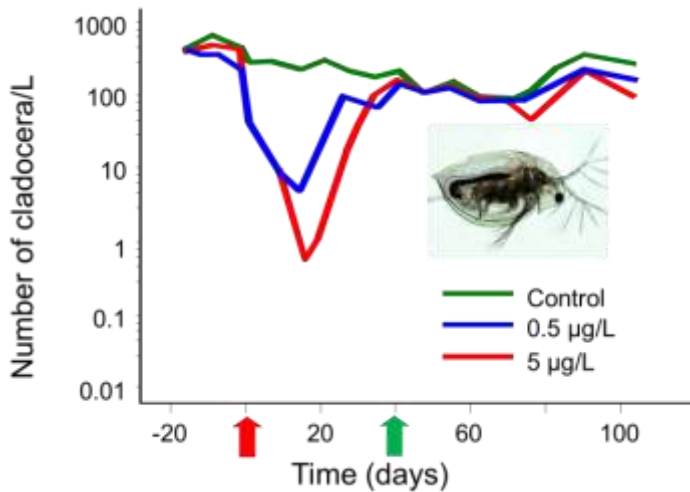


Mesocosms balance the control and replication of lab studies with the realism and complexity of field studies

Application to AIS control

- Efficacy and adverse effects
 - How well does 'the agent' work? What are the side effects?
- Regulation
 - Registration of new agent, new use of registered agent
- R&D
 - New agents, formulations, combinations, bio-control agents, physical control techniques
- Education
 - Species identification, application/deployment training

Adverse effects



Kaushik et al. 1985

- What off-target effects can you expect?
- Does not necessarily require inclusion of AIS
- Can explore dose-response relationships or compare agents
- Effects following exposure
 - Structural – What is affected?
 - Functional – How important is the effect?
 - Fate – where does ‘the stuff’ go?
- May need to contain agent

Potential Data

Phyto- and zooplankton

- Abundance and community composition
- Periphyton
 - Chlorophyll a
 - Phaeophytin

Vascular plants

- Height
- Biomass
- Phenology
- Lesions
- Adventitious community

Macroinvertebrates

- Abundance and community composition
 - Nektonic
 - Emerging
 - Benthic

Vertebrates (amphibian larvae, small fish)

- Abundance/survival
- Growth
- Development (tadpoles)
- Pathology

Functional

- Community metabolism
- Decomposition
- Production
 - Primary
 - Secondary

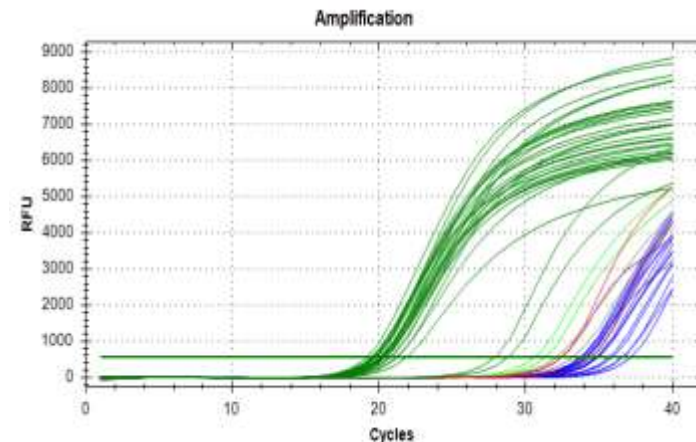
Water quality

- Temperature
- pH
- Conductivity
- Dissolved solids
- Suspended solids
- Organic carbon
- Chlorophyll a
- Turbidity
- Total nitrogen/NO₂/NO₃
- Alkalinity
- Acid extractables
- High resolution mass spec.
- Gases (CH₄, H₂S, etc.)
- ORP



Efficacy

- How well does the agent work?
- Requires incorporation of AIS – potential risk of escape
- Expose population of AIS to agent under realistic conditions
 - Dose response
 - Comparison of agents
- Studies combining efficacy with adverse effects possible
- Can also test/validate the abilities of detection methods (e.g. eDNA)



Risk of incorporating AIS

- Work with AIS that are not already present in the region?
 - If no – How will you know what to expect from an agent in your jurisdiction?
 - Lab studies and field studies may not correlate with real-world conditions in your area – water chemistry, dO_2 , temperature, etc.
 - If yes – How will you prevent spread of the organism?
 - Containment – prevent escape by wind, water, wildlife, workers



AITF Vegreville

Mailing Address:
PO Bag 4000
Vegreville, Alberta
Canada T9C 1T4

Street Address:
Hwy 16A & 75 St
Vegreville, Alberta
Tel (780) 632-8211
Fax (780) 632-8385

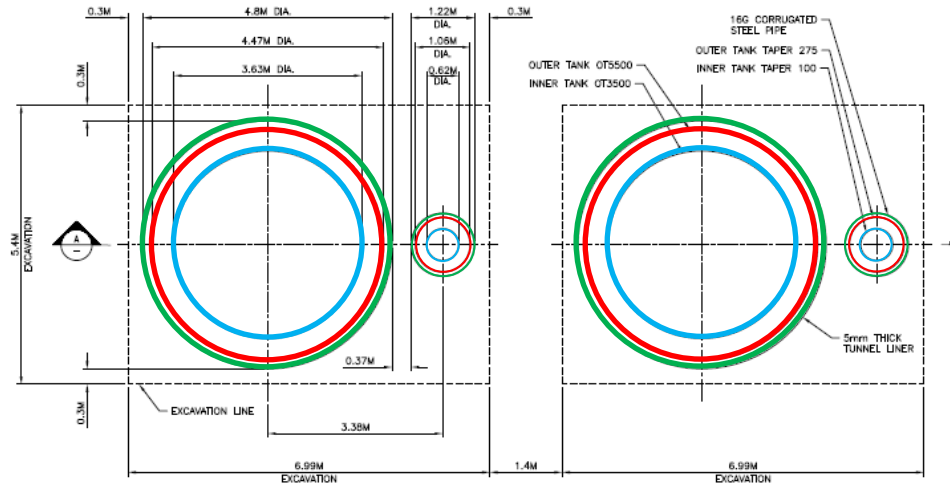
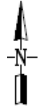
AITF Vegreville



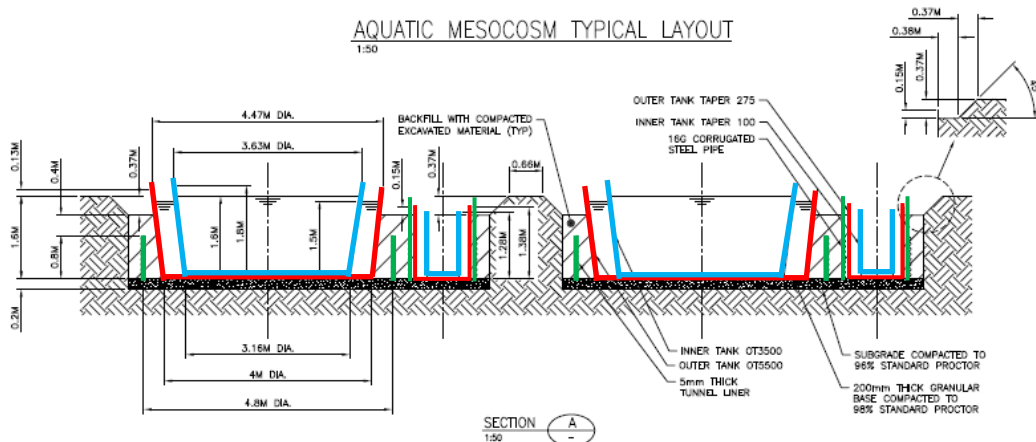
- Edmonton International Airport to Alberta Innovates Technology Futures - Vegreville is approximately 128 km (79 miles)
- Lloydminster to Alberta Innovates Technology Futures - Vegreville is approximately 150 km (93 miles)



Individual mesocosms



AQUATIC MESOCOSM TYPICAL LAYOUT
1:50



Support structures

Item	Purpose	Structure
Wastewater storage tanks	Temporary storage <ul style="list-style-type: none"> • Water from overflow tanks • Water drained from mesocosms 	5 x 25m ³ LLDPE upright tank within lined containment berm
Potable water storage tanks	Aged potable water to offset evaporative losses	2 x 25m ³ LLDPE upright tanks – no berm
Supply pond - shallow	Emergent veg.	Membrane lined depression - 10m x 14m x 0.5m
Supply ponds - deep	<ul style="list-style-type: none"> • Rooted and free-floating submerged veg. • Conditioned sediment 	4 x 15m ³ LLDPE open top tank (simplified mesocosm)



Questions?

Jim Davies

jim.davies@albertainnovates.ca

780-632-8278