Biological control of the invasive macrophyte Eurasian watermilfoil with the native milfoil weevil: Lake-wide population estimation

Tom Alwin
Outline

• Introduction
  – Definitions
  – Species of interest
  – Need for study
• Sampling a tiny aquatic insect…
• Conclusions & implications
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Invasive species

“A widespread non-indigenous species that has negative impacts on human health, an ecosystem or the services it provides is considered an invasive species.”

Garlic Mustard

Sea lamprey
Biological Control

“The use of living organisms to suppress the population of a specific pest organism, making it less abundant or less damaging than it would otherwise be.”

Eilenberg et al. 2001
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• Chapter 1
  – Sampling a tiny aquatic insect…

• Conclusions & implications
Myriophyllum spicatum = E. milfoil
E. milfoil

Non-indigenous & widespread

– Eurasia...
– Late 1940s
– Eastern US
E. milfoil

Spread

– Within water bodies
  • Seeds
  • Stolons
  • Fragmentation

– Between water bodies
  • Boats and trailers
  • Waterfowl
  • Rivers and channels
E. milfoil

Negative impacts
– Ecological
E. milfoil

Negative impacts

– Services
  • Boating & fishing
  • Swimming
  • Aesthetic value
E. milfoil

Prevention & Education
– Nutrient reduction
E. milfoil

Control
- Benthic barriers
- Harvesting
E. milfoil

Control – Chemical

Before Treatment

After Treatment

Photo courtesy of Marine Biochemists
E. milfoil

Control – Biological
Euhrychiopsis lecontei = milfoil weevil

Discovery
– Natural declines in VT
Milfoil weevil

Native range

(Creed 1998)
Milfoil weevil

Life-cycle & damage
Milfoil weevil

E. milfoil suppression
- Tank studies – effective
- Field enclosures – effective
- Lake-wide declines – few long-term studies
- Commercial stocking – variable
Milfoil weevil

Need for study

– Lake-wide scale
  • Improve understanding and efficacy
– Stakeholder perception and interest
Previous studies/monitoring

- Limited spatial scale
  - 1 – 4 beds

- Few stems per lake
  - Range: 60 – 780
  - Common: 120
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Determining appropriate sample and quadrat size to assess lake-wide *Euhrychiopsis lecontei* density

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Tom Alwin, Matt Fox and Kendra Cheruvelil
Goal

• Develop lake-wide sample program
  – Accurate and efficient
  – Science and management

Objectives

• Optimal quadrat size
• Power: Minimum # of samples to estimate N
Study Lake

Lake Ovid

- High densities
  - Both species
- Close to MSU
Methods & Results

E. milfoil pre-sampling
  – Point intercept
    • n = 480
    • cover = 39.5%
  – Map E. milfoil beds
    • Random sample locations
Methods & Results

Quadrat size
- Composite quadrat
- n = 15
- ANOVA
- No difference
Methods & Results

# of samples
- 0.10 m$^2$
  - $n = 118$
  - Time per sample
- Weevil lab processing
Methods & Results

# of samples
– Power analysis

\[ N = \left(\frac{t_{\alpha/2}}{d}\right)^2 \left(\frac{s^2}{m^2}\right) \]

\( N \) = number of samples
\( t_{\alpha/2} \) = \( t \) value for a probability
\( d \) = Accuracy
\( s^2 \) = sample variance
\( m \) = sample mean
## Methods & Results

$\#\ of\ samples\ (N) = (t_{\alpha/2/d})^2(s^2/m^2)$

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95% confidence interval ($\alpha=0.05$)

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90% confidence interval ($\alpha=0.10$)
# Methods & Results

Cost

– Measured in hours

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Hindsight

• Quadrat size
  – More composite quadrats
  – Differences in milfoil density

• # of samples
  – Replicate study
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Implications

• Previous sampling
  – Inaccurate estimation of lake-wide N

• Future scientific study
  – lake-wide scale
  – Need to address power when sampling

• Management/monitoring
  – Likely cost prohibitive
  – Monitor E. milfoil
Overall conclusions

• Power, power, power
• Important to study weevils
  – Advance knowledge plant/herbivore
  – Management applications - biocontrol
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Questions?