EVALUATION OF GROWTH AND SURVIVAL OF DIFFERENT GENETIC STOCKS OF MUSKELLUNGE

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PRESENTATION OVERVIEW

• Background and Study Design

• Results of “Project Green Gene”
  – Job 1: Growth Comparison
  – Job 2: Survival Comparisons
  – Job 3: Muskellunge Diet and Lake Impacts
Muskellunge Stocking

- Muskellunge are a popular predatory sportfish that reach great size.
- In Illinois all Muskellunge (Musky) are likely a product of stocking.
- Stocking source is an important consideration to maximize size and survival.
- Several studies have compared populations within a stock (Younk and Strand 1992, Margenau and Hanson 1997).
Figure 7. Unweighted pair group cluster analysis of unbiased genetic distance values (Nei 1978) based on all loci surveyed.

Koppelman and Phillipp 1986
# MUSKELLUNGE SOURCE POPULATIONS

<table>
<thead>
<tr>
<th>Population (abbreviation)</th>
<th>Source Water</th>
<th>Drainage (stock)</th>
<th>Latitude (north)</th>
<th>Mean Annual Air Temp (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky (KY)</td>
<td>Cave Run Lake</td>
<td>Ohio River</td>
<td>37° 35'</td>
<td>55.2</td>
</tr>
<tr>
<td>Ohio (OH)</td>
<td>Clear Fork Lake</td>
<td>Ohio River</td>
<td>39° 30'</td>
<td>49.6</td>
</tr>
<tr>
<td>Pennsylvania (PA)</td>
<td>Pymatuning Reservoir</td>
<td>Ohio River</td>
<td>41° 30'</td>
<td>47.4</td>
</tr>
<tr>
<td>New York (NY)</td>
<td>Lake Chautauqua</td>
<td>Ohio River</td>
<td>42° 07'</td>
<td>49.4</td>
</tr>
<tr>
<td>Wisconsin (WI)</td>
<td>Minocqua Chain</td>
<td>Upper Miss. River</td>
<td>45° 30'</td>
<td>39.3</td>
</tr>
<tr>
<td>Minnesota (MN)</td>
<td>Leech Lake</td>
<td>Upper Miss. River</td>
<td>46° 35'</td>
<td>39.9</td>
</tr>
<tr>
<td>Illinois (IL)</td>
<td>North Spring Lake</td>
<td>*</td>
<td>40° 40'</td>
<td>50.7</td>
</tr>
</tbody>
</table>
THEORETICAL PREDICTIONS

**Thermal Adaptation**
- Growth rates are adapted to the local thermal regime.
- Physiological processes tuned to this regime.
- Supported by studies of inverts, crustaceans and fish (including walleye) (Galarowicz and Wahl 2003)

**Countergradient Variation**
- High growth rates selected for by short growing season.
- Higher energetic reserves lead to higher overwinter survival.
- Supported by numerous studies in fish. (Conover and Present 1990, Shulze et al. 1996 and others)
POND EXPERIMENT

- Initiated in the fall, three trials
- Drained subsequent spring and fall
- Forage provided

<table>
<thead>
<tr>
<th>POND #1</th>
<th>POND #2</th>
<th>POND #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MISS = 33</td>
<td>MISS = 33</td>
<td>MISS = 33</td>
</tr>
<tr>
<td>OH = 33</td>
<td>OH = 33</td>
<td>OH = 33</td>
</tr>
<tr>
<td>IL = 33</td>
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</tr>
</tbody>
</table>

Illinois Natural History Survey - Sam Parr Biological Station
RESERVOIR EXPERIMENT

- **Pierce Lake**
  - Mean Annual Air Temperature = 48 F
  - 147 Acres

- **Mingo Lake**
  - Mean Annual Air Temperature = 52 F
  - 176 Acres

- **Sam Dale Lake**
  - Mean Annual Air Temperature = 55 F
  - 194 Acres
GROWTH COMPARISON (JOB 1)
POND EXPERIMENT

One Year After Stocking

Trial

Rate (g/g/g)

ANOVA, p ≤ 0.05
MINGO MALES

![Graph showing mean length growth over age for Illinois and Ohio male Mingo populations.](chart.png)
MINGO FEMALES

![Graph showing growth pattern of Mingo females.](image)
PIERCE MALES

![Graph showing the relationship between age and length for males in Illinois and Ohio.](image)
PIERCE FEMALES

![Graph showing age vs. mean length for Pierce females in Illinois and Ohio.](image)
SURVIVAL (JOB 2)
POND EXPERIMENT

One Year After Stocking

Trial

Logistic ANOVA, p ≤ 0.05
RESERVOIR EXPERIMENT - Juvenile Survival

Mingo Lake

Spring

Pierce Lake

Spring

Fall

Fall

ANOVA, p ≤ 0.05

Stocking year class
ADULT SURVIVAL

• Trap Net Data (Mingo/Pierce)
  – Spring
  – 2007-2009

• Electrofishing Data (Sam Dale)
  – Spring/Fall 2009
SPRING 2009 NETTING

• Mingo Lake
  – 63 fish, 84 net nights = 0.83 fish/net/night
  – 52 IL, 11 OH, 0 MISS

• Pierce Lake
  – 74 fish, 44 net nights = 1.7 fish/net/night
  – 53 IL, 21 OH, 0 MISS
MINGO LAKE SURVIVAL TO ADULTHOOD (Age-3)

ANOVA, p ≤ 0.05
PIERCE LAKE SURVIVAL TO ADULTHOOD

ANOVA, $p \leq 0.05$
Sam Dale Lake - Age 1+
ADULT ANNUAL SURVIVAL
LAKE MINGO

![Graph showing survival rates for two time periods, 2007-2008 and 2008-2009, for two stocks, St. Stock and Ohio Stock. The graph includes error bars indicating variability in survival rates.](image)
GROWTH AND SURVIVAL SUMMARY

• GROWTH
  – POND
    • OH>IL=MISS
  – RESERVOIR
    • Mingo OH=IL MISS?
    • Pierce IL>OH MISS?
    • Sam Dale MISS>OH=IL (tentatively)

• SURVIVAL
  – POND
    OH=IL>MISS
  – RESERVOIR
    OH=IL>MISS
MUSKIE IMPACTS (JOB 3)

• Groups of concerned anglers
  – “MUSKIE ARE EATING ALL THE BASS!”
  – “I KNOW THEY EAT THE CRAPPIE!”

• Limited prior research
  – Single lakes
  – Anecdotal evidence
    • No controls

Number of Illinois Lakes Stocked with Muskellunge Since 1988

The graph shows the number of lakes stocked with Muskellunge in Illinois from 1985 to 2010. The number of lakes stocked increased from around 5 in 1985 to around 40 in 2010, with some fluctuations in the middle years.
EFFECTS OF MUSKIE STOCKING

• Long term community data
  – Muskie Introductions
    • Lake Mingo
    • Ridge Lake
    • FAS Lakes
  – Control lakes
• Look for changes in stocked lakes
  – Largemouth bass, panfish
    – CPUE, Size
• Look at diet composition
LARGEMOUTH BASS RESPONSE LAKE MINGO

![Graph showing response to mingo before and after stocking.](image)
LARGEMOUTH BASS RESPONSE RIDGE LAKE

![Bar graph showing response of largemouth bass between Lincoln Trail (Control) and Ridge (Stocked) during different time periods.](image-url)
FAS (Fishery Analysis System)

• Stocked lakes
  – Mill Creek
  – Shovel Lake (Banner)
  – Staunton city

• Control lakes
  – Bloomington
  – Leaquana

• 8 years
  – 4 before
  – 4 after

• Largemouth bass
LARGEMOUTH BASS CPUE

![Chart showing comparison between Reference Lakes and Stocked Lakes before and after a time period.](Image)
LARGEMOUTH BASS SIZE

![Bar chart showing the comparison of largemouth bass size before and after in reference lakes and stocked lakes.](chart.png)
DIET COLLECTION

- Collecting diet data from age 0+ fish
- 5 lakes with diverse prey assemblages
- Nonlethal gastric lavage technique
LAKE MINGO

![Graph showing prey species distribution in Lake Mingo.](image)
PIERCE LAKE

![Graph showing the proportion of wet weight and frequency of occurrence for different fish species in Pierce Lake.]

- Proportion of Wet Weight
- Frequency of Occurrence

Species included in the graph:
- Bluegill
- Brook Silverside
- Gizzard Shad
- Yellow Perch

*Graph Credit: Source of data and graph implementation details.*
RIDGE LAKE

![Graph showing Proportion of Wet Weight and Frequency of Occurrence for Bluegill and Largemouth Bass.](image)
MUSKIE IMPACTS SUMMARY

- **Fishery Effects**
  - No impacts on LMB
    - Mingo, Ridge, Mill Creek, Shovel, Staunton City
  - No impacts on BLG
    - Mingo, Ridge
  - Further Analysis Needed

- **Diet Composition**
  - Shad dominate when available > 85%
  - Bluegill dominate when shad unavailable
  - Very little predation on game species
    - LMB
    - BLG
    - YEP
    - BK/WH CRAPPIE
Future Directions

• Chronic thermal maxima between stocks

• Physiological response to heat shock

• Stock-specific bioenergetic model
QUESTIONS?