Stock Characteristics of Lake Whitefish in Lake Michigan

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Lake Whitefish in Lake Michigan

• Native
• Benthivorous fish
• Important for energy transfer in Great Lakes
• Socioeconomically important to Great Lakes Basin
• Highly mobile
• Natal homing
Commercial Fishery

- Most lucrative commercial fishery on Lake Michigan
- Dockside value of $2.5-$5.5 million
- Growing roe market (caviar)
- Current value $160 per pound
Historical Harvest

** Data compiled from Great Lakes Fishery Commission database
Management

- Inter-jurisdictional fishery
  - WDNR
  - MDNR
  - CORA
- Quotas based on statistical catch-at-age models
- 13 management zones
Management

• Issues
  • Multiple agencies
  • Length of season
  • Recreational fishery
  • Superficial boundaries

• Ebener (1985) tagging study
  • Potential for a mixed-stock fishery
Stock Concept

- Stock is the basic unit of a fishery or a “management unit”
- Component of a fishery susceptible to harvest
- Useful when:
  - Describing population dynamics
  - Setting quotas or harvest regulations
  - Maintaining sustainability of a fishery
Genetic Stock Concept

Larkin (1972): “...a group of organisms, sharing a gene pool, that is sufficiently discrete and nominally identifiable that warrants management as such.”
Genetic Stock Concept

• To conserve genetic diversity through time
  • Local adaptations
  • Adaptability
  • Resilience
  • Sustainability
2001 LWF task recognized knowledge was insufficient to discriminate or manage LWF on a stock specific basis.

Recommended combining genetics and biological characteristics to rectify this issue.
Recent Research

- 6 genetically distinct stocks
- Based on variation at 11 microsatellite loci
- Next step mixed-stock analysis
Recent Research

- Mixed-stock analysis
- Closest stock consistently < 60% of harvest
- Composition of geographical stocks dynamic throughout commercial season and year to year
Recent Research

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Objectives

1. Determine if the accuracy of stock identification based on capture location varies by sampling period

2. Determine if biological differences exist among stocks
Sample sites

Wisconsin
- WI-2

Michigan
- WFM-02
- WFM-03
- WFM-05
- WFM-07
- WFM-08
Methods

- 1,200 lake whitefish total
- October 1-15 (early)
- October 16-31 (late)
- Target of 100 fish per genetic stock per year
- 1:1 sex ratio
Data collection

• Weight
• Total length
• Sagittal otoliths
• Pelvic fin clip
• Gonad mass
• Gonad condition
Methods
Stock Assignment

• 12 microsatellite loci
• ONCOR software
• Individual assignment to stock
Microsatellite?

- Non coding region of DNA
- Repeating patterns of base pairs
- No known biological function
- Surrogates for genetic diversity
Methods

Biological Characteristics

- Age structure
- Back-calculated mean total lengths-at-age
- Length frequency
- Weight-length relationships
- Growth
- Fecundity
Methods
Age Structure

- Age estimation using otoliths
- Image Pro® for otolith imaging

Male LWF
TL= 486 mm
10/4/2012
Naubinway, MI
What is an Otolith?

Male LWF
TL = 486
Naubinway, MI
Methods

Fecundity

• Gravimetric method
  • Weigh and enumerate multiple subsamples of 50-100 eggs
Preliminary Results
Objectives

1. Determine if the accuracy of stock identification based on capture location varies by sampling period

2. Determine if biological differences exist among stocks
Results
Stock Assignment

N=100

% Likelihood

Individual

[SOU]  [NOE]
Results
Stock Assignment

% Likelihood

Individual

SOU

NOE

SOU

NOE
Results
Stock Assignment

% Likelihood

Individual

N=50

NOR
NOE

N=50
Results
Stock Assignment

% Likelihood

Individual

NOR

NOE

NOR

NOE
Results
Stock Assignment

% Likelihood

Individual

NOR
NOE

NOR

NOE

NOR

NOE
Objectives

1. Determine if the accuracy of stock identification based on capture location varies by sampling period

2. Determine if biological differences exist among stocks
Results

Fecundity All Stocks

Slopes
$F = 0.18$
$df = 9, 183$
$P = 0.95$
## Results

Expected Fecundity for a 1,325 g Female LWF

<table>
<thead>
<tr>
<th>Stock</th>
<th>Expected Fecundity</th>
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<tr>
<td>Southern</td>
<td>24,241</td>
</tr>
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<td>Northeast</td>
<td>25,043</td>
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- The greatest difference among expected fecundities was 16%.
Results

Female Weight-Length Relationships

Slopes

\[ F = 2.11 \]
\[ df = 8, 186 \]
\[ P = 0.10 \]
### Results

**Expected Weights for a 525 mm Female LWF**

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- The greatest difference among expected weights was 12.5%
# Results

## Age Structure

<table>
<thead>
<tr>
<th>Stock</th>
<th>Mean Age</th>
<th>SD</th>
</tr>
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<tbody>
<tr>
<td>Southern</td>
<td>8.90</td>
<td>0.82</td>
</tr>
<tr>
<td>Northeast</td>
<td>7.05</td>
<td>0.67</td>
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Results
Age Structure

Frequency

Age
5 6 7 8 9 10 11 12

Southern
Northeast
Summary

• Stock assignment based on capture location is better at some sites than others
• No significant difference in stock-specific fecundity
• No significant difference in female W-L relationships
• Age structure shows potential differences
Acknowledgments

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• Erik Olsen (GTBNR)

All Commercial Fishermen
Questions