Current Status of Preyfish in Lake Michigan

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Introduction

• Lake Michigan ecosystem continues to change and suffer from degradation
• Invasives have exerted major influence
• Chlorophyll $a$, primary production have decreased
• Key native species gone or nearly gone
  – Diporeia sp., cisco, kiyi, emerald shiner
• Preyfish well below FCO
Preyfish – an Overview

- Important to economically/ecologically valuable fish
  - Chinook heavily reliant on alewife
  - Lake trout reliant on alewife, bloater, sculpins
  - Many species utilizing goby

- Important for food web
  - Conduit for energy/nutrients between benthic and pelagic zones
  - Link between zooplankton and piscivores
  - Can influence structure of zooplankton communities
Outline

• Introduction

• Survey methodology

• Temporal and spatial patterns in fish species
  – Species common to lakewide surveys
  – Benthic fish from bottom trawl

• Lakewide survey context

• Conclusions
<table>
<thead>
<tr>
<th></th>
<th>Bottom trawl survey</th>
<th>Acoustic/mid-water trawl</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time of day</strong></td>
<td>Day</td>
<td>Night</td>
</tr>
<tr>
<td><strong># trawls</strong></td>
<td>~69</td>
<td>~68</td>
</tr>
<tr>
<td><strong>Water column sampled</strong></td>
<td>Bottom ~1.4 m</td>
<td>From 1 m off bottom to ~2 m below the vessel</td>
</tr>
<tr>
<td><strong>Bathymetry sampled</strong></td>
<td>9-110 m</td>
<td>6-240 m</td>
</tr>
<tr>
<td><strong>Common species</strong></td>
<td>Alewife, Bloater, Rainbow Smelt</td>
<td></td>
</tr>
<tr>
<td><strong>Unique species</strong></td>
<td>Gobies, sculpins, perch, burbot</td>
<td>Cisco, emerald shiner</td>
</tr>
</tbody>
</table>
Acoustic Density of Alewife

- **Adult Alewife**
  - Biomass density (kg/ha)

- **YOY Alewife**
  - Numeric density (number/ha)
Bottom Trawl Density of Alewife

![Graphs showing the biomass and numeric density of adult and YOY alewife over the years from 1970 to 2015. The graphs display fluctuations in density with error bars indicating variability.]
YAO Alewife Distribution, 2016

Fish per hectare

Acoustic
- 0
- 1 - 426
- 427 - 1002
- 1003 - 1824
- 1825 - 3514

Bottom trawl
- 0
- 1 - 3
- 4 - 21
- 22
- 23 - 44
YOY Alewife Distribution, 2016

Fish per hectare
- Acoustic
  - 0 - 640
  - 641 - 1802
  - 1803 - 3754
  - 3755 - 6636
  - 6637 - 18680
- smllalenperha2
  - 0
  - 1 - 29
  - 30 - 52
  - 53 - 648
Change in YAO Alewife Distribution

2013 large alewife

2014 large alewife

2015 large alewife

2016 large alewife

fish/ha

0

> 0

0

0

> 0

Latitude

Longitude

Latitude

Longitude

Latitude

Longitude

Latitude

Longitude

Latitude

Longitude

Latitude

Longitude
Change in YAO Alewife Distribution

![Graph showing the distribution of YAO Alewife over different years with error bars indicating variability.](image-url)
Acoustic Density of Rainbow Smelt

**adult rainbow smelt**

**YOY rainbow smelt**
Bottom Trawl Density of Rainbow Smelt

a) Adult rainbow smelt

b) Age-0 rainbow smelt
Large Rainbow Smelt Distribution, 2016

Fish per hectare
- **Acoustic**
  - 0 - 151
  - 152 - 664
  - 665 - 1366
  - 1367 - 2287
  - 2288 - 3631
- **Bottom trawl**
  - 0
  - 1 - 11
  - 12 - 28
  - 29 - 68
  - 69 - 139
Small Rainbow Smelt Distribution, 2016

Fish per hectare

Acoustic
- 0 - 103
- 104 - 390
- 391 - 876
- 877 - 1407
- 1408 - 3054

Bottom trawl
- 0
- 1 - 11
- 12 - 28
- 29 - 68
- 69 - 139
Acoustic Density of Bloater

**Adult Bloater**

**YOY Bloater**
Bottom Trawl Density of Bloater

a) Adult bloater

b) Age-0 bloater
Large Bloater Distribution, 2016

Fish per hectare
- **Acoustic**
  - 0
  - 1 - 57
  - 58 - 135
  - 136 - 241
  - 242 - 442
- **Bottom trawl**
  - 0
  - 1 - 55
  - 56 - 209
  - 210 - 480
  - 481 - 1705
Bottom Trawl Density of Sculpins

**a) Deepwater sculpin**

**b) Slimy sculpin**
Density of Round Gobies

a) Round goby

b) Ninespine stickleback
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Are survey results always identical?

- No.
- Need both surveys to develop an adequate picture
- Both surveys are used in stock assessment modeling
Comparison of Acoustic and Bottom Trawl Biomass Density, 2014-2016
Survey Results Context

• Are species results always identical?
  • No, but this is expected

• Do surveys tell us the same thing in general?
  • Yes – prey fish biomass is at or near all time low
Total Biomass Density, Acoustic Survey
Total Biomass Density, Bottom Trawl Survey
2016 Alewife Age Composition from Surveys

Acoustic

Bottom trawl
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Conclusions

• Lakewide surveys indicate low biomass of prey fish
  – Bottom trawl all-time low
  – Acoustic 4\textsuperscript{th} lowest

• Recent period (2010-2016) marked by single strong year class, six relatively weak ones

• Adult alewife have become more coastal