Fish Community Indices of Ecosystem Health: How does the Toronto Harbour Compare to other Lake Ontario Nearshore Areas?

Jim Hoyle, Ontario Ministry of Natural Resources and Forestry
Christine Boston, Fisheries and Oceans Canada
Acknowledgements

- Toronto Region Conservation Authority—Rick Portiss
- Fisheries and Oceans Canada—Christine Boston
- COA funded
Background and Context

- Part of effort to monitor and assess Toronto waterfront fish community
- In context of BUI #3—Fish Populations

### Toronto AOC Delisting Criteria for BUI #3

(impaired fish populations—waterfront)

<table>
<thead>
<tr>
<th>Delisting Criterion</th>
<th>Restoration Targets (Delisting Criteria) from Clean Waters, Clear Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish Populations – waterfront</td>
<td>Biomass of resident, fish-eating species increased to levels about 20% of total resident biomass; biomass of specialist fishes increased to at least 40% of total biomass</td>
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<tr>
<td>Fish Populations – waterfront</td>
<td>Formerly abundant fish populations are rehabilitated where locally depressed or extinct</td>
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</tbody>
</table>
Talk Outline:

- MNRF Nearshore Fish Community Index Netting (NSCIN)
  - Implemented at Toronto in 2006, most recently September 2016
  - Conducted in partnership with TRCA
  - NSCIN also conducted at other Lake Ontario nearshore locations

- Collaboration with Fisheries and Oceans (e-fishing)
  - Compare NSCIN trap netting with Fisheries and Oceans boat electrofishing
  - Indices of ecosystem health (e.g., Index of Biotic Integrity)
Ontario Provincial Standard Protocol

- Developed on Ontario inland lakes
- Targets nearshore zone fish populations (warm and cool water species)
- Random selection of sampling sites
- Designed to compare different lakes and years
- Sample size requirements worked out (Lester et al. 1996, CJFAS)

Reference:
Nearshore Fish Community Index Netting (NSCIN)

Ontario Provincial Standard Protocol

- Using to assess fish community status in AOCs since 2001 (2006)

<table>
<thead>
<tr>
<th>Year</th>
<th>Lake Ontario</th>
<th>St. Lawrence River</th>
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<tbody>
<tr>
<td>2016</td>
<td>✓ ✓</td>
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<td>2015</td>
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<thead>
<tr>
<th>Area</th>
<th>Hamilton Harbour</th>
<th>Toronto Harbour</th>
<th>Presqu’ile Bay</th>
<th>Weller’s Bay</th>
<th>West Lake</th>
<th>East Lake</th>
<th>Bay of Quinte (upper)</th>
<th>Bay of Quinte (middle)</th>
<th>Bay of Quinte (lower)</th>
<th>North Channel</th>
<th>Thousand Islands</th>
<th>Lake St. Francis</th>
</tr>
</thead>
</table>

Toronto RAP Science Seminar November 14, 2016
Nearshore Fish Community Index Netting (NSCIN)

What have we learned?

- **Degree of exposure** (connectivity) to Lake Ontario influences fish species composition and abundance

- Proportion of fish community comprised of PISCIVORES greater than 0.2 [PPB]

- Developed an “Index of Biotic Integrity” [IBI]
  - 11 metrics reflecting species richness, trophic structure, invasive species, overall biomass

**References:**


Nearshore Fish Community Index Netting (NSCIN)—Toronto 2016 Update

- 24 trap net sets each year over a 2 week period in September
- 6 years (2006 to 2016)
- 29 fish species
- Variety of warm and cool water species
- Some coldwater species
- Native and non-native

Too many bullheads and carp, too few walleye and smallmouth bass.

Toronto RAP Science Seminar November 14, 2016
Nearshore Fish Community Index Netting (NSCIN)—Toronto 2016 Update

- Indices of ecosystem health
  - PPB
  - IBI

![Fish Image]

**Proportion Piscivore Biomass**
- Target is 0.20
- Data from 2006 to 2016

**Index of Biotic Integrity**
- Target is ???
- Data from 2006 to 2016
What should IBI be at Toronto?

- Not all nearshore areas the same
  - Major habitat types
  - Level of human use
Fisheries and Oceans Canada

- Developed on Great Lakes AOCs (Bay of Quinte, Hamilton Harbour, Severn Sound)
- Targets nearshore zone fish populations (warm and cool water species)
- Minns et al., 1994, CJFAS [IBI]
- Toronto waterfront sampled in 2014
Boat Electrofishing

Fisheries and Oceans Canada

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Electrofishing Schedule

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<td>Hamilton Harbour</td>
<td>Bronte shore</td>
<td>Toronto Harbour</td>
<td>West Lake</td>
<td>Prince Edward Bay</td>
<td>Bay of Quinte</td>
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Two Gear Types

- Common goal—published independent measures of ecosystem health (e.g., IBIs) for nearshore fish communities

**Trap Net**

- passive gear
- broad spatial scale
- large fish species

Ministry of Natural Resources and Forestry

**Boat Electrofishing**

- active gear
- precise spatial scale
- small fish species

Fisheries and Oceans Canada
Two Gear Types

- Common goal—published independent measures of ecosystem health (e.g., IBIs) for nearshore fish communities

<table>
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<tr>
<th>Location</th>
<th>IBI Value</th>
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IBI values range from 0 to 100, with different gear types represented by blue and red bars. Trap Net and E-fishing are indicated.
Two Gear Types—IBI Comparison

- Two gear give same result
- High confidence

Challenge

What should IBI be at Toronto?

![Graph showing IBI comparisons](image)

- Hamilton
- Toronto Harbour
- Bay of Quinte

Nearshore Area
Lake Ontario AOCs

- Trap Net
- E-fishing

Index of Biotic Integrity (IBI)

Bay of Quinte

- Pre-phosphorus
- Post-phosphorus
- Dreissenid

Time-stanza

y = 0.98x
R² = 0.79
Next Steps

Challenge

What should IBI be at Toronto?

More Auxiliary Information:

1. **Patterns among nearshore areas:**
   - Fetch
   - Land Use

2. **Gear type differences:**
   - Species-specific size distribution