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)

Delisting Criterion	RestorationTargets (Delisting Criteria) from Clean Waters, Clear Choices
Fish Populations – waterfront	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
Fish Populations – waterfront	Formerly abundant fish populations are rehabilitated where locally depressed or extinct

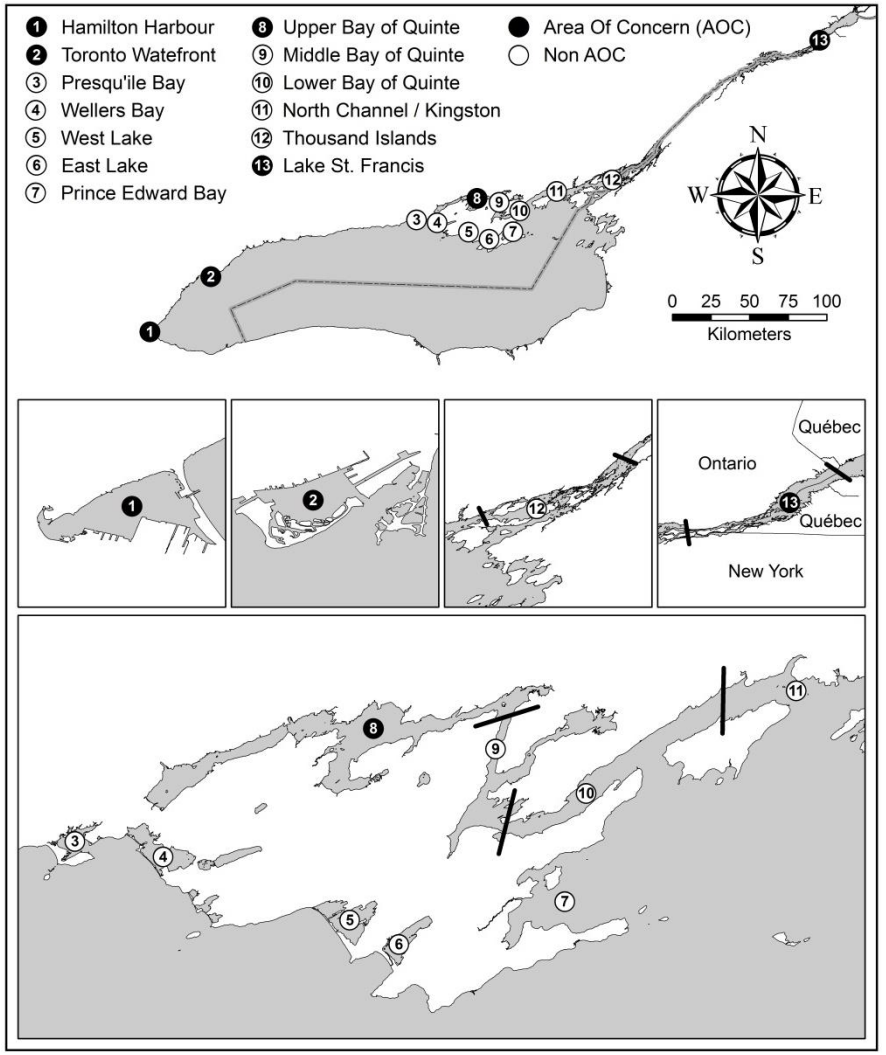
Talk Outline:

- 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**)

Nearshore Fish Community Index Netting (NSCIN)

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:

Lester, N.P., Dunlop, W.I., Willox, C.C. 1996. Detecting changes in the nearshore fish community. Can. J. Fish. Aquat. Sci. 53:391-402.

Nearshore Fish Community Index Netting (NSCIN)

Ontario Provincial Standard Protocol

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

	Annual NSCIN Trap Net Schedule												
Year	Lake Ontario											St. Lawrence River	
2016	√	√						√					
2015	√		√	√				√					
2014	√	√						√					
2013					√	√	√	√					
2012	√	√						√					
2011								√	√	√			
2010	√	√						√					
2009							√	√	√	√	√	√	
2008	√		√	√				√					√
2007		√			√	√		√					√
2006	√	√											
2005								√	√	√			
2004								√	√	√			
2003								√	√	√			
2002								√	√	√			
2001				√	√			√					
Area	Hamilton Harbour	Toronto Harbour	Presqu'ile Bay	Weller's Bay	West Lake	East Lake	Prince Edward Bay	Bay of Quinte (upper)	Bay of Quinte (middle)	Bay of Quinte (lower)	North Channel	Thousand Islands	Lake St. Francis

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:

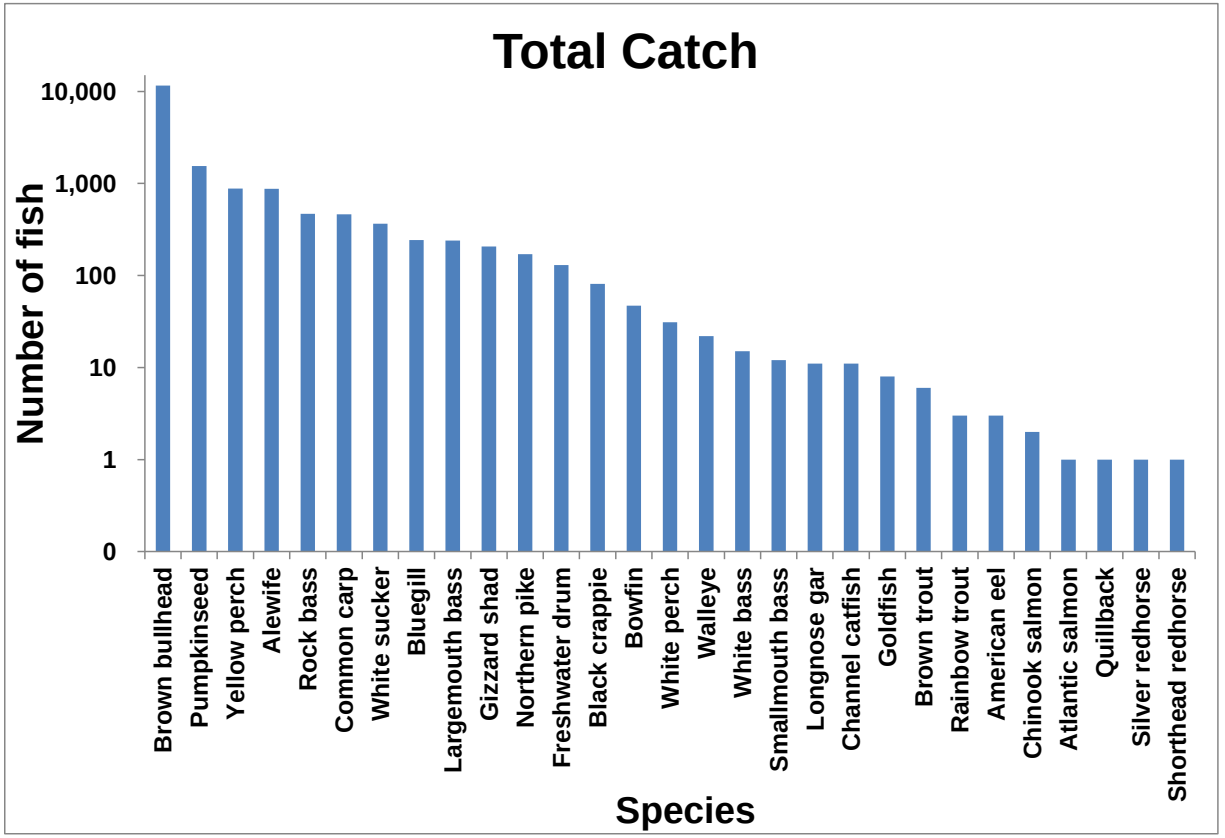
Bowlby, J.N., Hoyle, J.A. Predicting restored nearshore fish populations in two Areas of Concern in Lake Ontario using a comparative approach. Aquatic Ecosystem Health & Management (in press).

Hurley, D.A., Christie, W.J., Minns, C.K., Millard, E.S., Cooley, J.M., Johnson, M.G., Nicholls, K.H., Robinson, G.W., Owen, G.E., Sly, P.G., Geiling, W.T., Crowder, A.A., 1986. Trophic structure and interactions in the Bay of Quinte, Lake Ontario, before and after point source phosphorus control. In: Minns, C.K., Hurley, D.A., Nichols, K.H. (Eds.), Project Quinte: Point Source Phosphorus Control and Ecosystem Response in the Bay of Quinte. Can. Spec. Pub. Fish. Aquat. Sci., Lake Ontario 86.

Hoyle, J.A., Yuille, M.J. 2016. Nearshore fish community assessment on Lake Ontario and the St. Lawrence River: A trap net-based index of biotic integrity, Journal of Great Lakes Research. 42:687-694.

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

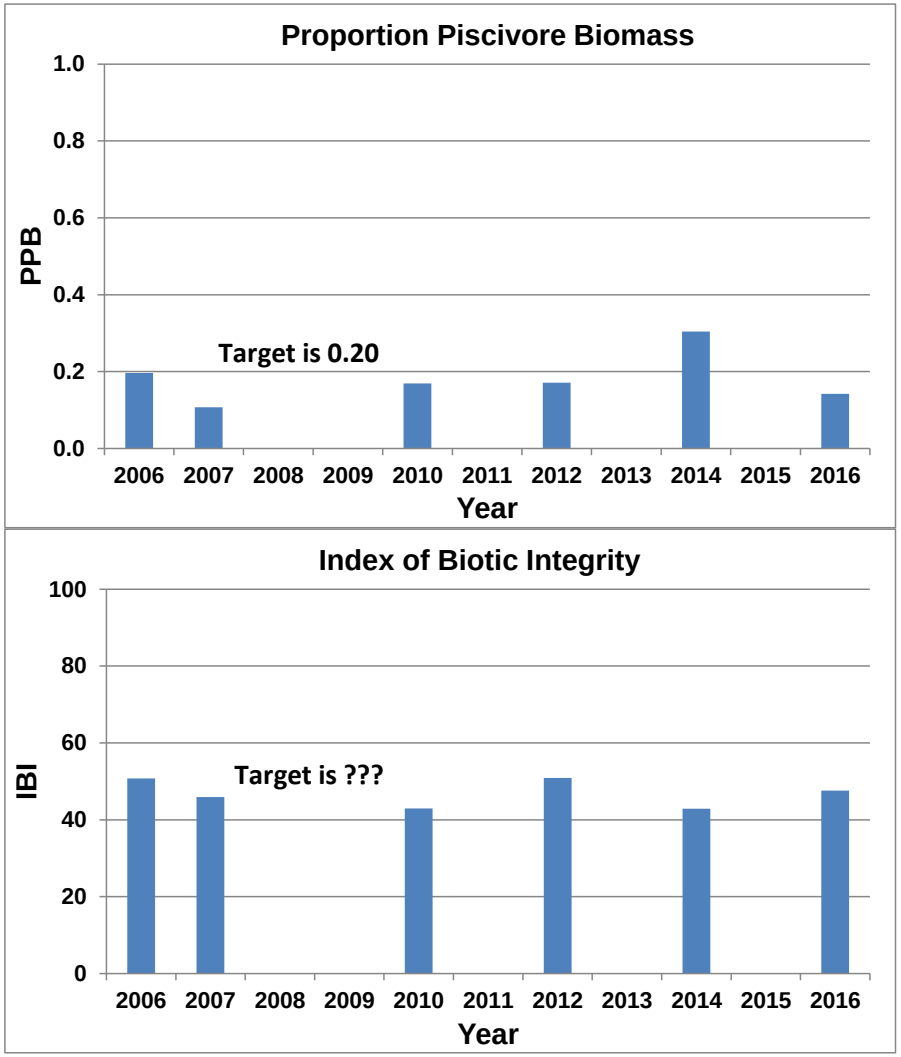
- 24 trap net sets each year over a 2 week period in September
- 6 years (2006 to 2016)
- 29 fish species
- Variety of warm and cool water species
- Some coldwater species
- Native and non-native



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

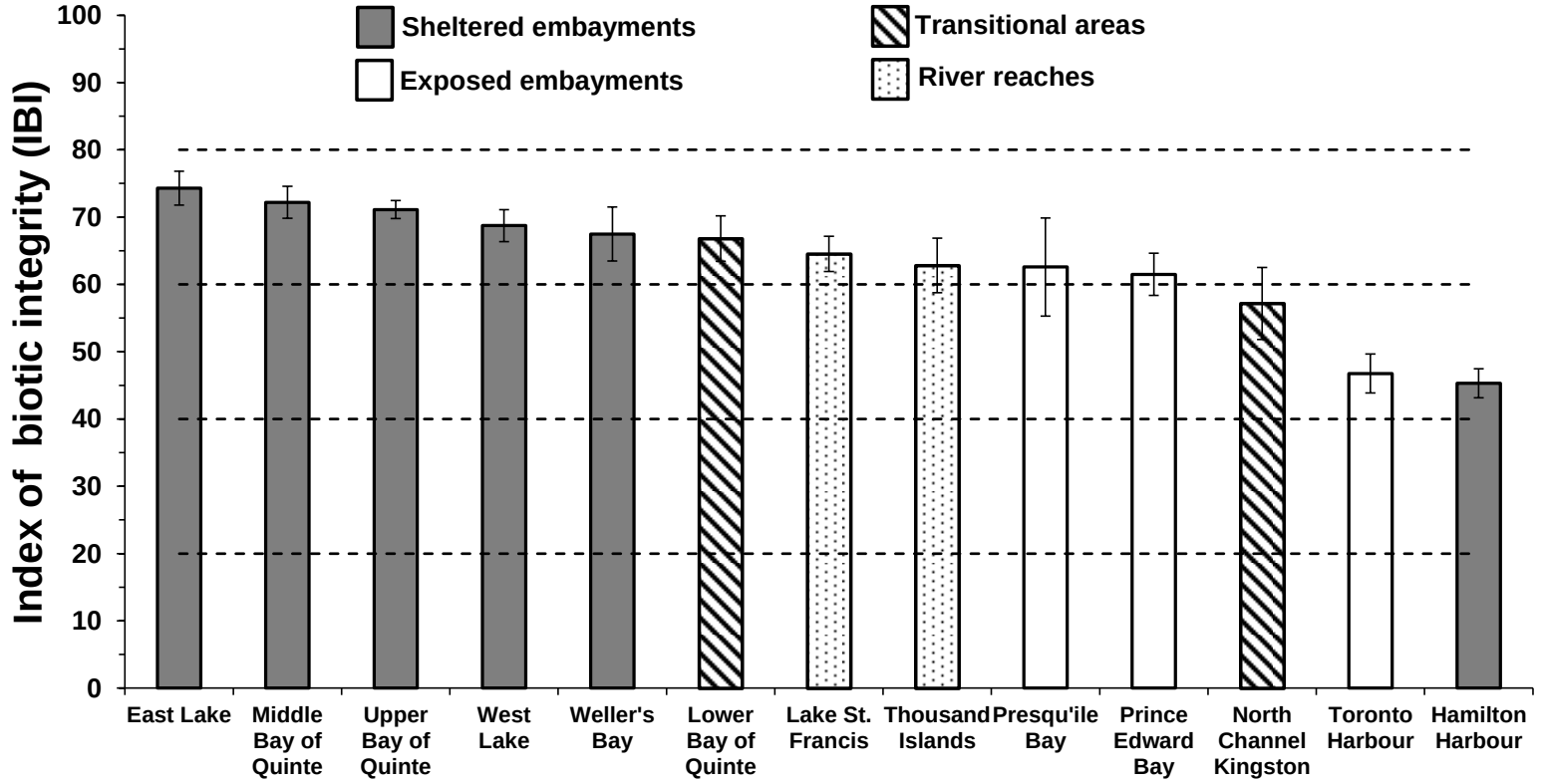
Nearshore Fish Community Index Netting (NSCIN)—Toronto 2016 Update

- Indices of ecosystem health
  - PPB
  - IBI



What should IBI be at Toronto?

- Not all nearshore areas the same
  - Major habitat types
  - Level of human use



Boat Electrofishing

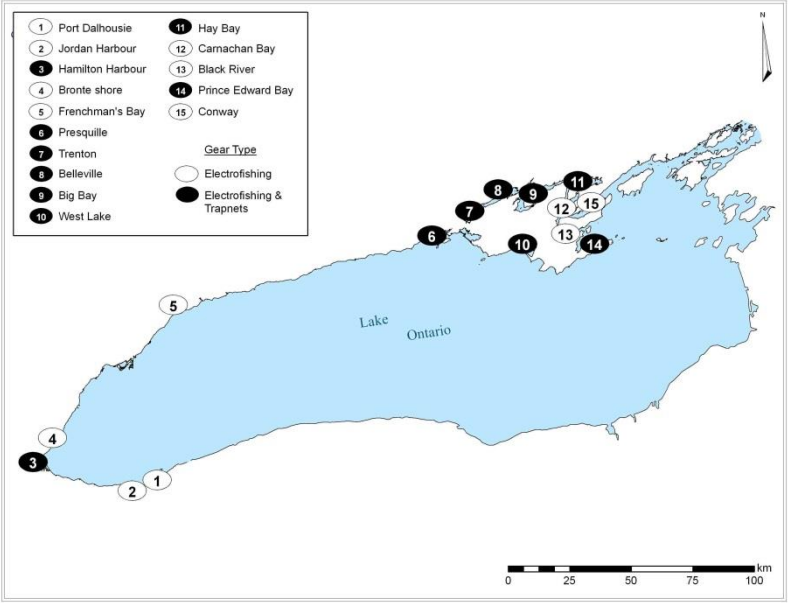
Fisheries and Oceans Canada

- **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

- **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**



Year	Electrofishing Schedule							
2016			√					
2015								√
2014					√			
2013			√	√				
2012			√					
2011			√			√	√	√
2010		√	√	√				
2009	√	√		√		√	√	√
2008	√	√	√	√				
2007						√		√
2006			√					
Area	**Port Dalhousie**	**Jordan Harbour**	**Hamilton Harbour**	**Bronte shore**	**Toronto Harbour**	**West Lake**	**Prince Edward Bay**	**Bay of Quinte**

Two Gear Types

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

Trap Net
Ministry of Natural Resources and Forestry

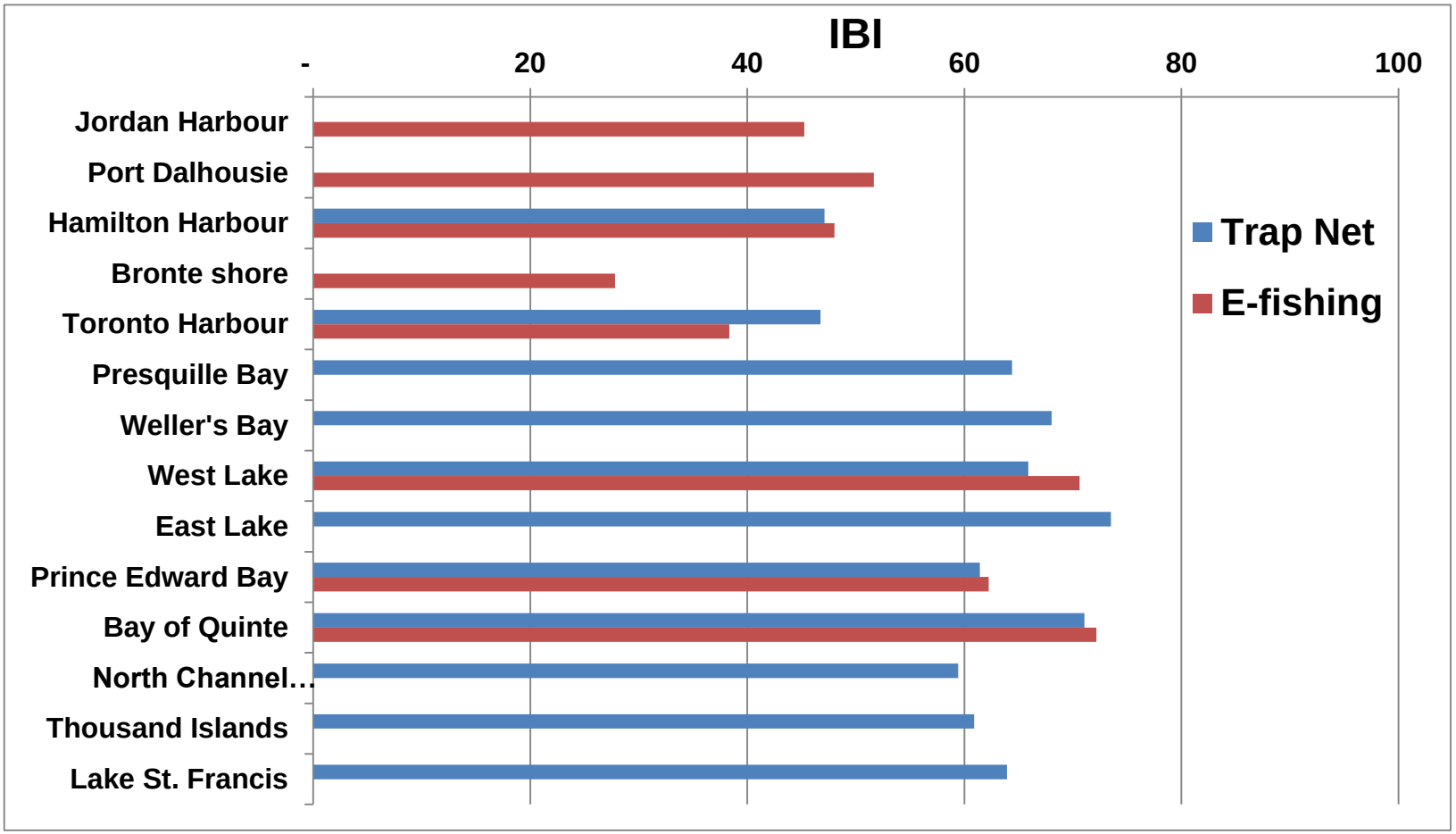
-passive gear
-broad spatial scale
-large fish species

Boat Electrofishing
Fisheries and Oceans Canada

-active gear
-precise spatial scale
-small fish species

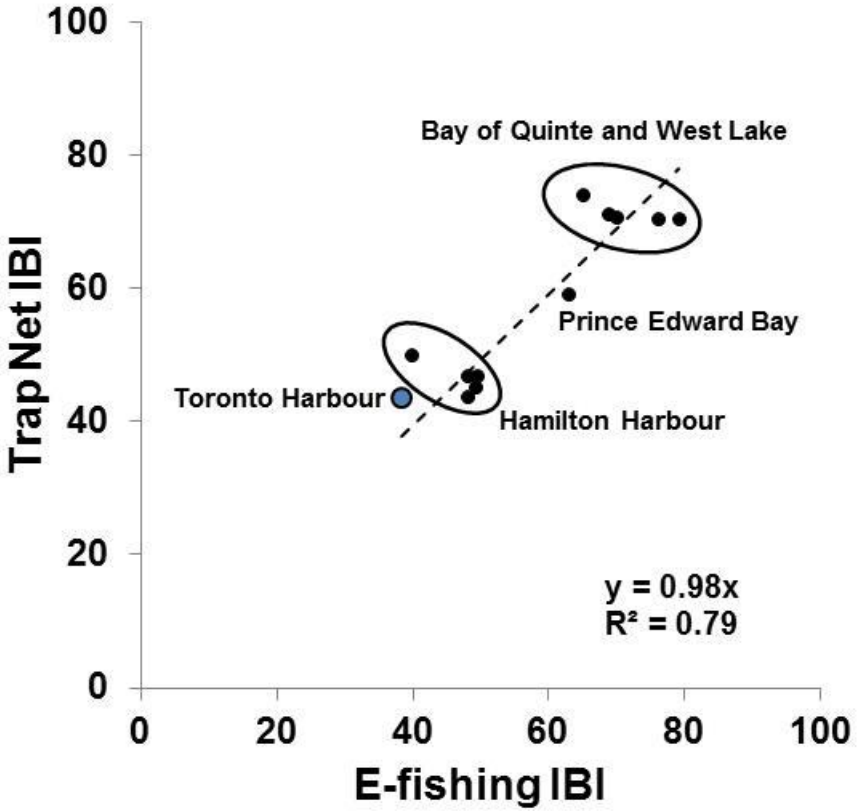
Two Gear Types

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



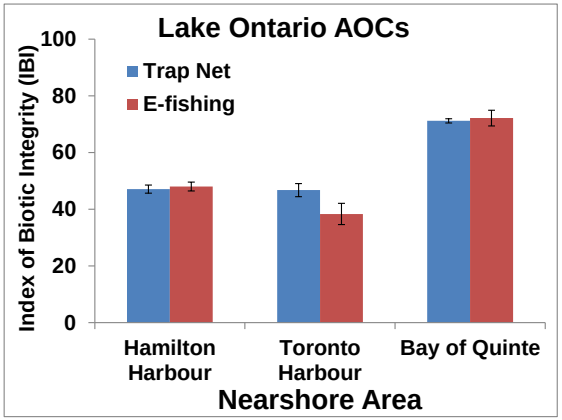
Two Gear Types—IBI Comparison

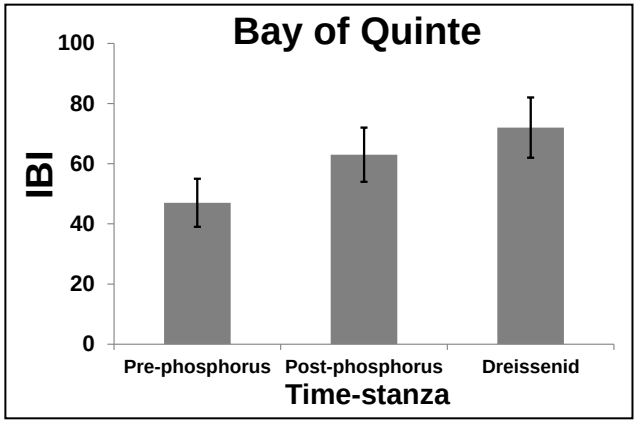
- **Two gear give same result**
- **High confidence**



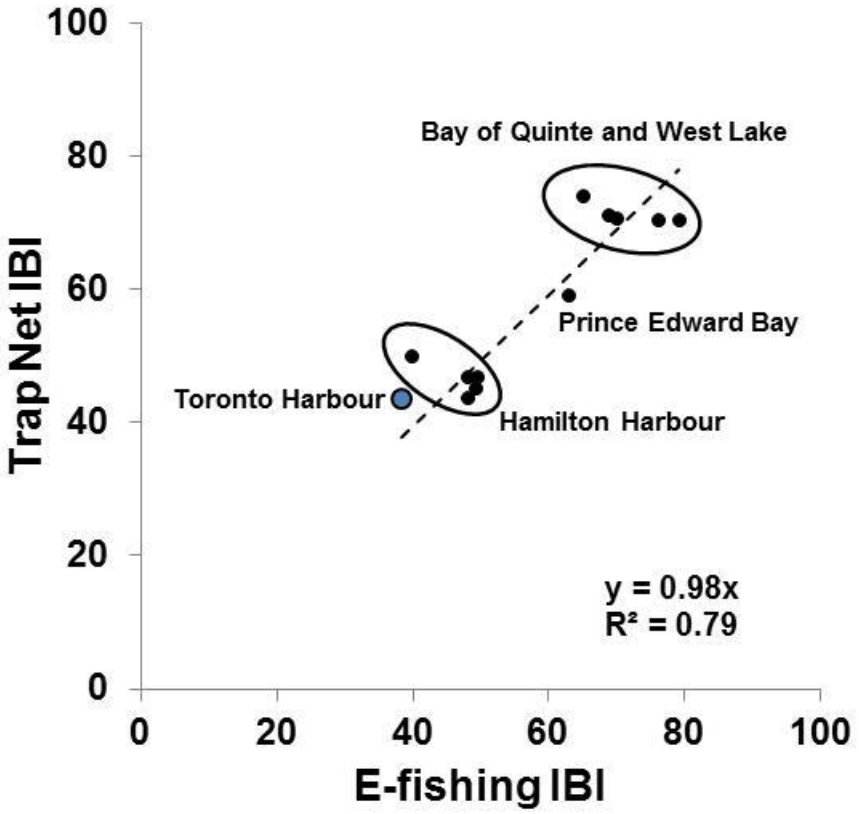
Challenge

What should IBI be at Toronto?





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