

Jun 21st, 1:15 PM - 1:30 PM

Fish Passage Studies I: Bi-directional, Selective Fish Passage: The Complications of Fish Passage in the Laurentian Great Lakes

Andrew Muir
Great Lakes Fishery Commission

Rob McLaughlin
University of Guelph

Tom Pratt
Fisheries and Oceans Canada

Follow this and additional works at: https://scholarworks.umass.edu/fishpassage_conference

Muir, Andrew; McLaughlin, Rob; and Pratt, Tom, "Fish Passage Studies I: Bi-directional, Selective Fish Passage: The Complications of Fish Passage in the Laurentian Great Lakes" (2016). *International Conference on Engineering and Ecohydrology for Fish Passage*. 19.
https://scholarworks.umass.edu/fishpassage_conference/2016/June21/19

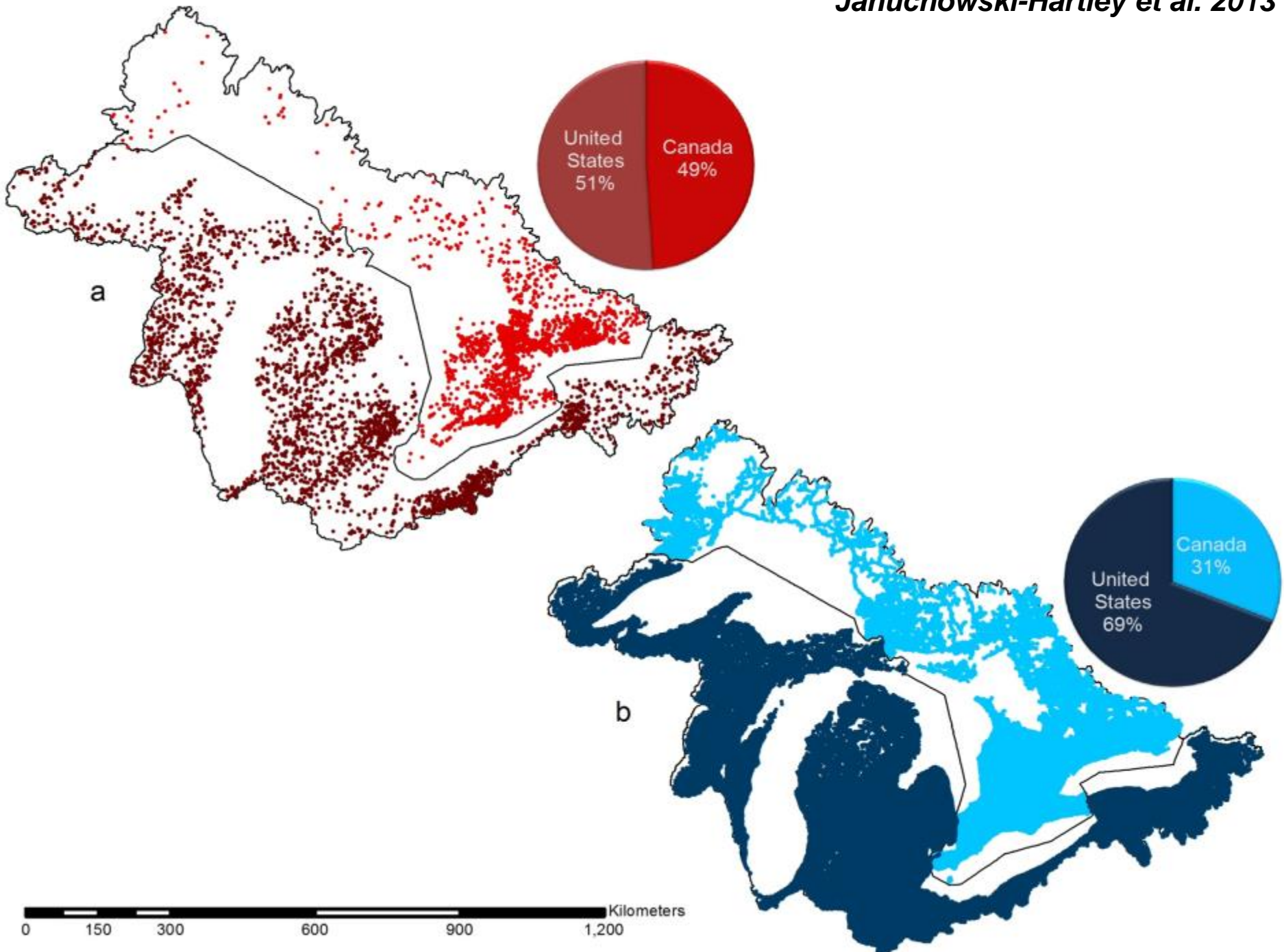
This Event is brought to you for free and open access by the Fish Passage Community at UMass Amherst at ScholarWorks@UMass Amherst. It has been accepted for inclusion in International Conference on Engineering and Ecohydrology for Fish Passage by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.

Bi-directional, Selective Fish Passage: The Complications of Fish Passage in the Laurentian Great Lakes



Andrew Muir, Great Lakes Fishery Commission
Rob McLaughlin, University of Guelph
Tom Pratt, Fisheries and Oceans Canada

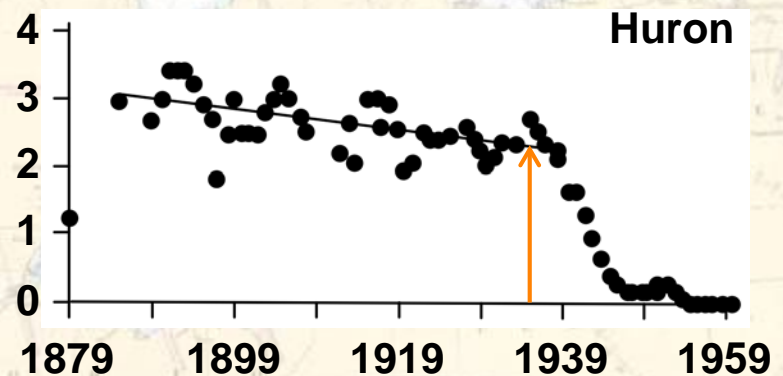
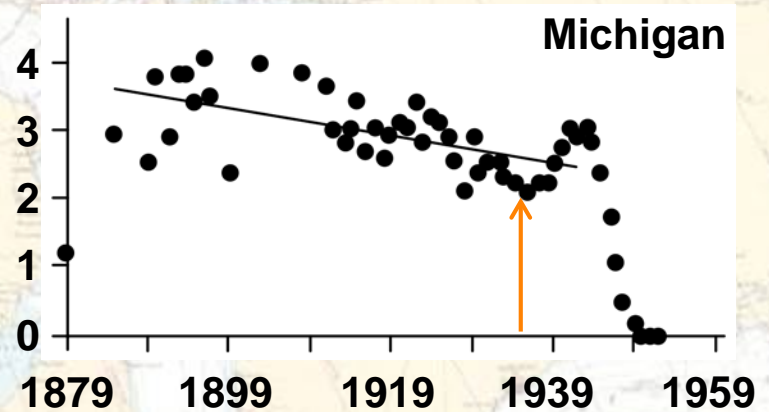
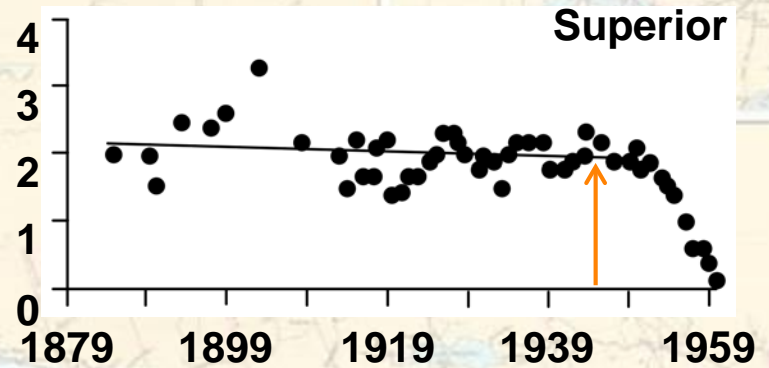
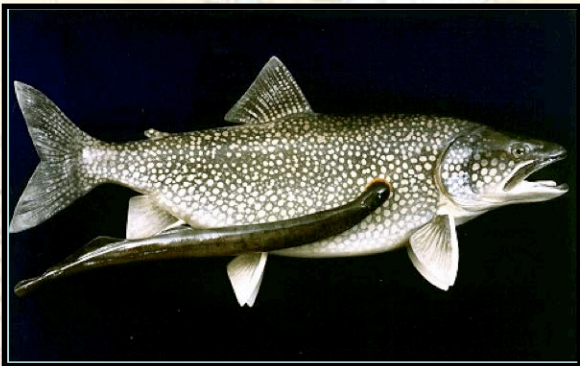




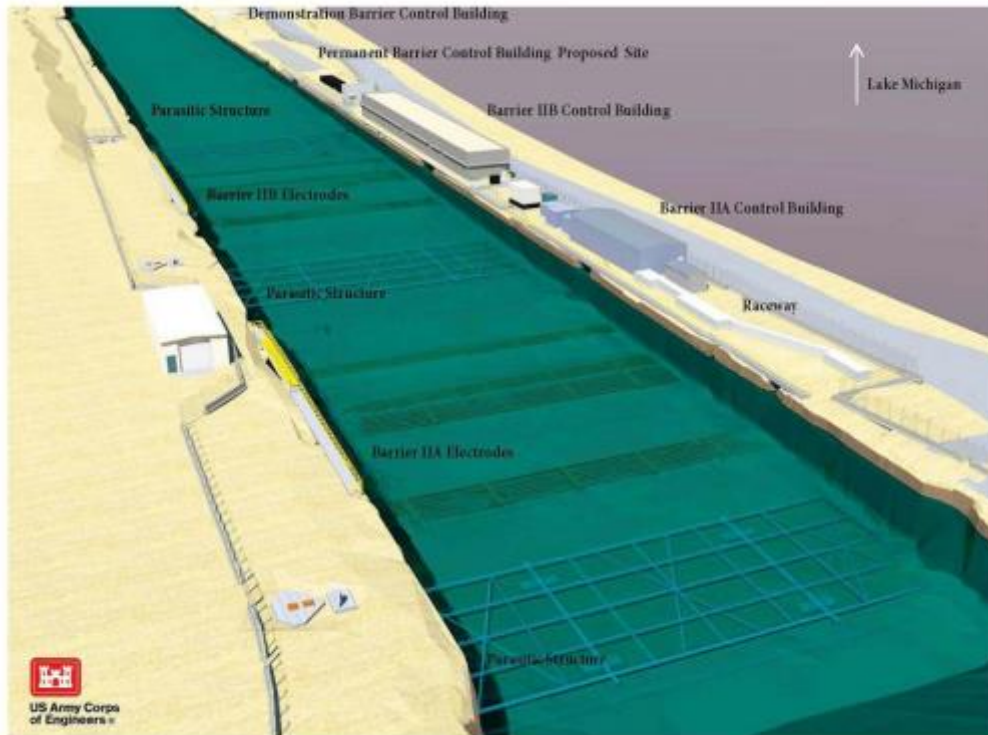
Sea Lamprey



**commercial
catch of
lake trout
(millions of
kg)**



Asian Carp on the Horizon

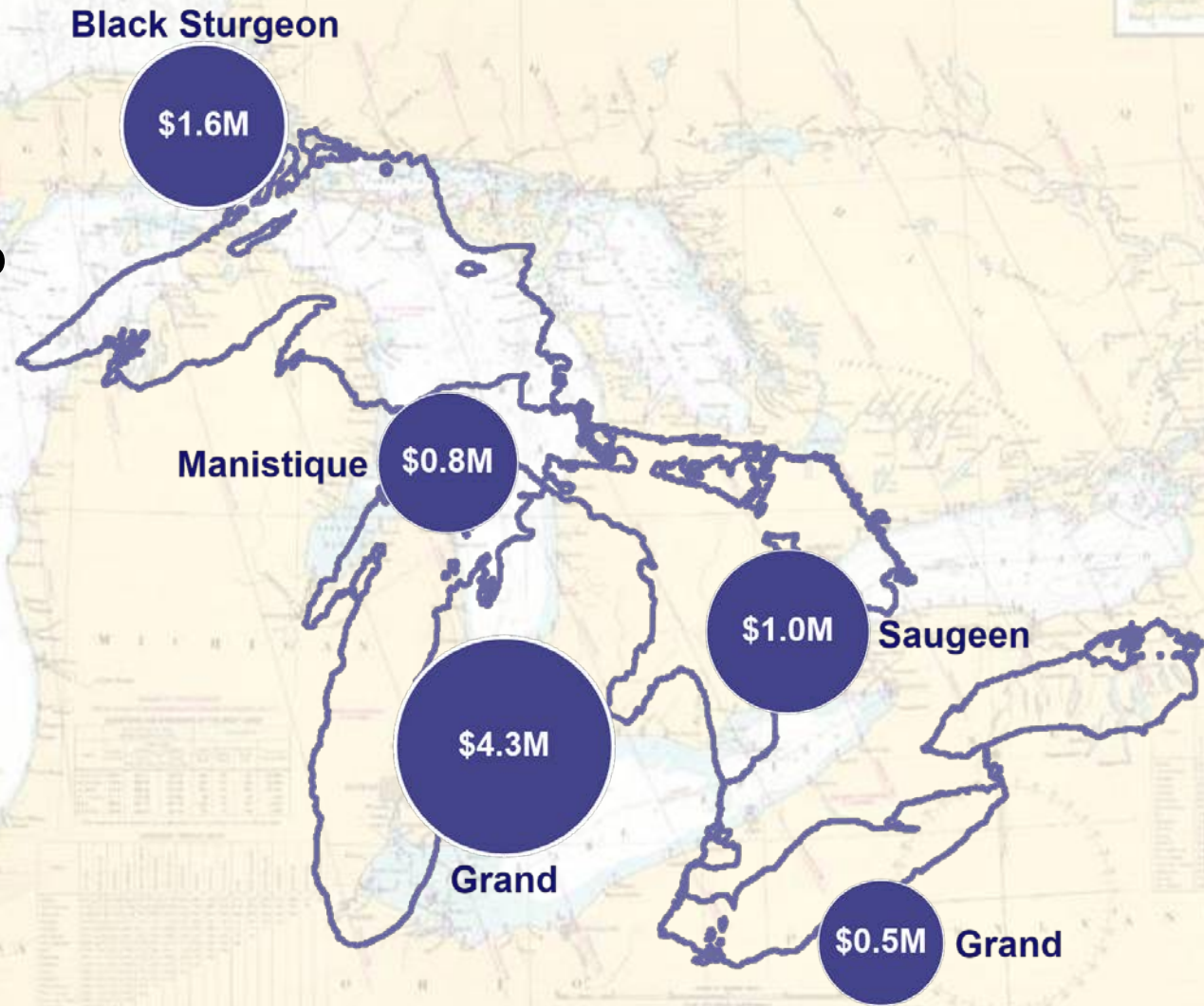


- Electrical barrier keeping Asian carp out of the Great Lakes



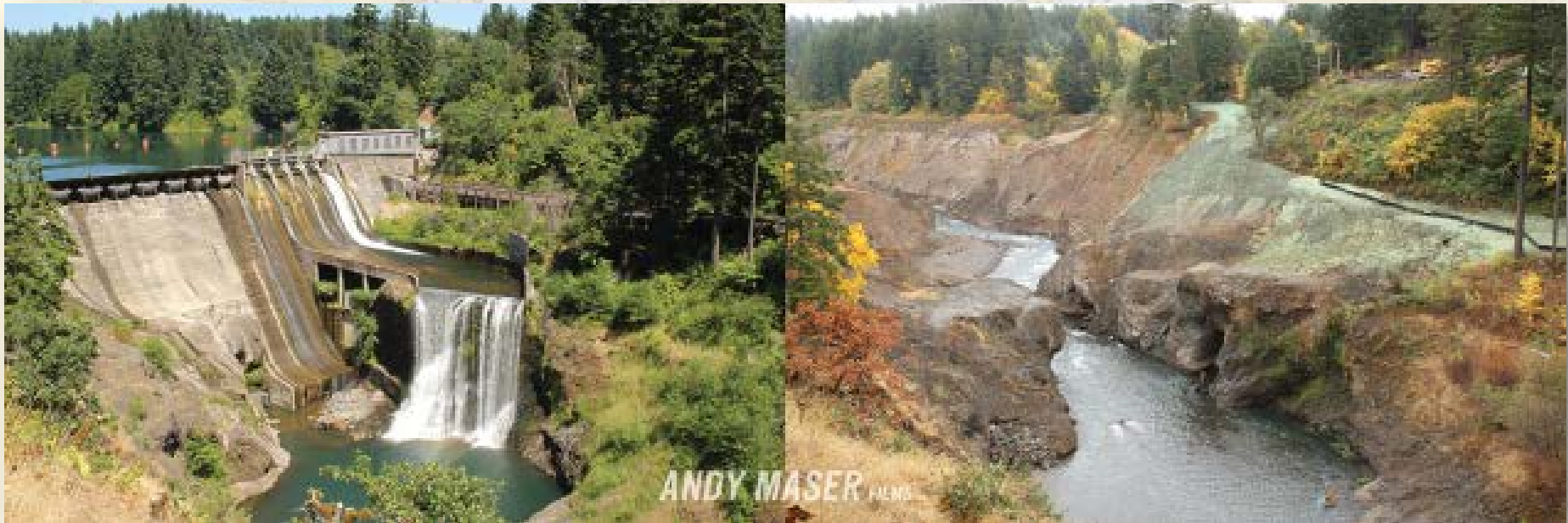
Increasing Pressure for Dam Removals

- Removing these 5 dams could use 40% of the sea lamprey control budget – and there are more conflicts to come



Management Challenge

RESTORATION
via
FRAGMENTATION or CONNECTIVITY



Research Goal

- Provide bi-directional movement of desirable fishes through and removal of invasive fishes in fragmented watersheds (e.g., selective passage)

INSIGHTS Precision medicine comes to psychiatry p. 48
Secure sustainable seafood from developing countries p. 44

PERSPECTIVES

ECOLOGY
1000 dams down and counting
Dam removals are reconnecting rivers in the United States
By J. R. Olden, J. D. Olden, J. D. Olden

For over 100 years, the construction of large dams was mostly driven, not by the threat to Edward Fisher's coast. The Atlantic coast long, by 1970, had 1000 dams. Since then, dams have been removed at an increasing rate. In the United States, more than 1000 dams have been removed since 1980. Dam removals are reconnecting rivers in the United States. This is a major step in restoring the health of our nation's rivers. Dam removals are reconnecting rivers in the United States. This is a major step in restoring the health of our nation's rivers. Dam removals are reconnecting rivers in the United States. This is a major step in restoring the health of our nation's rivers.



FISH and FISHERIES

FISH and FISHERIES, 2012, 34, 300-304

Unintended consequences and trade-offs of fish passage

Robert J. McLaughlin^{1,2}, Eric B. Sogard³, Theodore Castro-Solis⁴, Michael J. Jones⁵, Martin A. Kopp⁶, Thomas C. Pratt⁷ & Jack-André Yéou-Espin⁸

¹Department of Integrative Biology, University of Guelph, Guelph, ON, Canada, N1G 2W1; ²St. John's Aquaculture Fish Research Laboratory, 1305-8RD Leiston Science Centre, St-John's, NB, Canada, E0A 1A0; ³Quantitative Fisheries Center, Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, USA; ⁴Scotts Lake Laboratory for Fisheries and Aquatic Sciences, Fisheries and Aquatic Sciences, Health, Safety, and Environment, Canada, St. John's, NB, Canada; ⁵St. John's Aquaculture Fish Research Laboratory, 1305-8RD Leiston Science Centre, St-John's, NB, Canada, E0A 1A0; ⁶Department of Biological Sciences, University of Guelph, Guelph, ON, Canada, N1G 2W1; ⁷St. John's Aquaculture Fish Research Laboratory, 1305-8RD Leiston Science Centre, St-John's, NB, Canada, E0A 1A0; ⁸St. John's Aquaculture Fish Research Laboratory, 1305-8RD Leiston Science Centre, St-John's, NB, Canada, E0A 1A0.

Abstract
We synthesized evidence for unintended consequences and trade-offs associated with the passage of fish. Preventing fish passage at dams and dam removals are being carried out increasingly as resource managers seek ways to reduce fragmentation of migratory fish populations and restore biodiversity and ecosystem services in tributaries altered by dams. The benefits of preventing upstream passage are highlighted widely. Possible associated consequences and trade-offs of upstream passage are less well known, but remain poorly examined and understood. Unintended consequences arise when passage of native and desirable introduced fishes is delayed, reduced, or blocked, or when passage of nonnative and undesirable introduced fishes is enhanced. These consequences include: reduced recruitment and habitat use that reduce Darwinian fitness (e.g., ecological traps or highly selective, seasonally and seasonally, trade-offs arise when passage decisions intended to benefit native species interfere with management decisions intended to control the unwanted spread of non-native fishes and aquatic vertebrates, or parasitic diseases and contaminants carried by hatchery and wild fishes. These consequences and trade-offs will vary in importance from system to system and can result in large economic and environmental costs. For more informed decisions about how to manage fish passage (either substantial risks and could benefit from use of a formal, structured process that allows integration, identification, and where possible, quantitative evaluation of these risks. Such a process can also facilitate the design of an adaptive framework that provides valuable insights into future decisions.

Keywords Dam removal, fish passage, migration, risk, structured decision-making, uncertainty

Project Objectives

1. Develop and implement selective bi-directional fish sorting technology as an adaptive management experiment
2. Determine protocols for implementing bi-directional selective fish passage throughout the Great Lakes Basin
3. Set solutions in a global context so the approach can be exported

Sorting an Assortment of Things

HOW IT WORKS

STORY BY KATIE PECK ILLUSTRATION BY GRAHAM MURDOCH

SINGLE-STREAM RECYCLING

The most annoying aspect of recycling—and one of the biggest hurdles to its widespread adoption—is having to separate paper, glass, and plastic before they hit the curb. New recycling machines are changing that. With single-stream recycling, recyclables go into one bin, which a truck delivers to a materials-recovery facility, such as Willimantic Waste

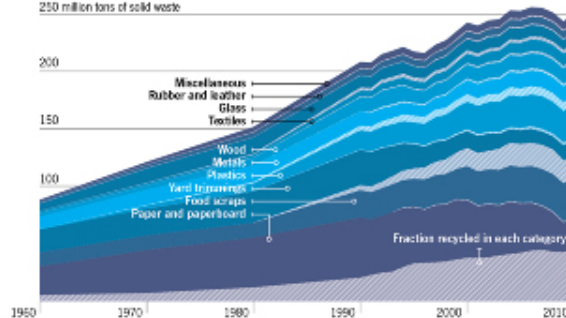
Recycling in Willimantic, Connecticut. There, a largely automated system of conveyor belts, screens, magnets, and lasers separates materials so that they can be sold to metal and plastic recyclers and paper mills.

Of the 570 recycling facilities in the U.S., 240 now have single-stream operations, according to Eileen Berenyl, of the solid-waste research-and-consulting firm Governmental

Advisory Associates. While the system isn't perfect—its high-speed operation can lead to contamination from broken glass—the simplicity of it means households actually recycle more. "If people want a higher recycling rate, it has to be convenient," says Chaz Miller, of the National Solid Wastes Management Association. "And I think the technology is only going to improve."

Recycling Rates in the U.S.

250 million tons of solid waste



STATS

2.4

Tons of carbon dioxide left out of the atmosphere per ton of solid waste recycled, whether by single-stream or otherwise

One third

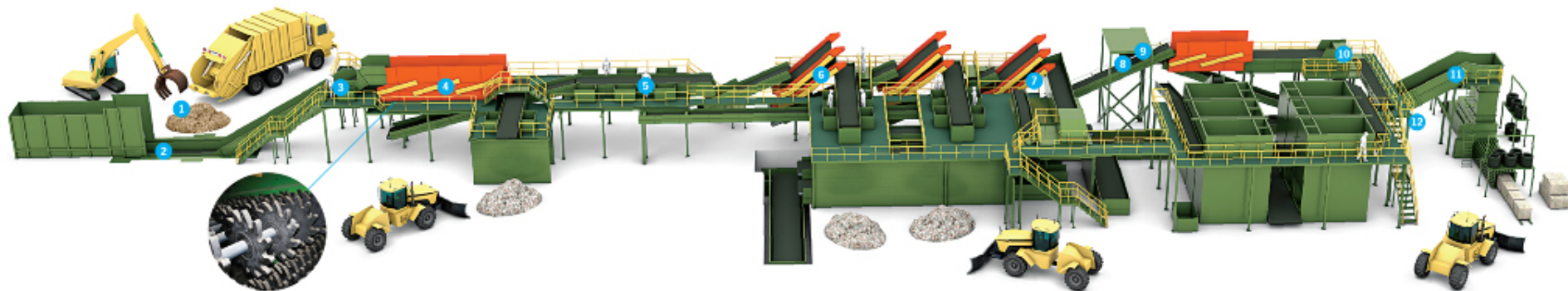
Fraction of municipal solid waste in the U.S. that's currently recycled

100 million

Number of U.S. residents served by single-stream recycling programs

92

Percentage recycling rates increased when Florida's Manatee County implemented single-stream recycling in 2005



- | | | | | | | | | | | | |
|---------------|-------------|-----------------|--------------------|----------------|---------------------|--------------|-----------------------|------------------------|-----------------|-------|----------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Tipping Floor | Drum Feeder | Initial Sorters | Large Star Screens | Second Sorters | Star Medium Screens | Glass Sorter | Magnetic Metal Sorter | Eddy Current Separator | Infrared lasers | Baler | Landfill |

INSET COURTESY LIBBY CURTULLA, MANAEE COUNTY RECYCLING SOLUTIONS

Sorting an Assortment of Things

HOW IT WORKS

STORY BY KATIE PECK | ILLUSTRATION BY GRAHAM MURDOCH

SINGLE-STREAM RECYCLING

The most annoying aspect of recycling—and one of the biggest hurdles to its widespread adoption—is having to separate paper, glass, and plastic before they hit the curb. New recycling machines are changing that. With single-stream recycling, recyclables go into one bin, which a truck delivers to a materials-recovery facility, such as Willimantic Waste

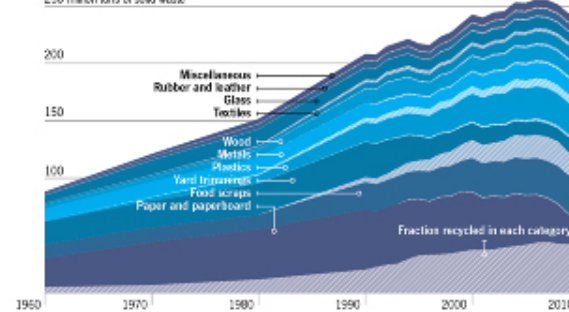
Paper in Willimantic, Connecticut. There, a largely automated system of conveyor belts, screens, magnets, and lasers separates materials so that they can be sold to metal and plastic recyclers and paper mills.

Of the 570 recycling facilities in the U.S., 240 now have single-stream operations, according to Eileen Berenyl, of the solid-waste research-and-consulting firm Governmental

Advisory Associates. While the system isn't perfect—its high-speed operation can lead to contamination from broken glass—the simplicity of it means households actually recycle more. "If people want a higher recycling rate, it has to be convenient," says Chaz Miller, of the National Solid Wastes Management Association. "And I think the technology is only going to improve."

Recycling Rates in the U.S.

250 million tons of solid waste



STATS

2.4

Tons of carbon dioxide left out of the atmosphere per ton of solid waste recycled, whether by single-stream or otherwise

One third

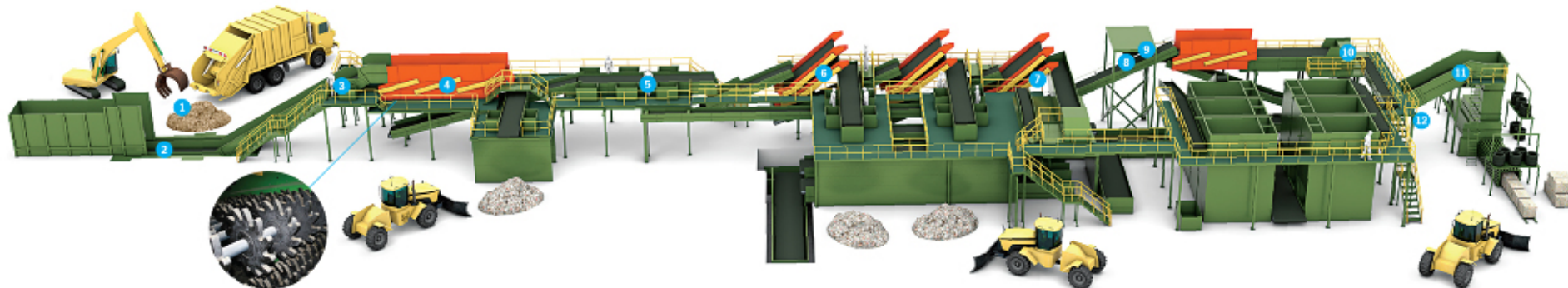
Fraction of municipal solid waste in the U.S. that's currently recycled

100 million

Number of U.S. residents served by single-stream recycling programs

92

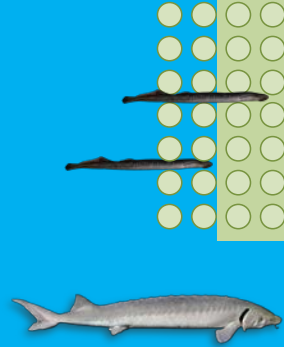
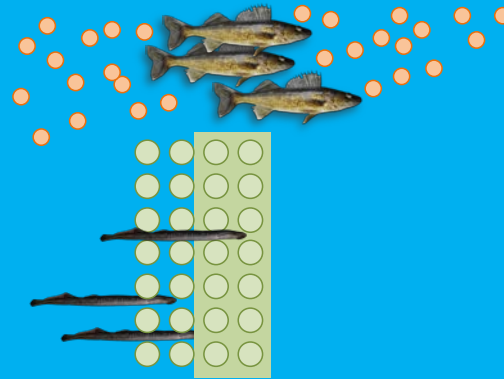
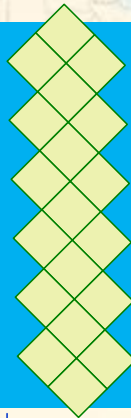
Percentage recycling rates increased when Florida's Miami-Dade County implemented single-stream recycling in 2005



Integration

Conceptual Approach Integrating Technologies

Upstream Electrical Guidance



Life History

- Seasonal
- Diel

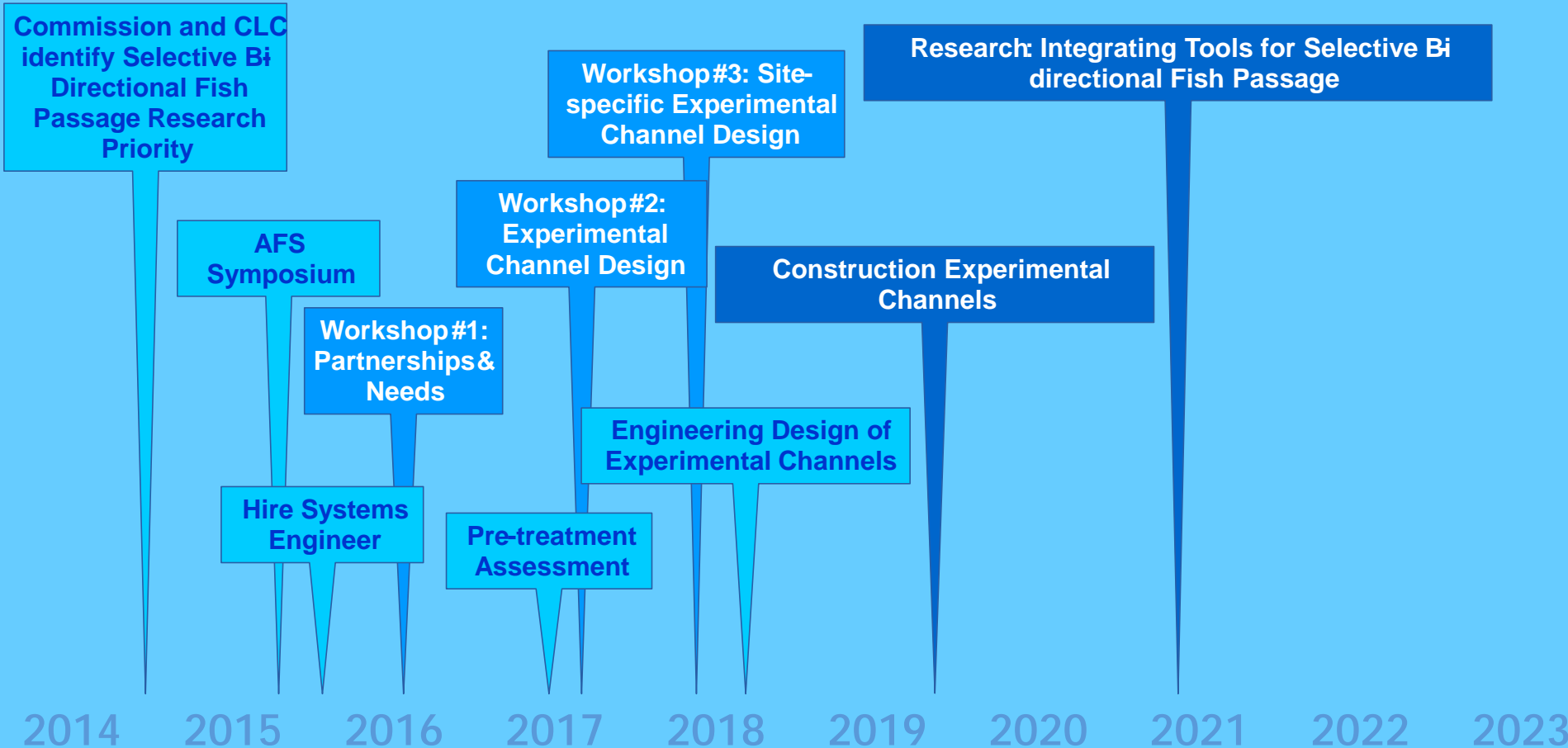
Morphology

- Video shape recognition
- Elevators
- Screens
- Ladders

Behaviour

- ELST
- Funnel
- Novel
- Pheromones
- Alarm cues
- Co₂ curtain

Proposed Workplan



Progress

- **FY2016 and FY2017 secured and FY2018 request submitted (~ \$500,000 per year)**
- **Apr. 30 - posted for Computational Scientist/Engineer (start date: 01 September 2016)**
- **Decision analysis for site selection underway**
- **State and local partners coming online**
- **Workshop 02-03 November 2016**



Tom Pratt:

thomas.pratt@dfo-mpo.gc.ca

Rob McLaughlin:

rlmclaug@uoguelph.ca

Andrew Muir:

amuir@glfc.org



KEEP CALM

BECAUSE

WE NEED

YOUR

HELP!

A Brief History of Barriers

- Early barriers for milling, mining and forestry
- More recently, barriers for water regulation, recreation and hydroelectric power generation
- Purpose built barriers for controlling invasive species



Sea Lamprey Expansion

Dates First Observed

Lake Superior:
1938

Lake
Huron:
1937

Lake
Michigan:
1936

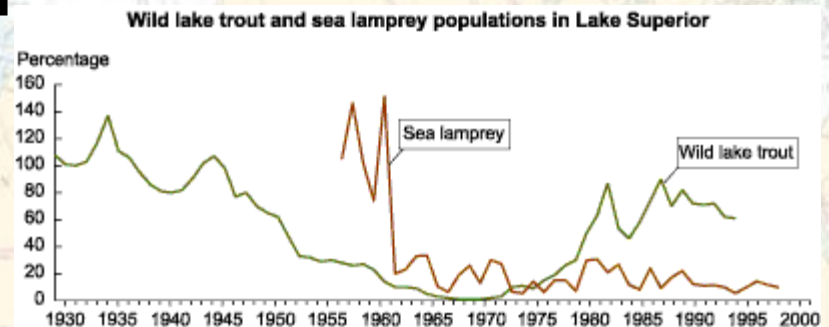
Lake
Ontario:
1835

Lake Erie:
1921



Sea Lamprey Invasion

- Sea lampreys helped decimate Great Lakes fish populations
- Barriers are an integral component of a \$21MM annual binational sea lamprey control effort



Integrating Technologies

Electr



Chemical repellants

P

Integrating Technologies



U.S. Fish & Wildlife Service

Yukon River Video Project

Fairbanks Fish & Wildlife Field Office

Fish wheels are commonly used as a capture method to determine relative abundance and run timing of Yukon River salmon. These "test wheel" catch rates are used by fishery managers to assess the in-season salmon runs on a daily basis. The wheels use live boxes to store fish until they are counted by dip netting. Recent studies on Yukon River fall chum salmon suggest that holding time and crowding in live boxes may affect the ability of fish to travel upstream to spawning streams. This is of particular concern during years of low salmon abundance.

A remote video system was developed to obtain salmon passage rates without the use of fish wheel live boxes, eliminating fish handling and crowding concerns. After fish wheel capture, fish travel down a chute, are video recorded, and then re-enter the river. The system consists of a color CCD camera mounted above the fish wheel chute and connected



This video system continuously records fish passing through the fishwheel and captures the information on a laptop for later analysis.

to a laptop computer through a video capture card. A time-lapse VCR is linked into the system for back-up. The system is powered by 12 volt batteries. During daytime operation, a water-wheel generator charges the batteries. At night, lights necessitate the use of a small gasoline generator.

Video capture software allows the recording of only video frames containing fish images. These images are stored in computer video files. Video capture can be triggered using various methods i.e. magnetic switch door, motion sensor, and image recognition. Frame rate and number of frames captured before or after a triggering event are controlled by the software. The resulting files are reviewed and tallied using video reviewing software specifically de-

signed for generating fisheries Catch Per Unit Effort data. The time-savings using this method over traditional viewing of time-lapse VCR tapes can be substantial.

Presently, three Yukon River fish wheels are equipped with this video system. Accurate daily counts of four salmon species, sheefish, whitefish, and various resident fish species are obtained using the video system. The benefits of video counting are a lowering of fish stress, 24 hour sampling, reduced data recording errors, and lower operational costs. Other applications of this technology include monitoring fish passage at dams and weirs, identification of marked/unmarked fish in tagging studies, and remote monitoring of animal behavior.



The video capture program allows easy identification of the species of fish and whether or not it is tagged.

U.S. Fish & Wildlife Service
1 800/344 WILD
www.fws.gov

For more information, contact:
U.S. Fish & Wildlife Service
Dave Daum
101 12th. Ave., Room 110, Fairbanks, Alaska 99701
907/456/0290

Visit the Fisheries & Habitat home page:
<http://alaska.fws.gov/fisheries/fieldoffice/http://fairbanks/monitoring.htm>

- Shape recognition
- Behavioral recognition
- Color identification
- Enumeration

Conceptual Approach Integrating Technologies

Upstream Electrical Guidance

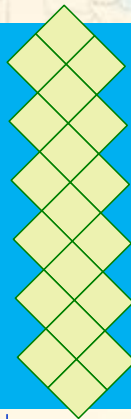
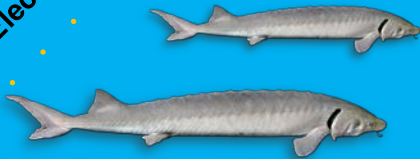


Life History

- Seasonal
- Diel

Conceptual Approach Integrating Technologies

Upstream Electrical Guidance



Life History

- Seasonal
- Diel

Morphology

- Video shape recognition
- Elevators
- Screens
- Ladders