

Jun 20th, 2:00 PM - 2:15 PM

# Penobscot I: Monitoring the Penobscot River Restoration Project: Baseline Data to Inform Ecosystem Response

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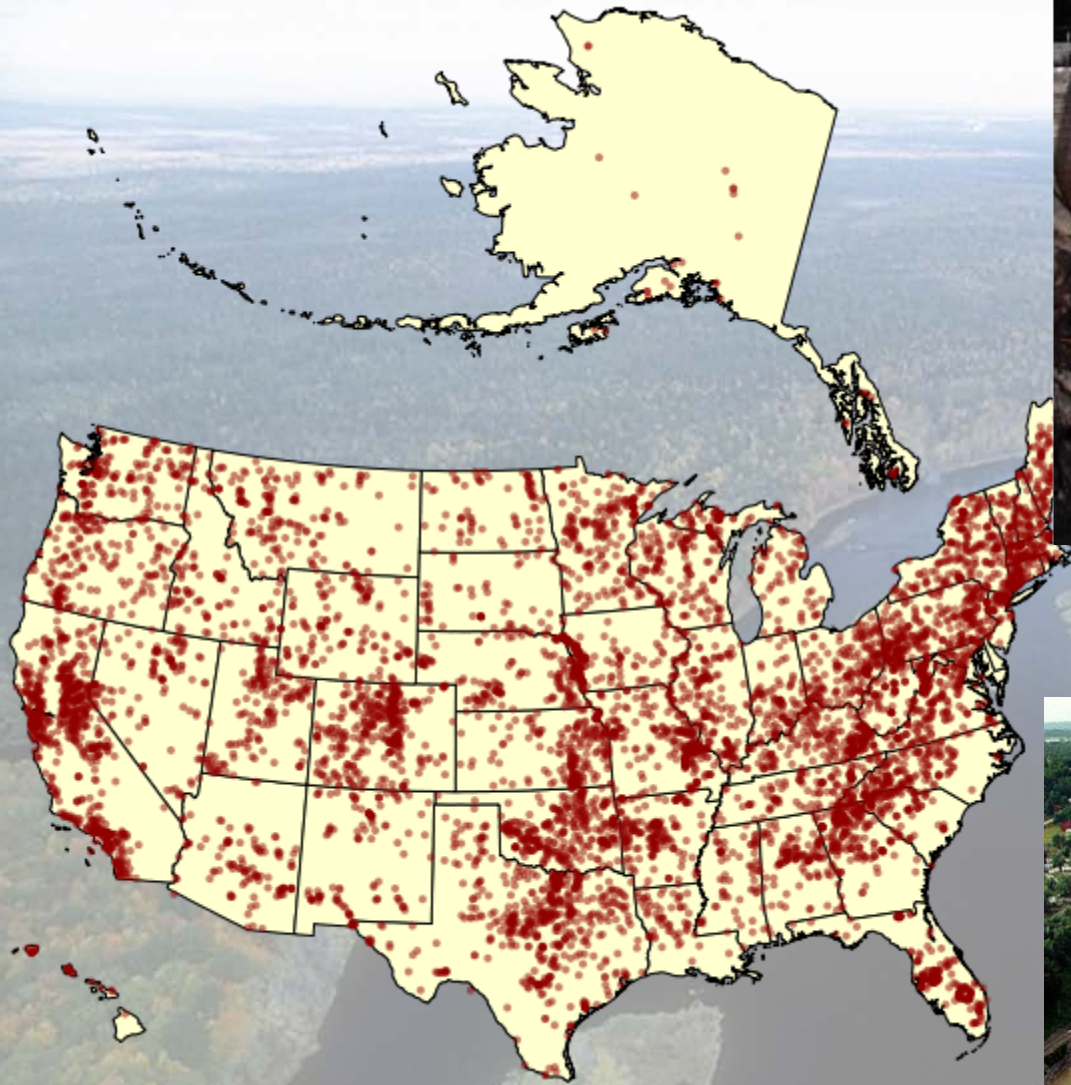
**Presenter Information**

Molly Payne Wynne, George Aponte Clarke, Rory Saunders, Timothy Sheehan, Mathias Collins, and Joshua Royte



# Monitoring the Penobscot River Restoration Project: Baseline Data to Inform Ecosystem Response

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Timothy Sheehan, Mathias Collins, and Joshua Royte



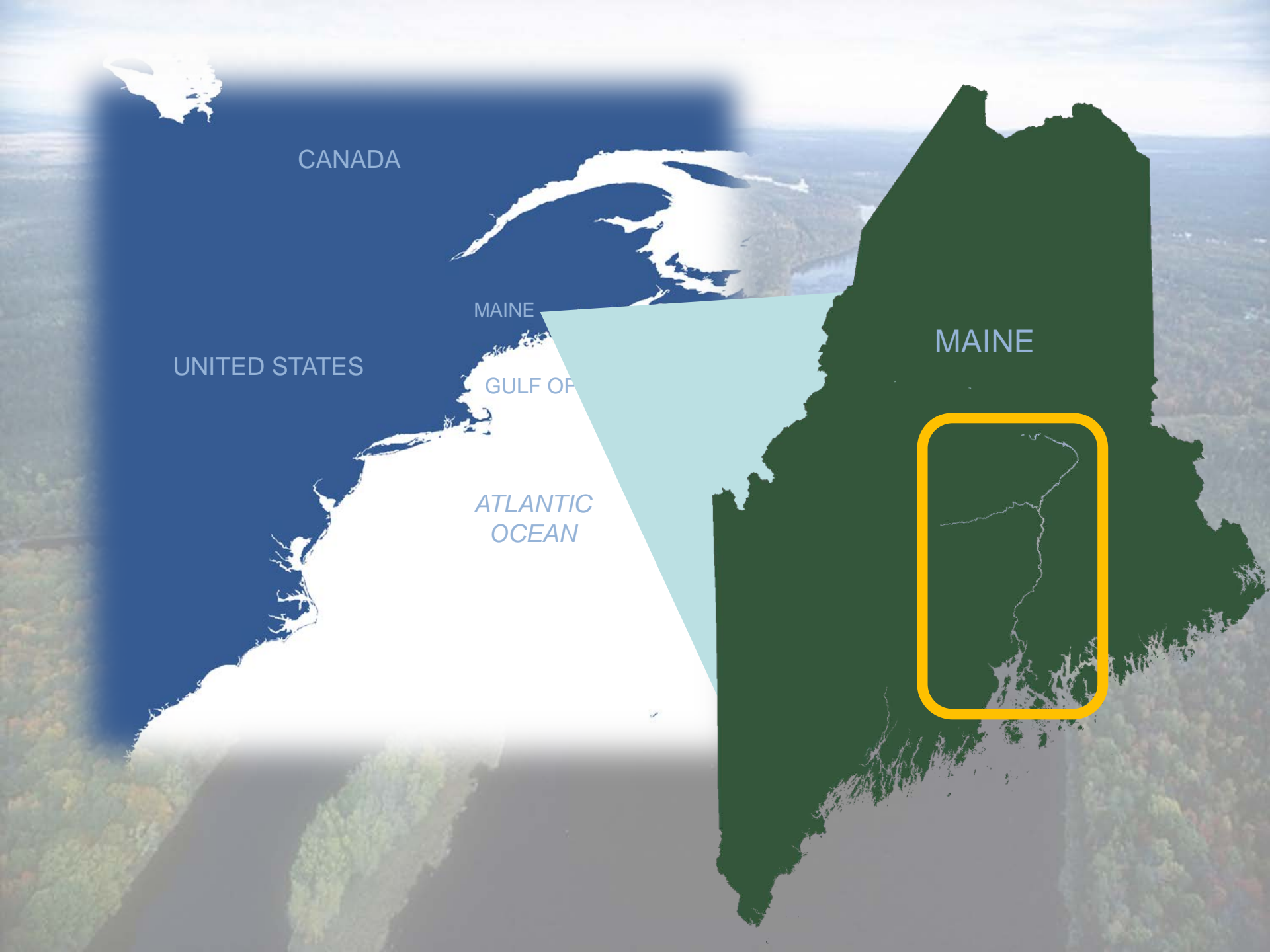
National Inventory of Dams-  
Major US Dams 2006



Condit Dam, White Salmon River



Edwards Dam, Kennebec River



CANADA

UNITED STATES

MAINE

GULF OF

ATLANTIC  
OCEAN

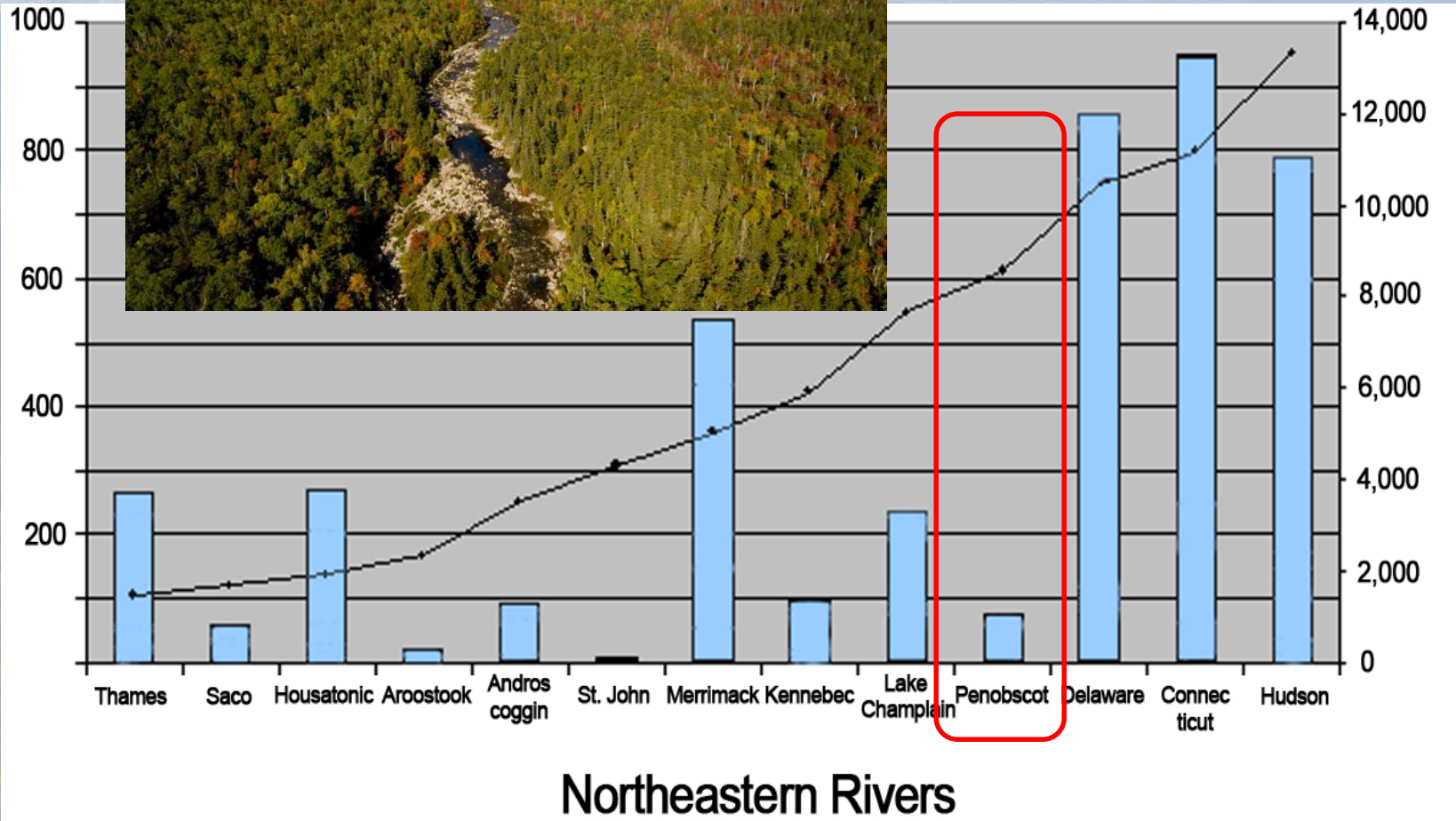
MAINE







Number of dams (Blue Bars)



Watershed size (mi<sup>2</sup>)

Comparison of rivers in the Northeast U.S.

## Energy

## Fish Passage

# Guiding Image/ Objective

Medway Dam

West Enfield Dam

Milford Dam

Stillwater Dam

Orono Dam

Ellsworth Project  
(Union River)

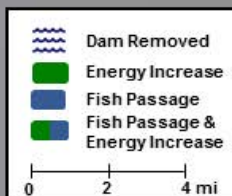
West Enfield Dam  
Existing Fish Passage

Howland Dam  
Decommission /  
Innovative Fish Bypass

Milford Dam  
New Fish Lift  
Complete 2014

Great  
Works Dam  
Removed 2012

Veazie Dam  
Removed 2013



→ Removed Two Dams  
closest to sea: Veazie & Great Works

→ Bypass Howland Dam  
for inland habitat access

→ Improved Fish passage  
at four other dams

→ Increased Energy  
to maintain power generation

→ Enhanced Habitat Access  
1,000 miles of historic habitat

→ Help Restore:  
11 species of native sea-run fish  
associated traditions, culture, and  
economic opportunities



An aerial photograph of a wide river flowing through a dense forest. The river is the central focus, curving from the upper right towards the lower left. The surrounding land is covered in lush green trees, with some areas showing hints of autumn colors. The sky is overcast with soft, grey clouds. The overall scene is a natural, scenic landscape.

# Project Monitoring:

Before-After Approach

Physical Channel



Fisheries



Water Quality



Habitat Use



Riparian Zone and Wetlands



Food Webs



## Project

## Objectives

## Investigators

Channel Geometry, Bed Sediments and Photographic Monitoring

channel elevation, sediment characterization, and repeat photographic monitoring at permanent cross sections.

Kelley and Belknap 2012

Water Quality, Water Temperature, and Benthic Macro-invertebrate Monitoring

water quality/chemistry, water temperature, and benthic macro-invertebrates

Kusnierz et al. 2012

Fish Passage: Upstream Passage of Salmon and Other Diadromous Species (PIT tag methods)

PIT tag technology assessments of fish passage and migration timing/movements of Atlantic salmon, American Shad, and alewife.

Sigourney et al.

Fish Passage: Seaward Migration of Salmon Smolt (active tag methods)

Movement rates and survival of downstream passage for salmon smolts  
Passive tracking using an array of acoustic receivers cooperatively maintained by USGS, University of Maine and NOAA.

Stich et al.

Fish Passage: Shortnose Sturgeon Habitat Use and Spawning

monitoring of shortnose sturgeon to identify preferred habitat, spawning and population size estimates.

Zydlewski et al.

Fish Passage: Diadromous Species Assembling Below Lowest Dam (hydroacoustics)

continuously record the presence and direction of travel of diadromous fish moving through the lower river.

Zydlewski & Erbland 2012

Fish Community Monitoring at the Reach Level (electrofishing and seining methods)

quantify and characterize fish assemblages in the lower ~70 kilometers of river system using electrofishing and other methods.

Kiraly et al. 2012

Wetland and Riparian Habitat Mapping

monitoring of wetland and riparian plants and habitat repeated one year and five years following dam removals.

Boyle Associates 2012; TNC PRRT, et al.

Marine-Derived Nutrients and Ecosystem Function (stable isotope methods)

Determine incorporation of marine-derived nutrients and organic matter in to riverine food webs

Wilson and Sherwood 2012

The Penobscot Estuarine Fish Community and Ecosystem Survey

Investigate novel fish capture techniques and hydroacoustics methods to monitor changes in species composition over time and space in the Penobscot estuary.

NOAA

# Water Quality

## Benthic macroinvertebrate community composition

- Maine DEP aquatic life model
- Indices of community structure

## Water quality changes

- Temp, DO, conductivity, BOD, E. coli bacteria, total coliform, total suspended solids, turbidity, secchi disc visibility, total P, chlorophyll a, pH

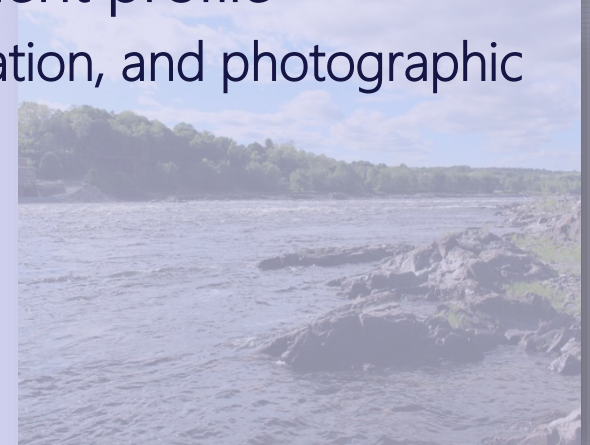
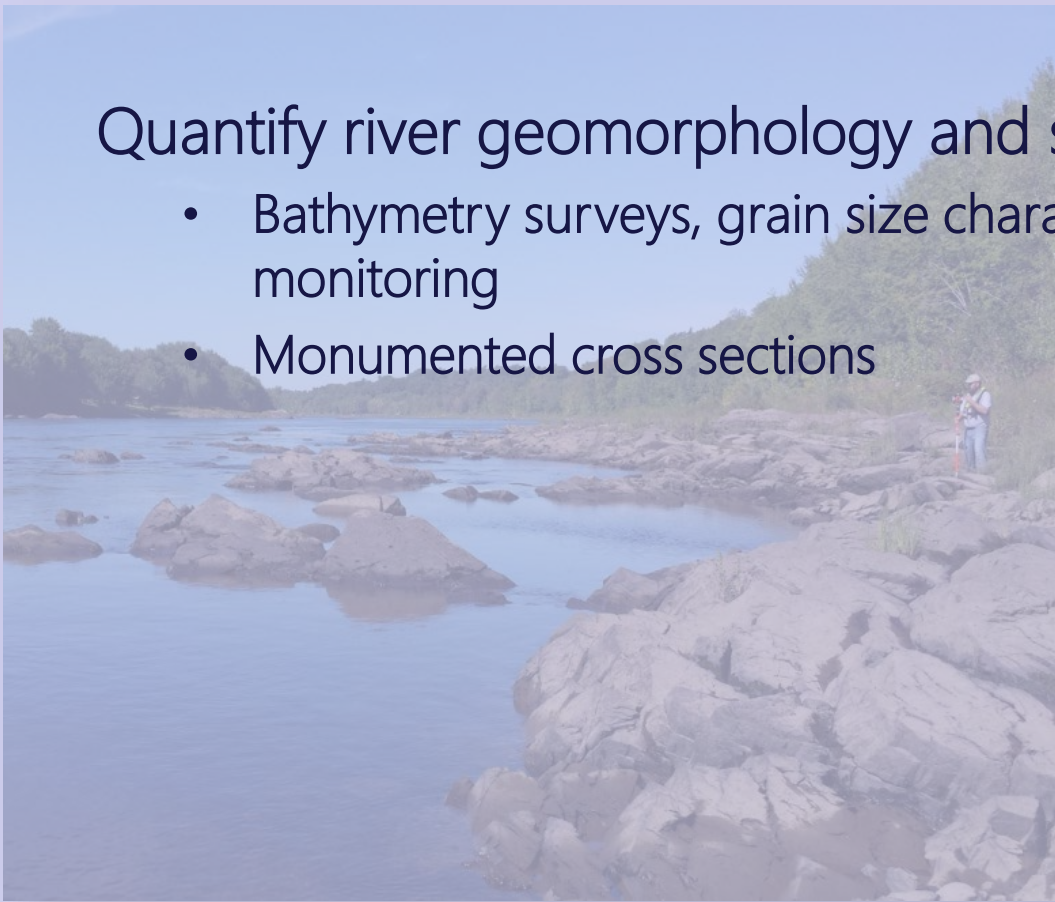


D. Kusnierz, Penobscot Indian Nation

# Geomorphology and Hydrology

Quantify river geomorphology and sediment profile

- Bathymetry surveys, grain size characterization, and photographic monitoring
- Monumented cross sections



A. Kelley, Univ. Maine; G. Stewart, USGS

# Fish Community

Quantify fish community structure

- Continue and expand 2008 and 2009 data sets (Kleinschmidt Assoc.)
  - Applied electrofishing methodology

Hydroacoustics

- Estimated abundance at lower reach
  - Cross river section

Photo by Bridget Besaw, courtesy of Penobscot River Restoration Trust



S. Coghlan Univ. Maine; G. Zydlewski, Univ. Maine

# Fish Passage

## Upstream Passage

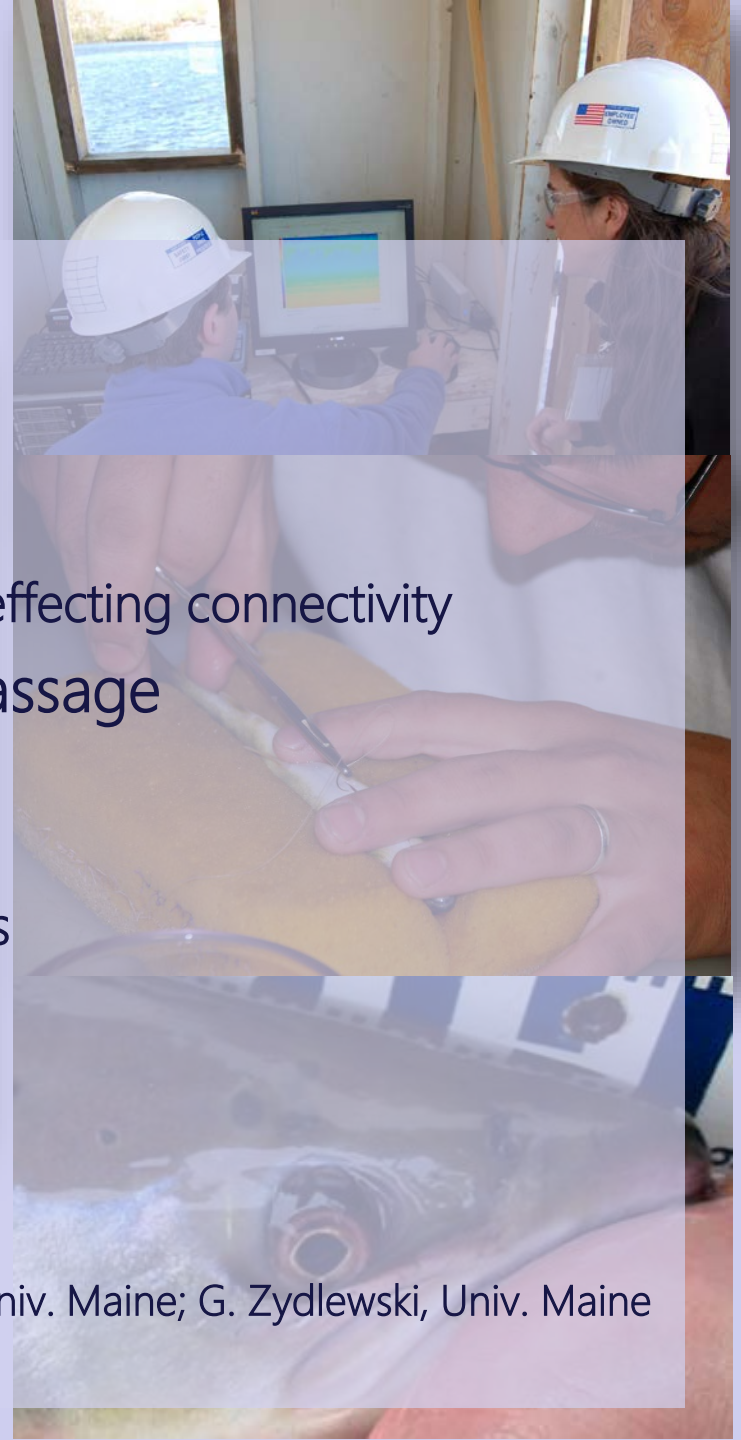
- Homing efficiency
- Migratory delay at fishways
- Passage rates
- Environmental and operational variables effecting connectivity

## Downstream Atlantic salmon smolt passage

- Downstream survival
- Evaluate path choice
- Radio and acoustic telemetry methods

## Hydroacoustics

- Estimated abundance at lower reach
- Cross river section



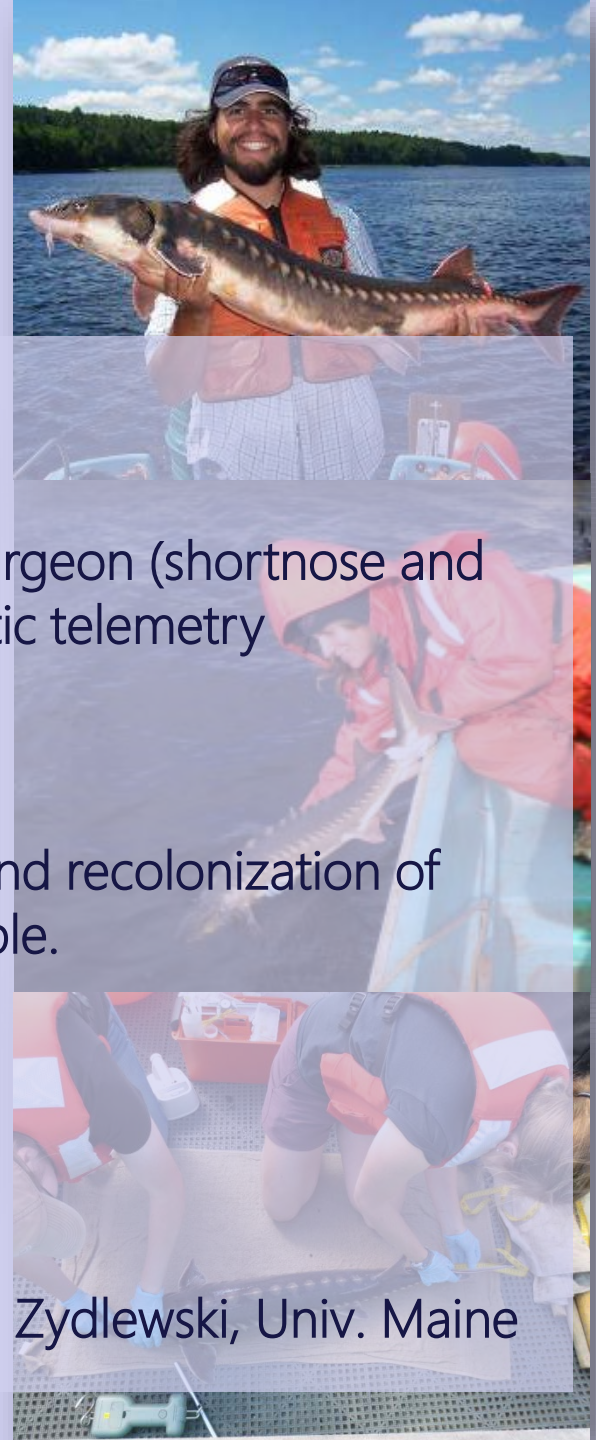
# Sturgeon Reproduction and Habitat Use

## Habitat use

- Assessment of two species of endangered sturgeon (shortnose and Atlantic sturgeon) in the lower river via acoustic telemetry

## Assessment of spawning habitat

- Habitat modeling; monitor dynamics and recolonization of suitable spawning habitat now accessible.
- Larvae and egg surveys



G. Zydlewski, Univ. Maine



# Wetland, Riparian, and Ecosystem Response

- Assessing Marine-Freshwater Food Web Linkages Using Stable Isotopes
- Wetland and Riparian Habitat Mapping
- Bird Community Monitoring
- Estuarine Fish Community Monitoring

Wilson, USM & Sherwood, GMRI; Call, Univ. Maine; Lipsky, O'Malley, Stevens, Kocik, and Saunders; NOAA

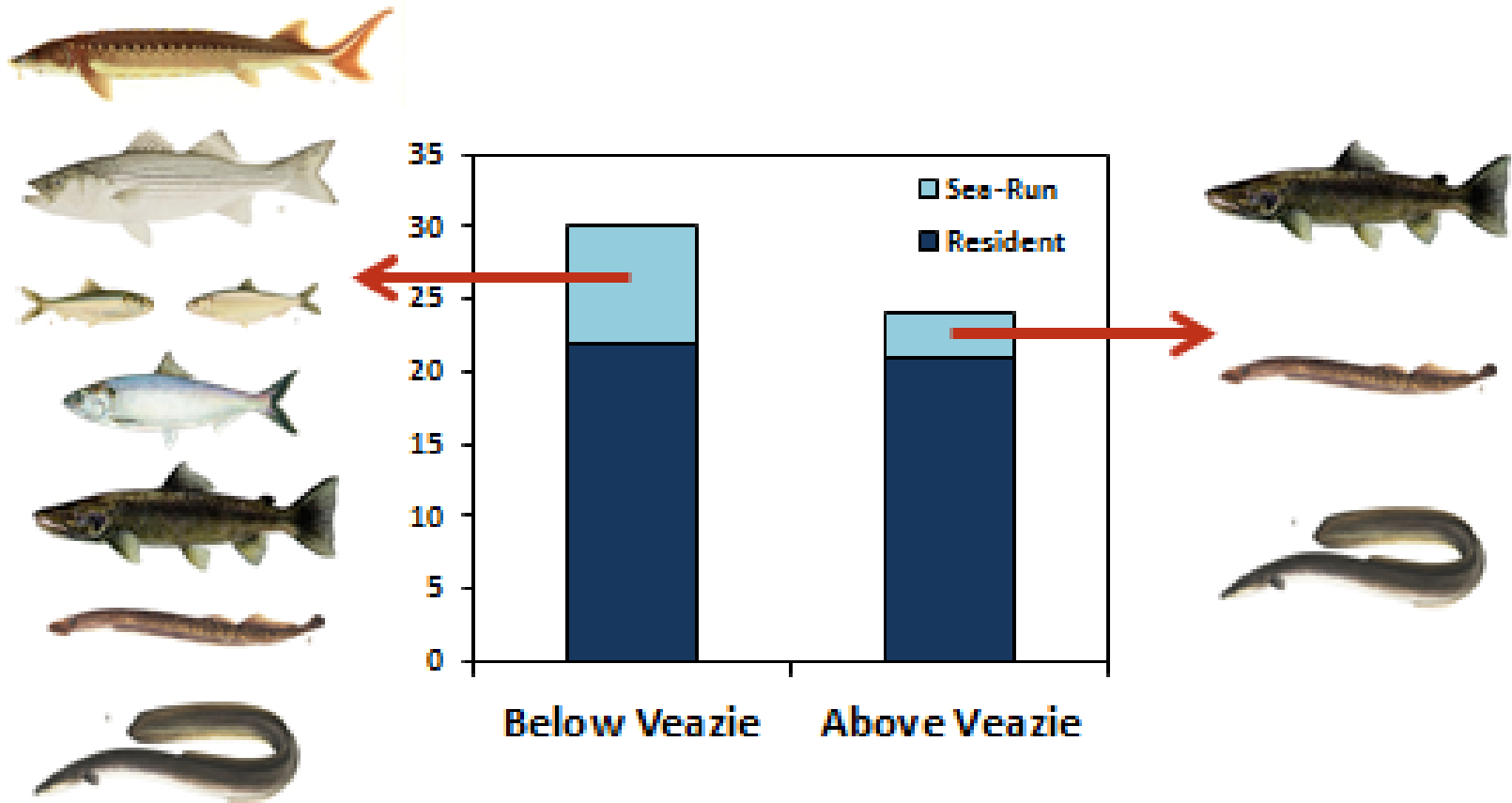


# Baseline Patterns

1. All 12 native diadromous species of fish are present in the Penobscot River, many of which are successfully reproducing on their own
2. Diadromous species persist despite having access to only a small percentage of their historic habitat
3. Veazie Dam represented a near complete barrier to migration of most species of diadromous fish.
4. Water quality does not appear to be limiting for most diadromous species
5. Large changes to flow, sediment regime, and habitat (except in the immediate vicinity of the former dam sites) are unlikely.

3. *Veazie Dam represented a near complete barrier to migration of most species of diadromous fish.*

## Sea-run species documented below vs. above Veazie Dam



Slide Courtesy of Dr. Stephen Coghlan, University of Maine

# 4. *Water quality does not appear to be limiting for most diadromous species*

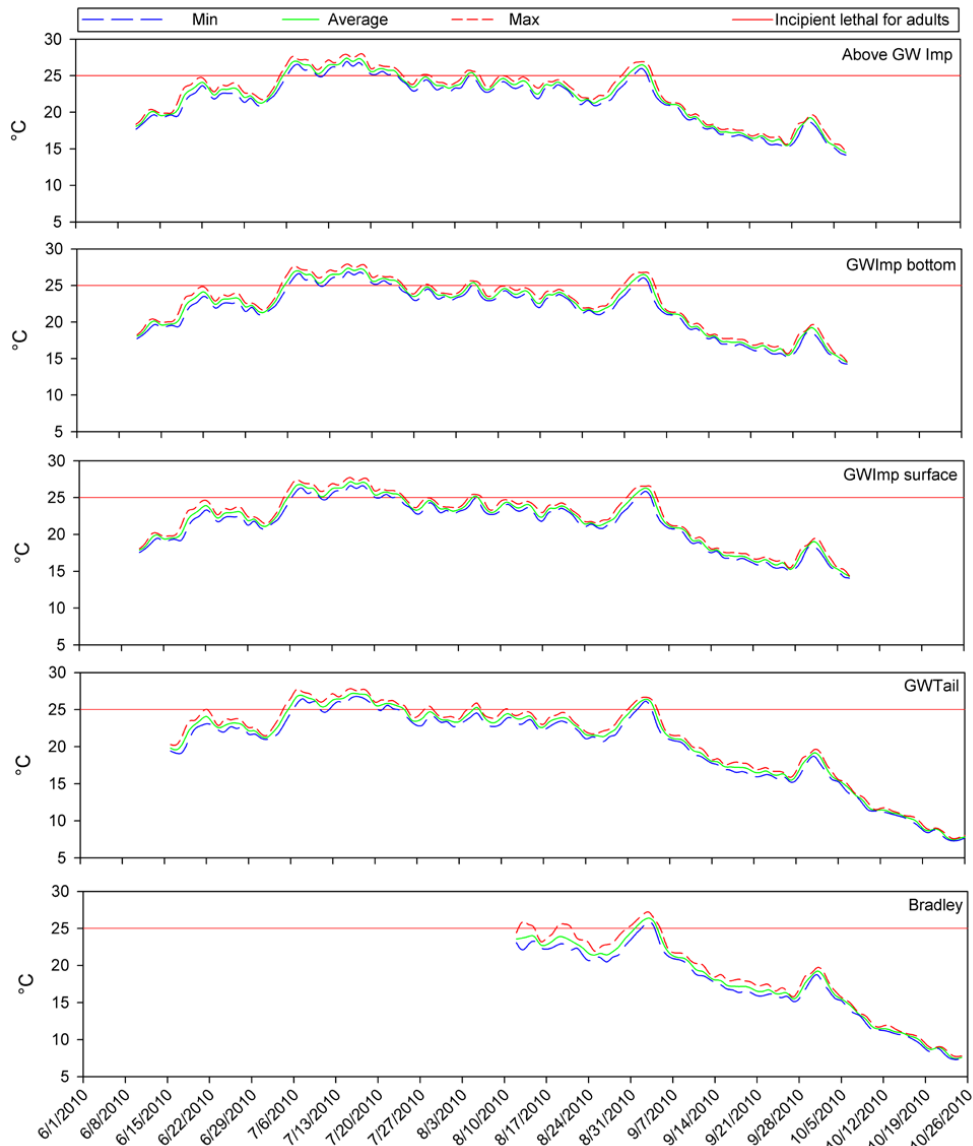
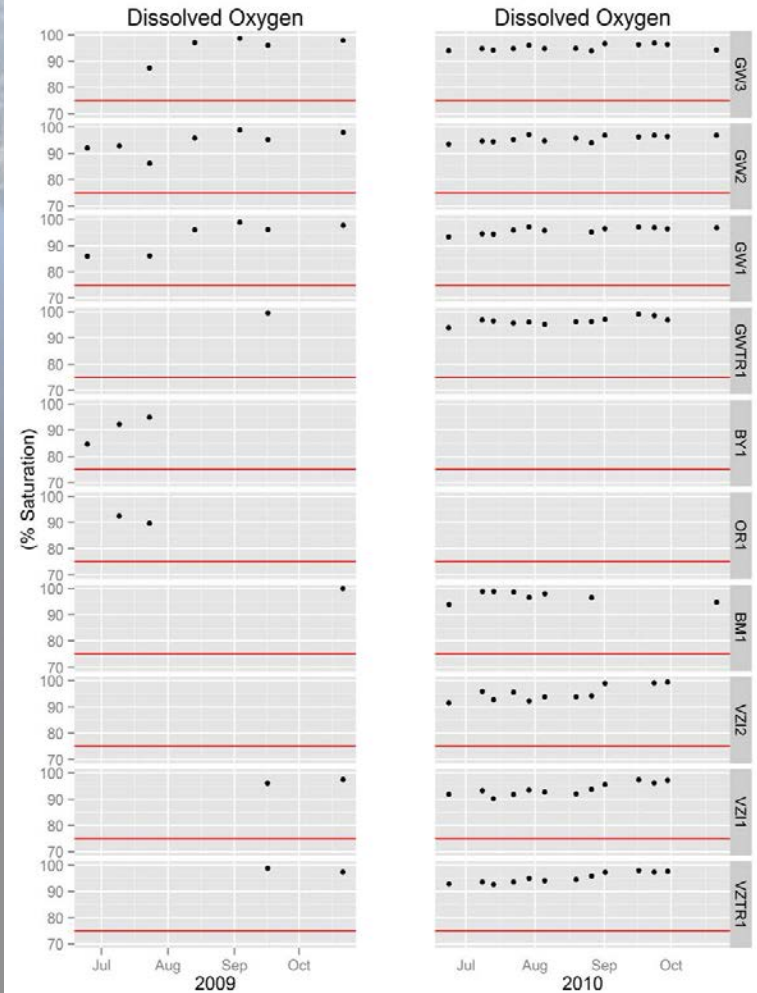
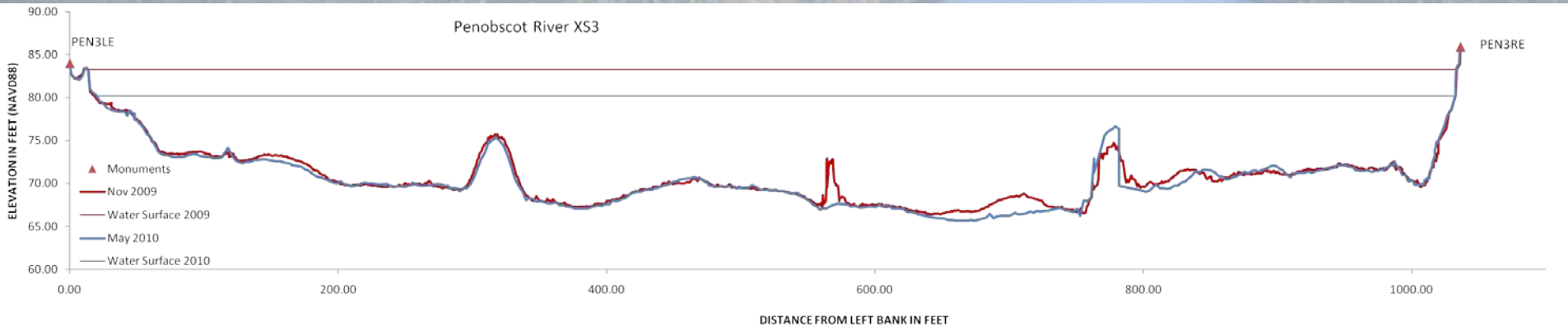


Figure 22. Dissolved oxygen percent saturation measured at sites associated with Great Works and Veazie dams in 2009 and 2010. Red line indicates minimum Class B criteria of 75%.



**5. Large changes to flow, sediment regime, and habitat (except in the immediate vicinity of the former dam sites) are unlikely.**



# Baseline Conditions

Importantly, we have a snapshot of pre dam removal conditions and thus an objective basis for evaluation of restoration outcomes post project implementation.



An aerial photograph of a wide river flowing through a dense forest. The river is dark blue and winds through the landscape, with several islands and peninsulas. The forest is a mix of green and brown, suggesting autumn. The sky is overcast and grey. The text "A River Reborn?" is overlaid in the center in a dark blue, serif font.

# A River Reborn?





# 2016 Fish Counts\*

<b>Atlantic salmon</b>	<b>190</b>
<b>River herring**</b>	<b>1,194,577</b>
<b>American shad</b>	<b>2,945</b>
<b>Striped bass</b>	<b>195</b>
<b>Sea lamprey</b>	<b>582</b>

\* As of June 13, 2016; Maine DMR at Milford Fish Lift

\*\* An additional 464,979 river herring counted at Blackman Stream

# Acknowledgements

Research Collaborators from:

- University of Maine, University of Southern Maine, Gulf of Maine Research Institute, Penobscot Nation, USGS, NOAA
- Diadromous Species Restoration Research Network (DSRRN), Brookfield Hydro
- And the countless others who made this work possible...



