Sea-Run Fish Communities of the Eastern Maine Coastal Current: Status, Change, Vulnerability, and Resilience

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Maine’s Sea-Run (Diadromous) Fish

- Brook Trout
- Rainbow Smelt
- River Herring (alewife, blueback)
- American shad
- Atlantic salmon
- Atlantic Sturgeon
- Shortnose Sturgeon
- American eel
- Striped Bass
- Tomcod

(NOAA Fisheries)
US Landings or Assessments

- **Sturgeon**
- **Atlantic salmon**
- **Striped Bass**
- **River Herring**

Figure 1. Total commercial landings of river herring from the U.S. Atlantic Coast, 1950-2007 (Source: NMFS, Fisheries Statistics Division, Silver Spring, MD, pers. comm. as cited in ASMFC 2009).
US Landings or Assessments - Status

American Shad

Atlantic salmon

Striped Bass

River Herring

Figure 1. Total commercial landings of river herring from the U.S. Atlantic Coast, 1950-2007 (Source: NMFS, Fisheries Statistics Division, Silver Spring, MD, pers. comm. as cited in ASMFC 2009).
Maine Landings
EBFM and Atlantic Salmon

... recognizes ... interactions among the affected fishery-related components of the ecosystem

Native Fish Community

Invasive Spp.
EBFM and Atlantic Salmon

... including humans; and seeks to optimize benefits among a diverse set of societal goals.”
Fisheries Management in a Changing Climate
Lessons From the 2012 Ocean Heat Wave in the Northwest Atlantic

BY KATHERINE E. MILLS, ANDREW J. PERSHING, CURTIS J. BROWN, YONG CHEN, FU-SUNG CHIANG, DANIEL S. HOLLAND, SIGRID LEHTA, JANET A. NYE, JENNY C. SUN, ANDREW C. THOMAS, AND RICHARD A. WAHLE*

INTRODUCTION
Climate change became real for many Americans in 2012 when a record heat wave affected much of the United States, and Superstorm Sandy pounded the ecosystems and economies. Marine species responded to warmer temperatures by shifting their geographic distribution and seasonal cycles. Warm-water species moved northward, and some species (Tebaldi et al., 2006; Hansen et al., 2012). The 2012 Northwest Atlantic heat wave provides valuable insights into ways scientific information streams and fishery management frameworks may need to
Rivers Are Changing - Can Fish Adapt?

**NUMBER OF SIGNIFICANT TRENDS FOR MEAN FLOWS FOR ALL SITES**

27 trend tests per month

- **More water in these months**

- **Less water in these months**
NEVA – Assessing Future Vulnerability

Northeast Fisheries Climate Vulnerability Assessment (79 species)

Exposure
- Sea surface temperature*
- Air temperature*
- Salinity*
- Ocean acidification (pH)*
- Precipitation*
- Currents**
- Sea level rise**

Sensitivity
- Habitat Specificity
- Prey Specificity
- Sensitivity to Ocean Acidification
- Sensitivity to Temperature
- Stock Size/Status
- Other Stressors
- Adult Mobility
- Spawning Cycle
- Complexity in Reproductive Strategy
- Early Life History Survival and Settlement Requirements
- Population Growth Rate
- Dispersal of Early Life Stages

*modelled results (mean & variance)
**written description only

NEVA – Assessing Future Vulnerability

Fish & Invertebrate Vulnerability Assessment (2016)

Atlantic salmon

Overall vulnerability = very high

Hare et al. 2016
American Shad  
Blueback Herring  
Shortnose Sturgeon  
Alewife  
Rainbow smelt  
Atlantic sturgeon  

Overall vulnerability = high  

Hare et al. 2016
Species Adaptations to Change

Image from: http://kinooze.com/the-constant-change-adaptation/
It’s About Time . . . Changes in Migration Timing


Salmon Smolt Ocean Entry
Adult River Returns
River Herring Returns

River – less ice time, earlier spring floods
Northeast U.S. Shelf and Climate: Alewife

- Historical changes in distribution
- Life history / stock boundaries / catchability
- 24 of 36 fish stocks shifted poleward / deeper (Nye et al. 2009)

Alewife At Sea Distribution – Spring Survey

http://www.int-res.com/abstracts/meps/v393/p111-129/
http://www.nefsc.noaa.gov/epd/ocean/MainPage/ioos.html
Future Projections – Alewife Distribution

- Future changes projected through coupled biological-climate models
- Northeastward movement will continue

*Lynch et al. (in press) Projected ocean warming creates a conservation challenge for river herring populations*
Fostering Resilience
Lower Penobscot River Restoration – A Great Start

• Lower river species (sturgeon, smelt, and striped bass) gained 100% unimpeded access to historic habitat

• American shad and blueback herring will gain access to over 93% of historic habitat *IF they pass up to five fishways (including Milford)*

• The *majority* (66%) of alewife habitat is still inaccessible after implementation of PRRP

• Most habitat for *highly migratory species (e.g., salmon)* will be above 2-5 dams instead of 4-7 dams
Culverts and Process-Based Restoration

NARRAGUAGUS RIVER CONNECTIVITY, 2000-2018
February 02, 2019

WEST BRANCH BROOK
August 08, 2018

GRAND LAKE BROOK
September 09, 2015

MOOSEHORN 2015
September 09, 2015
Take Homes

• Climate Impacts on Sea-run Ecosystems -
  • River and Oceans Changing
• Fish Responses to Change – variable
  • Salmon – resiliency shown
  • Alewife – opportunity to expand northward
• Likely species changes will occur
  • Diadromous Fish among Most Vulnerable
• Building Resilient Fish Communities
  • Healthy Habitats
  • Reconnecting Oceans and Upstream Rivers and Lakes
  • Conservation of Fish Genetic Diversity is one Key to Resilience
    • *** Maine has All Native Species Present… for now