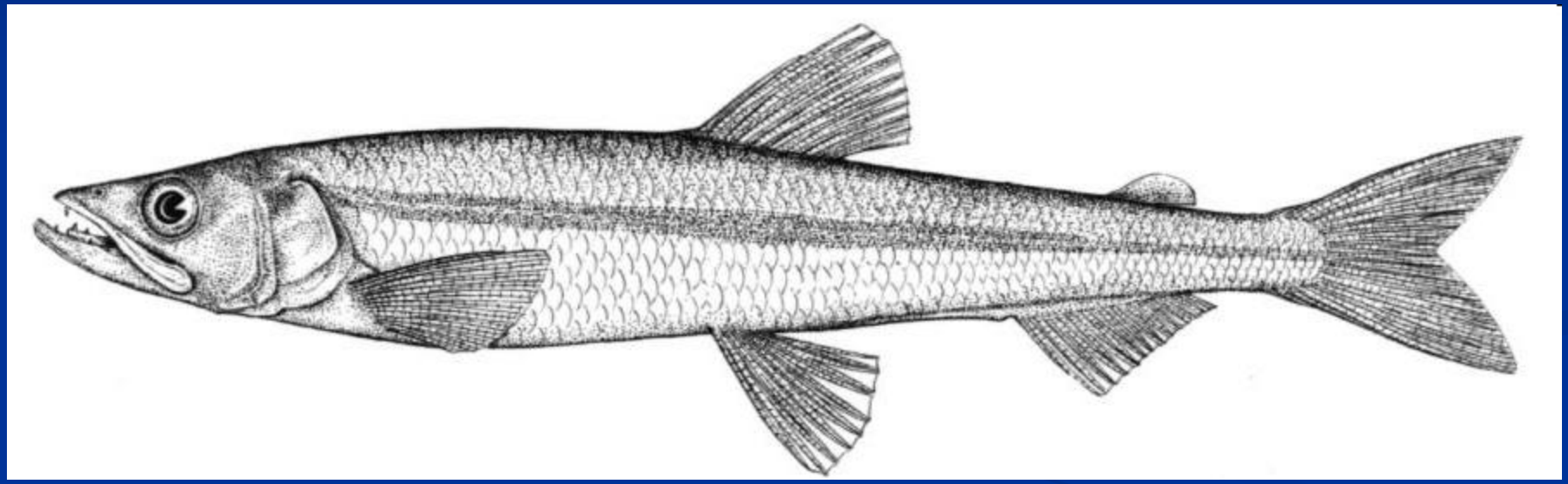
A Multi-State Collaborative to Develop and Implement a Conservation Program for Rainbow Smelt



Claire Enterline, Maine Department of Marine Resources

Penobscot Science Exchange, November 4, 2010

Anadromous Rainbow Smelt

Can live up to 6 years and 10”, but more typically 2-3 years and 6”

Eat plankton, small shrimp and fish

Spring
- Spawn at head of tide

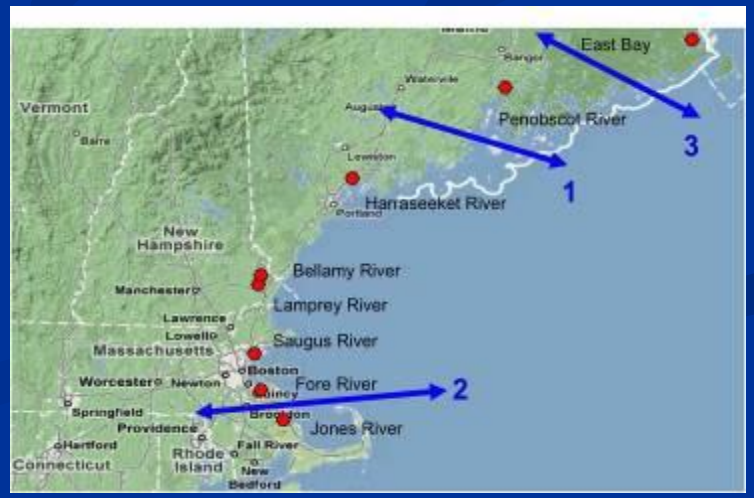
Summer
- Young of the year in estuaries, adults in coastal waters

Fall
- Open bays, moving towards shore

Winter
- Sheltered bays, large tidal rivers

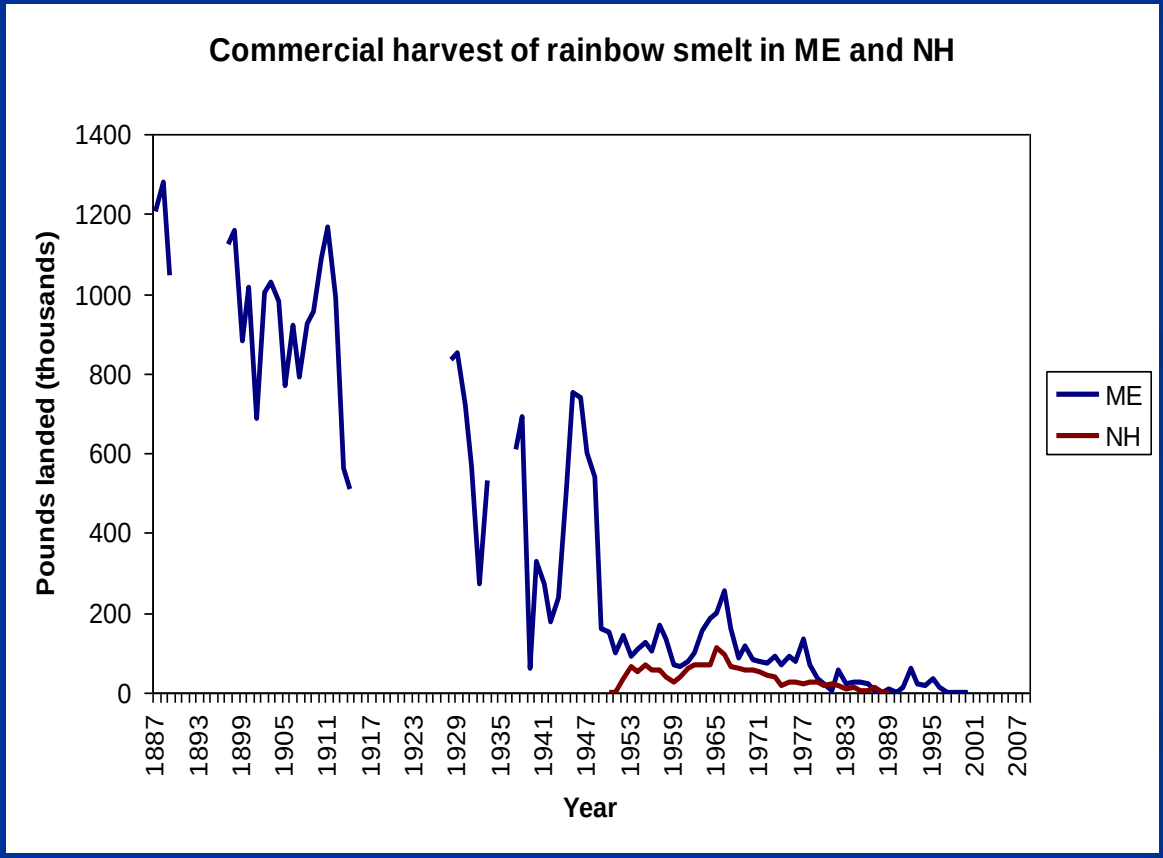
May spawn in different streams each year within the same river system

Variation in genetic structure of populations > four distinct regions



Rainbow Smelt: Fishery

- Commercial bait fish in early 1900's, but as landings declined, so has the fishery



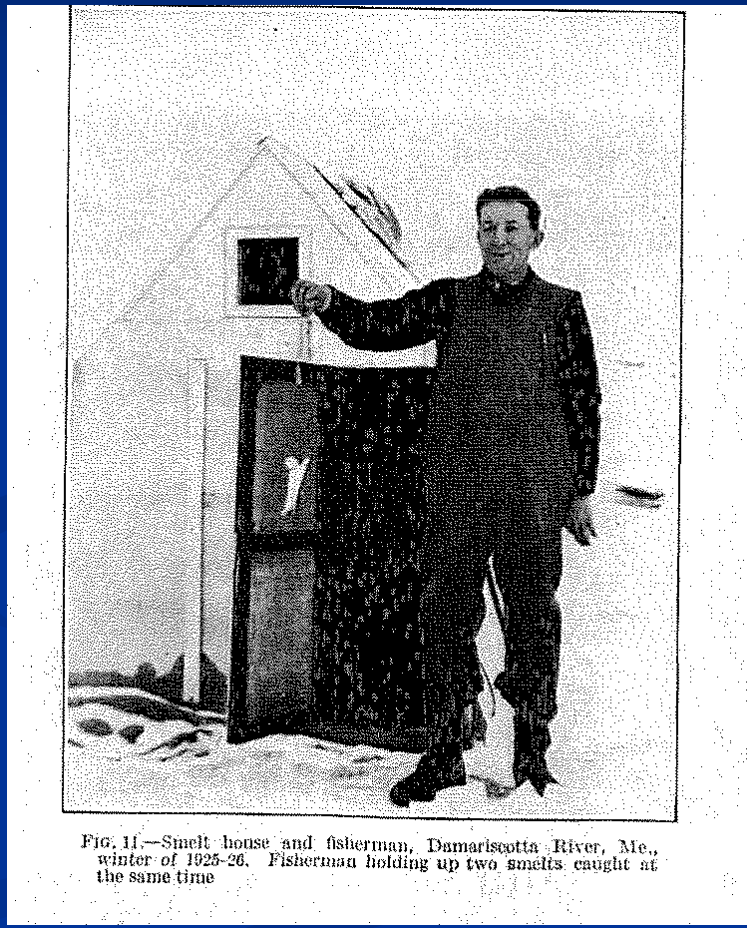
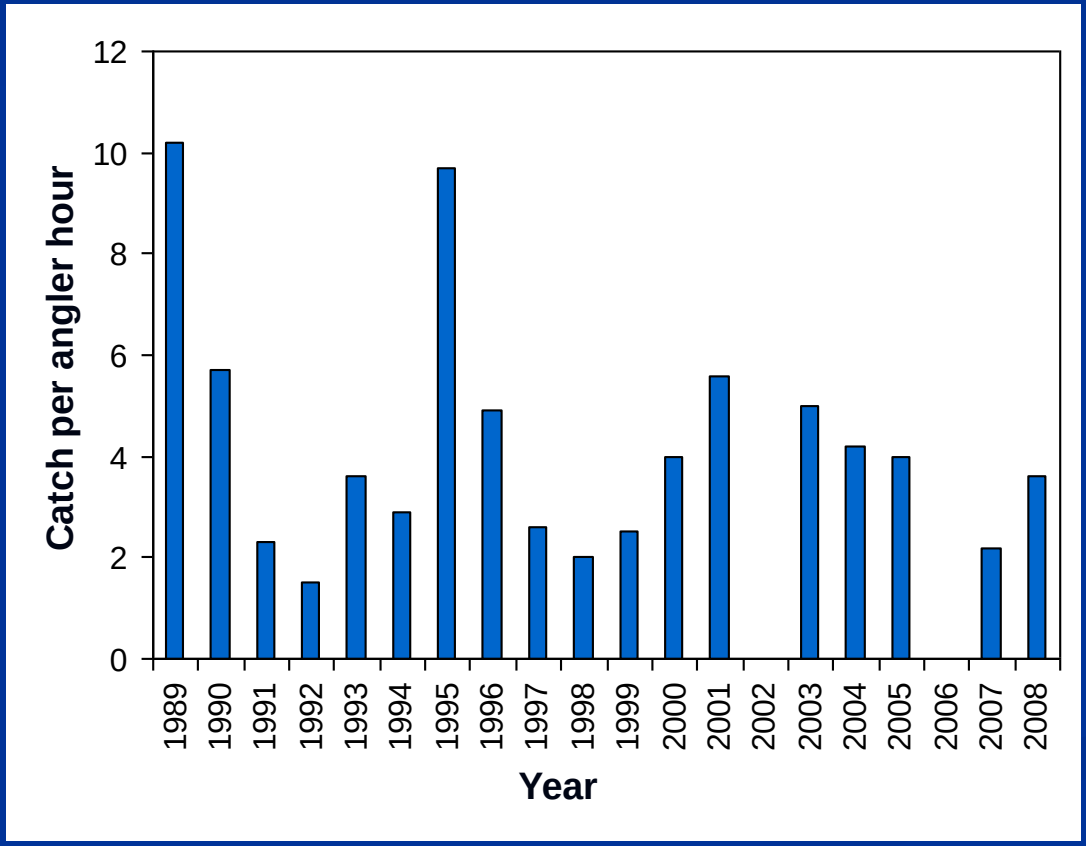


FIG. 11.—Smelt house and fisherman, Damariscotta River, Me., winter of 1925-26. Fisherman holding up two smelts caught at the same time

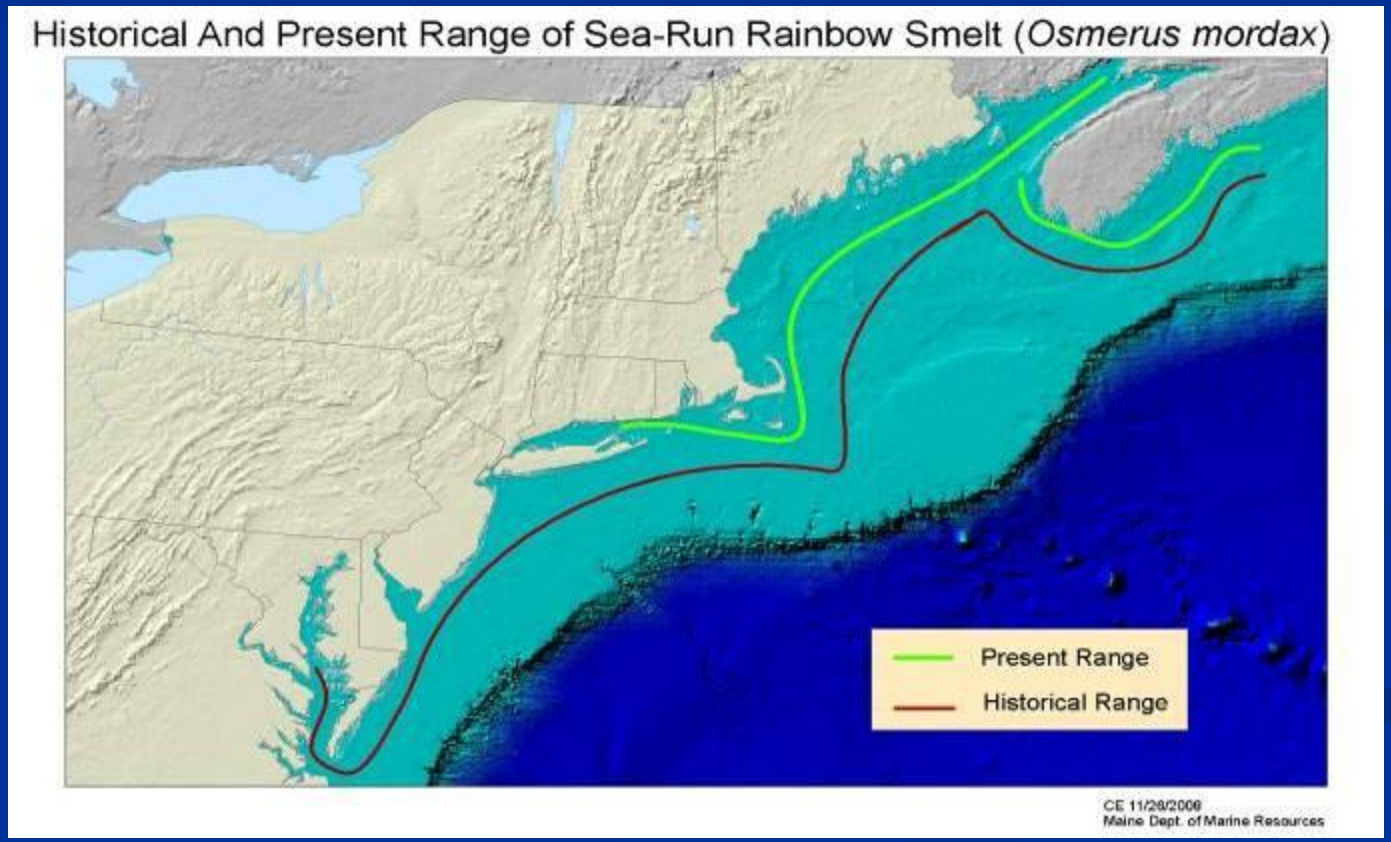
Rainbow Smelt: Fishery

- Healthy recreational fisheries in Maine and New Hampshire



Rainbow Smelt: Species of Concern

- Threats to spawning:
  - Obstructions
  - pH (acid rain, land use)
  - Habitat alteration
  - Eutrophication
- Possible threats to adults:
  - Historical commercial fishery
  - Rising ocean temperature
  - Marine predation



Sources: Fuda *et. al.*, 2007; Geffen, 1990

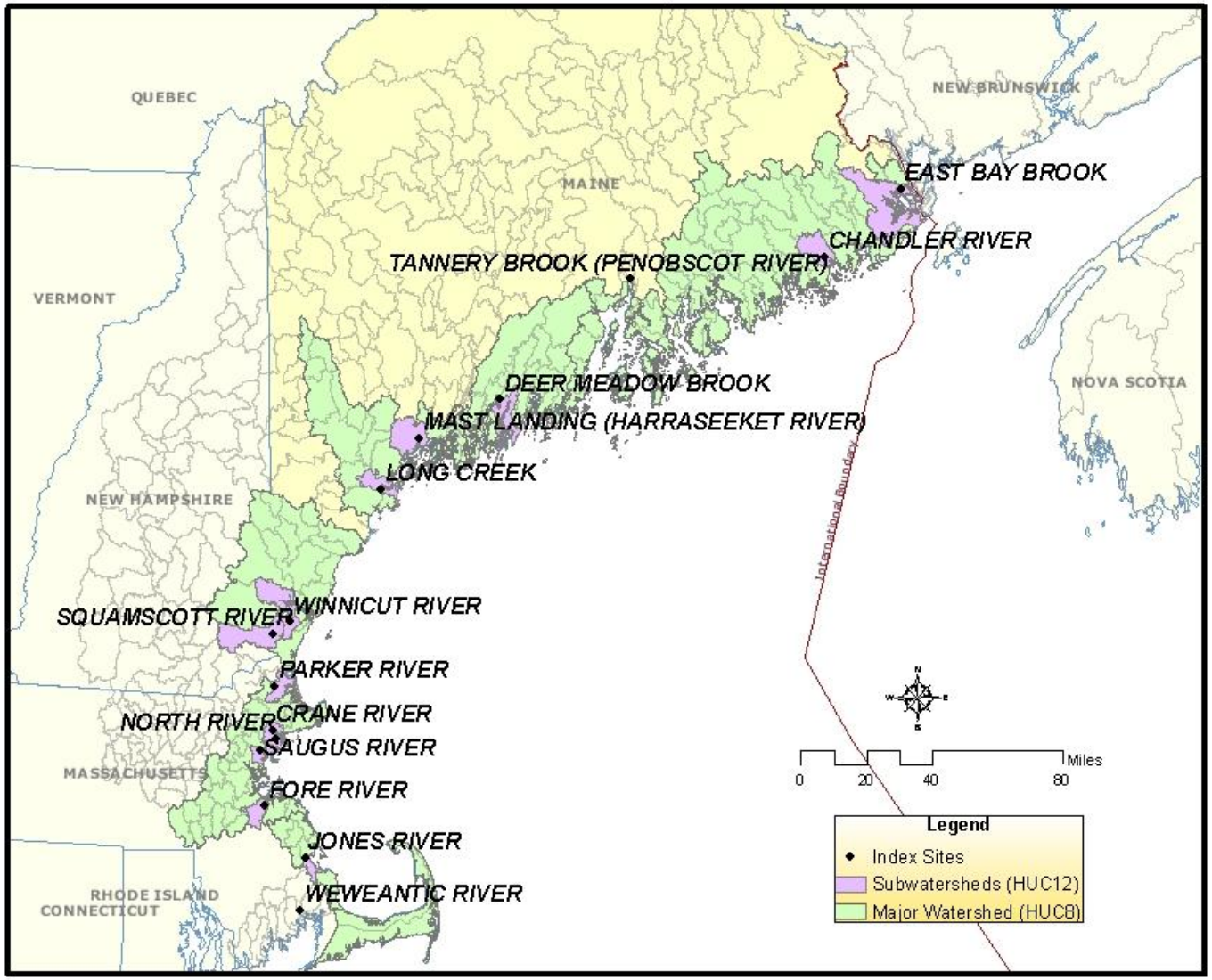
Project objectives

- Enhance understanding of rainbow smelt in Gulf of Maine, with particular focus on spawning populations
- Assess threats to spawning rainbow smelt (RBS) populations and egg survival
- Develop regional conservation plan to protect smelt in the Gulf of Maine

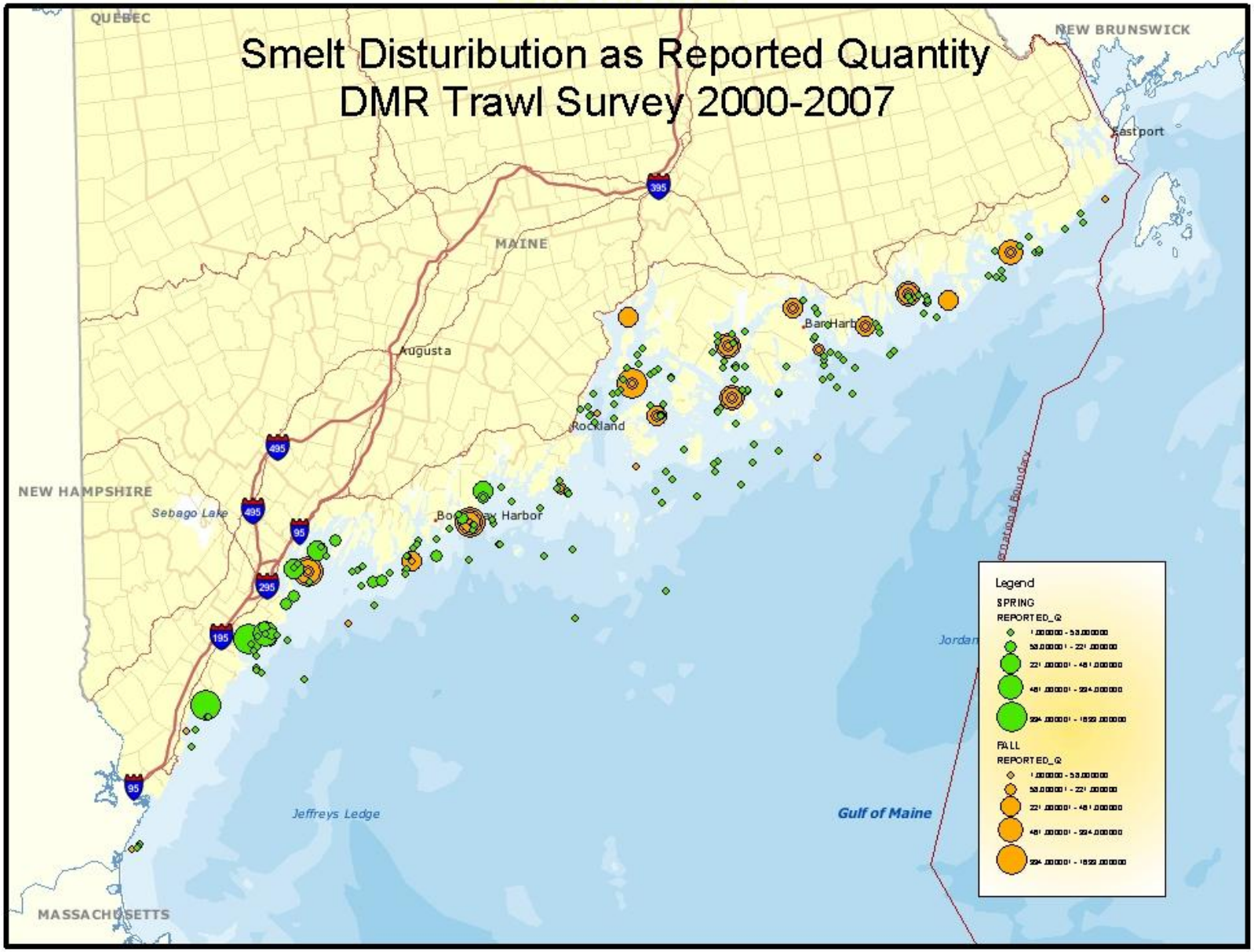
Objective 1: Enhance understanding of rainbow smelt, particularly spawning populations

- Describe spawning population characteristics and differences within the Gulf of Maine
- Document key spawning habitat conditions (periphyton growth, aquatic health via biomonitoring)
- Assess genetic distinctions in the Gulf of Maine
- Assess toxic contaminants and pathological condition
- Describe annual movement

Gulf of Maine Species of Concern Grant
Rainbow Smelt (Osmerus mordax) 2009 Index Sites



10/6/2009 C. Enterline



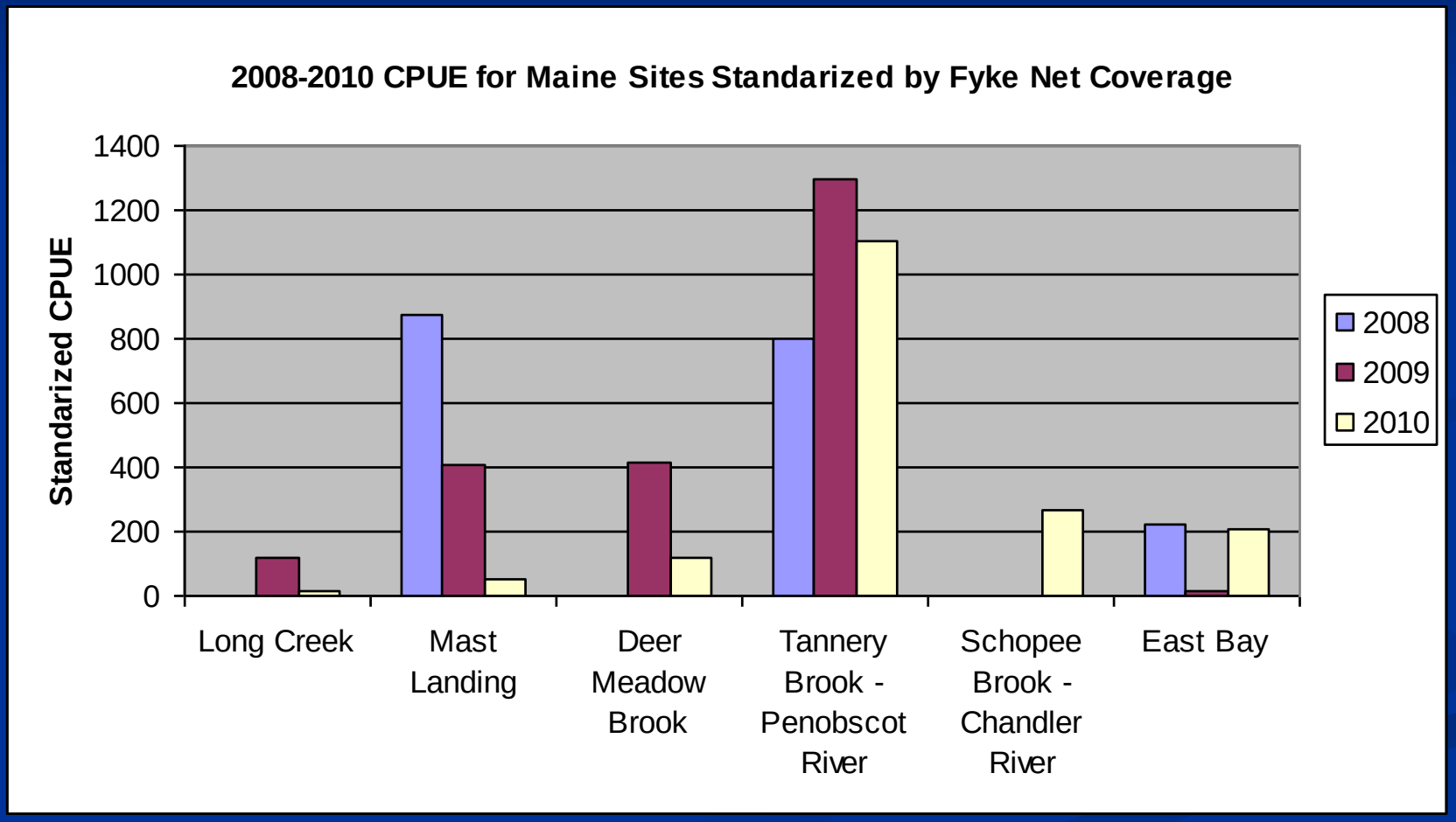
CE Edit 12/3/08

Methods—Population characteristics

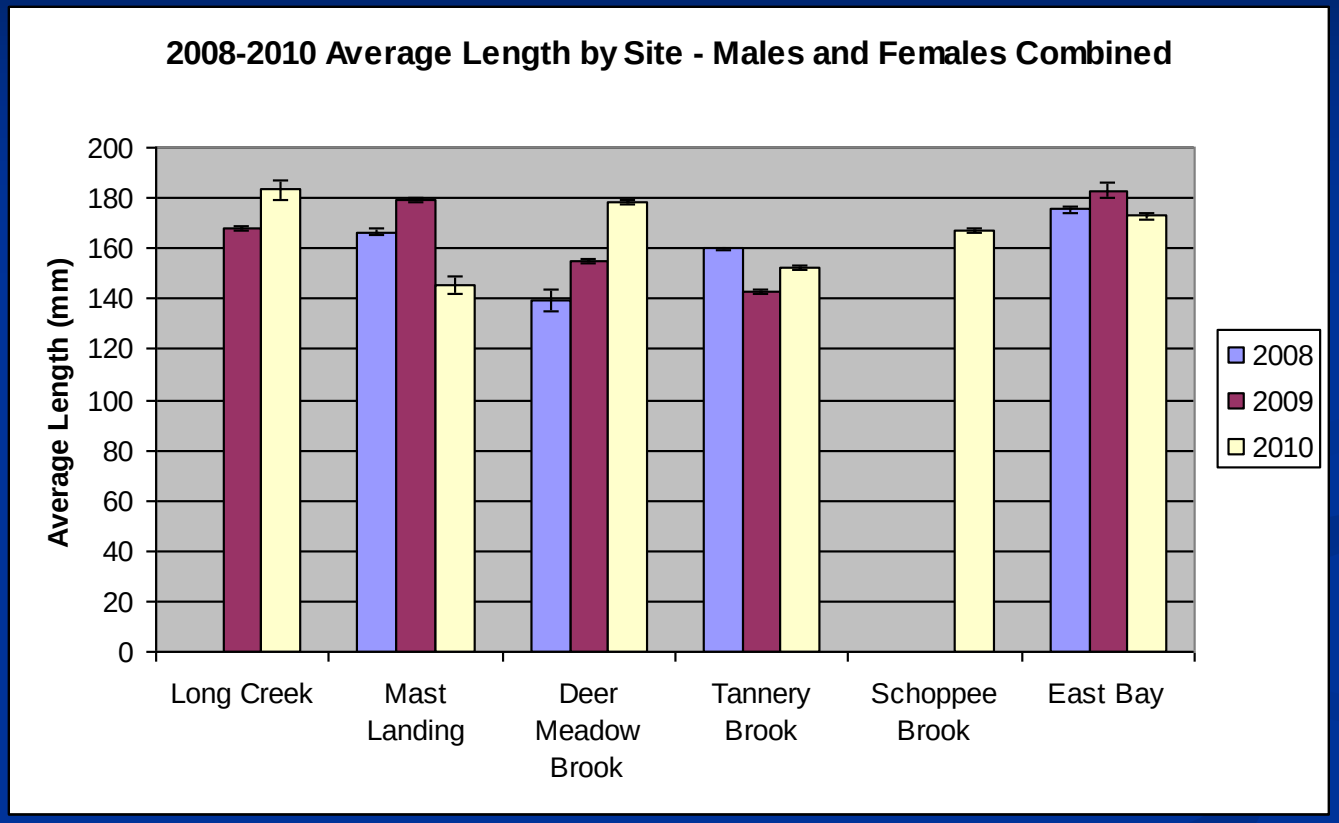
Fyke nets used to capture smelt throughout spawning season:

- Catch per unit effort (CPUE)
- Length distribution
- Sex ratios
- Age structure
  - Annual survival rates
  - Instantaneous mortality
- Collect samples for analyses of genetics, toxic contaminants, and pathology analyses

Preliminary Results: CPUE



Preliminary Results: Length Between Sites



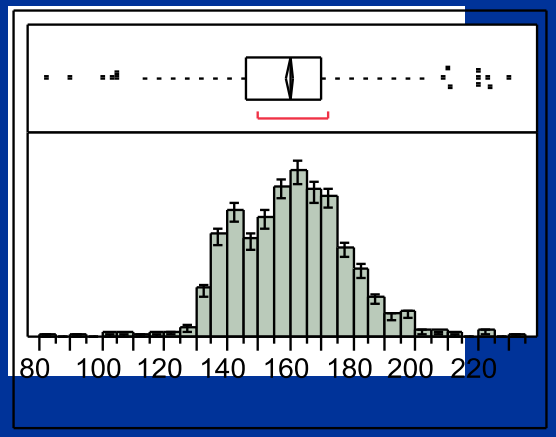
Average length changes each year dependent on dominant age class and mortality

Tracking Age Cohorts

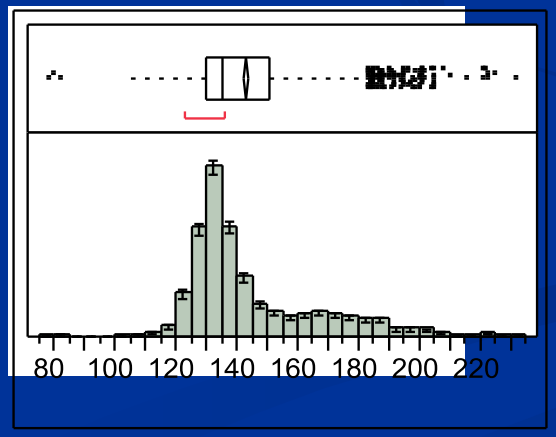
Figures show length distributions for each year for both males and females at Tannery Brook

Note small age-2 cohort in 2009

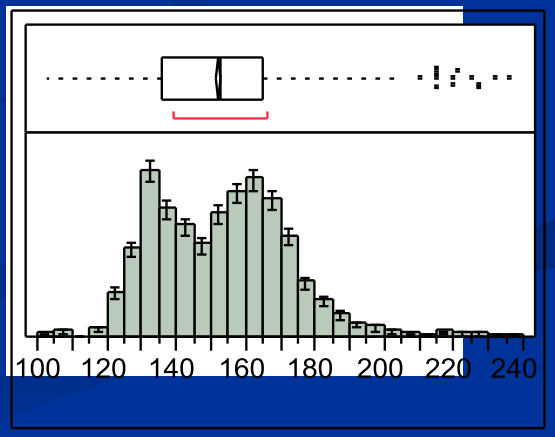
2008



2009



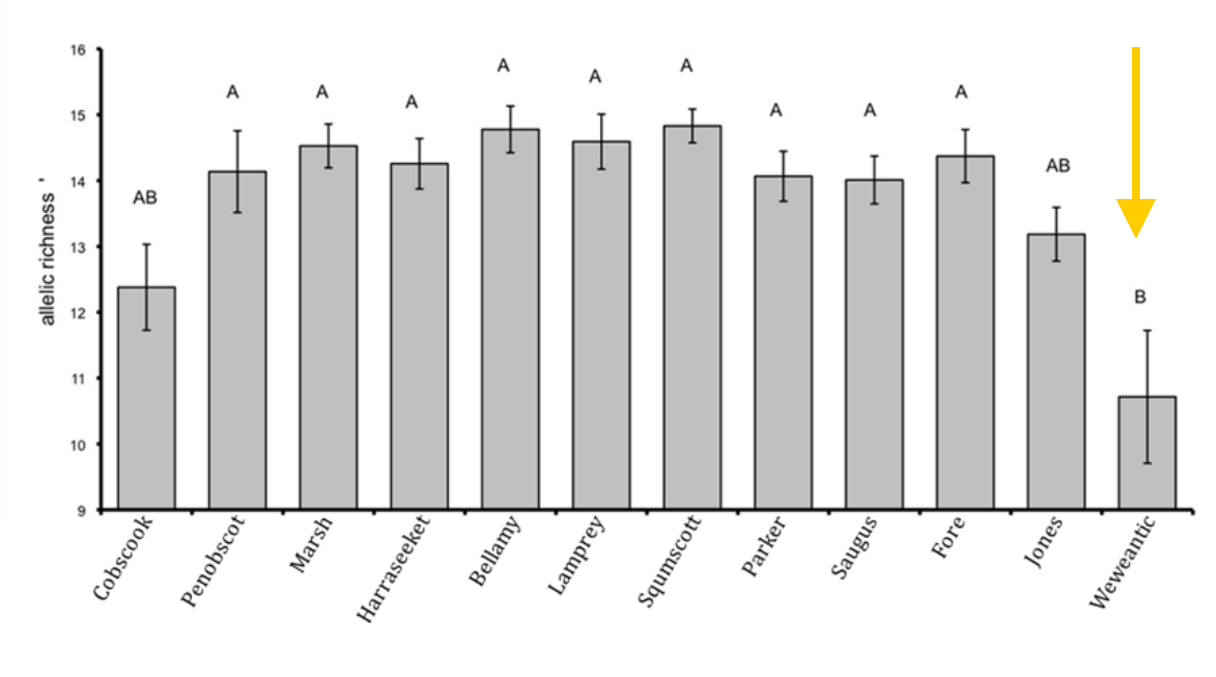
2010



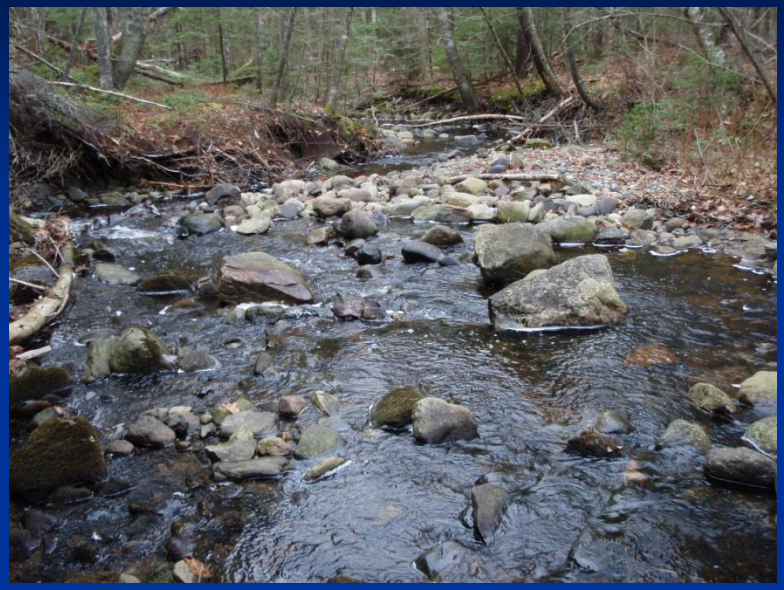
Preliminary Genetic Results

Smelt in stressed populations may mature at smaller sizes

- Genetic work shows lack of allelic diversity in rivers where smallest average length at age 1 is observed, southern edge of range



Methods—Spawning habitat characteristics

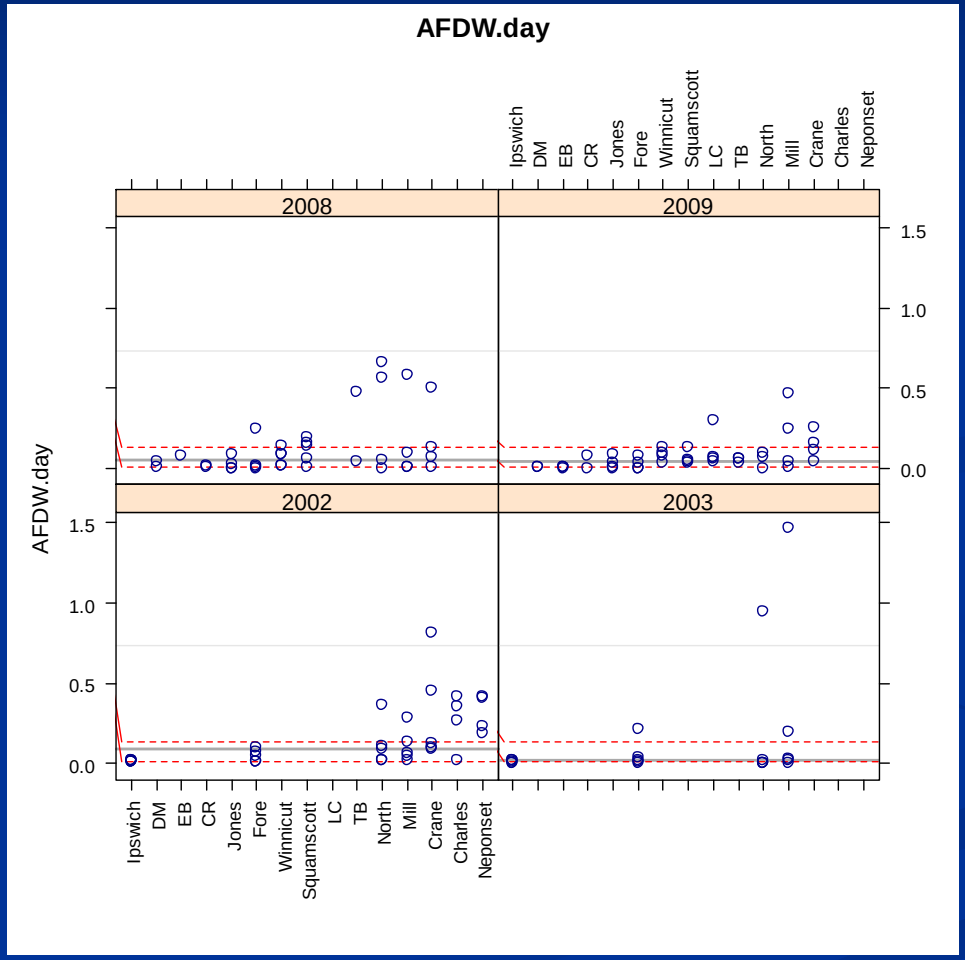


General habitat characterization:

- Channel width and depth
- Flow velocity
- Substrate type
- Water quality
  - Water temperature
  - Dissolved oxygen
  - pH
  - Nutrient concentrations
- Canopy cover
- Periphyton standing stock and growth rates
- TN and TP
- Metals and Alkalinity

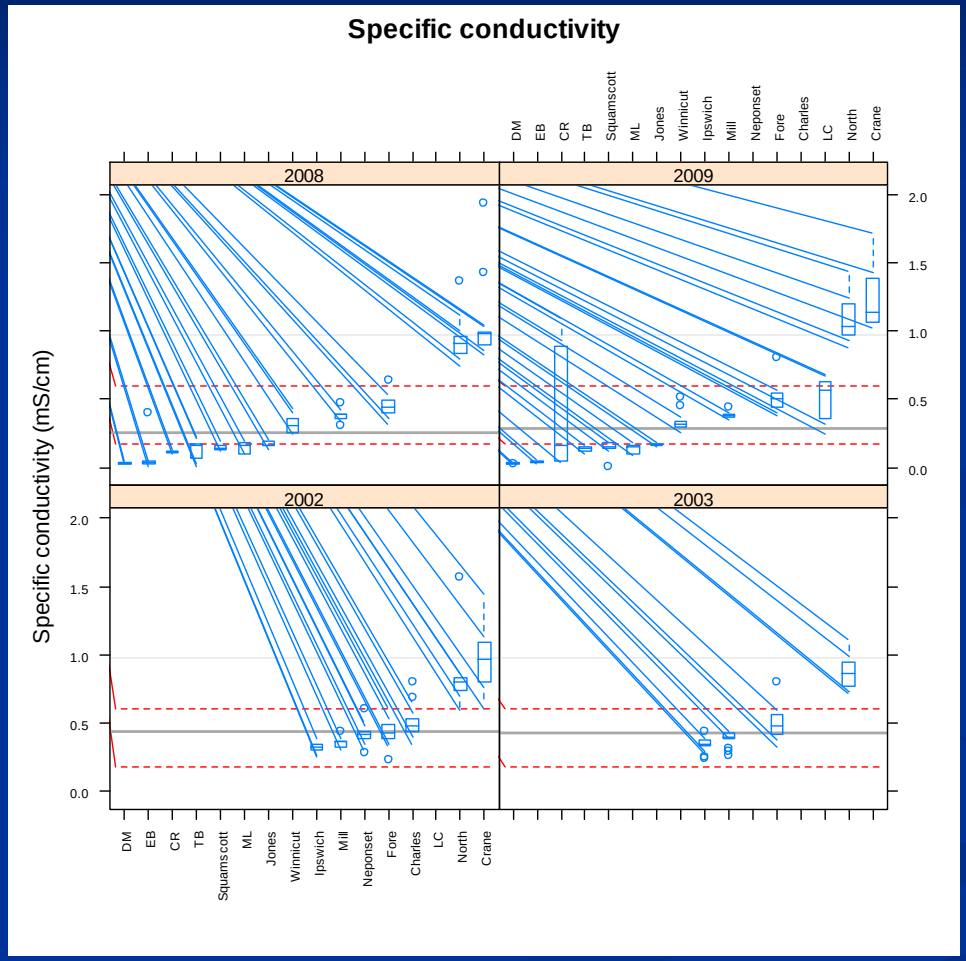
Periphyton

Tannery Brook is in upper third of daily growth



Mean Ash-Free dry weight per day by River. Gray line is median for year. Red dashed lines are 1st and 3rd quartiles for all data combined.

Conductivity will be compared with metals concentrations: Tannery Brook on lower side: Preliminary results indicate low metals in water



Boxplots of distribution of specific conductivity. Grayline is median for year. Red dashed lines are 25th and 75th quantiles for all years and rivers combined.

Objective 2: Assess threats to spawning populations

Goal: Study a subset (14-16) Gulf of Maine (GOM) watersheds in depth to identify variables most affecting spawning success

→ Use GIS to predict spawning success in other GOM watersheds

Extensive research has shown that stream quality declines with increasing urbanization, agriculture use, and population density

Model Variables

DETERMINATE *(GIS)*

- Road crossings
- Obstructions (hanging culverts, dams)
- Population density
- Percent impervious surface
- Licensed groundwater discharges
- Land cover
  - % Forested
  - % Wetland
  - % Agriculture
  - % Developed Low, Medium, High
  - % Developed Open Space
    - Golf courses, fertilized grass areas

DEPENDENT *(Field)*

- Water Chemistry
  - pH
  - Temperature
  - Conductivity
  - Turbidity
  - Dissolved oxygen
- Species richness
- RBS CPUE
- Periphyton growth
- Nutrient concentrations, TN and TP

•All data for field variables collected during the spring spawning run from March to June. Complete data set will be 2008-2011.

Objective 3: Conservation Strategies

- Spawning habitat and water quality
- Upstream passage and restoration
- Fishery regulations
- Stock enhancement
- Further research

Recreational Ice Fishery, ME

Dead Eggs, Squamscott River, NH

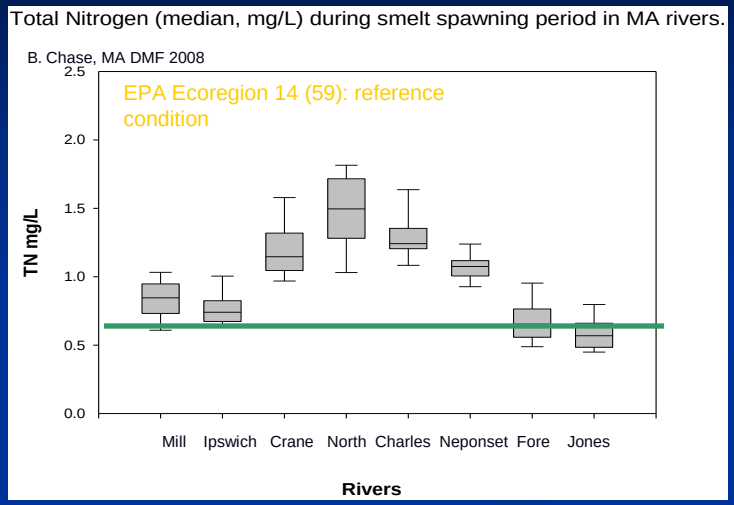
Hanging Culvert, Cascade Brook, ME

Spawning Habitat and Water Quality

- Recommend to US EPA 'critical values' for nutrient concentrations and algal biomass
- Recommend to cities and towns Best Management Practices
  - Greenways in stream corridors
  - Smart Growth and Low Impact Development

http://www.mass.gov/czm/smartgrowth/index.htm

  - Stormwater bylaws, education campaigns, and remediation



Stock Enhancement

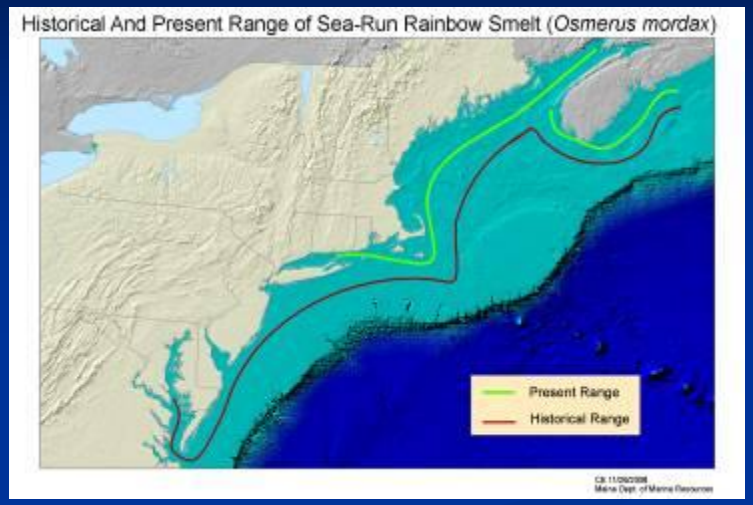
Currently: MA DMF stocks fertilized eggs from the Fore River (good run) into the Crane River (severely depleted run)

- Reintroduce RBS in rivers
  after dam removal/culvert redesign, water quality improvement, etc.

Must conduct pathology and genetic studies before stocking

Further Research

- Rise in near shore sea surface temperature
- Marine predation
- Larval survival
- Bycatch (shrimp fishery)
- Annual movements



Project partners

- Maine Department of Marine Resources
- New Hampshire Department of Fish and Game
  - Great Bay National Estuarine Research Reserve
- Massachusetts Division of Marine Fisheries
- University of New Hampshire
- USGS Conte Anadromous Fish Research Laboratory

- Funding through NOAA, NMFS Office of Protected Species

Questions?

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