What has gone on before: Summary of the Stock Structure Workshop

ESA Extinction Risk Workshop,
Boston, MA July 10-13th 2012

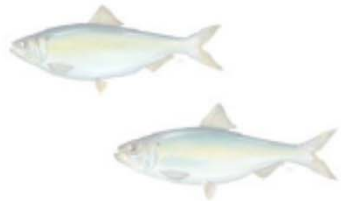
Conclusions

- **River herring have declined coast-wide**
  - Declining commercial landings following the 1960s
  - Declining commercial CPUE
  - Declining run counts in many rivers
  - Declines in average length and size-at-age in many rivers
  - SCAA and DB-SRA model runs
- **Fisheries independent indices were quite variable**
  - Most started after the decline in commercial landings
  - Currently observing relatively small amounts of inter-annual variation
  - Regional (north vs. south) patterns may be due to climate change

Stock Status

- **The coastwide meta-complex of river herring on the US Atlantic coast is depleted to near historic lows**
- "Depleted" status indicates that there was evidence for declines in abundance due to a number of factors, but the relative importance of these factors in reducing river herring stocks could not be determined.

Stock Status



- **52 in-river stocks** for which data were available
  - **Historically:**
    - → **22 were depleted**
    - → **1 stock was increasing**
    - → **28 stocks could not be determined**
  - **In most recent years:**
    - → **2 were increasing**
    - → **4 were decreasing**
    - → **9 were stable**
    - → **38 rivers did not having enough data**

Stock Status

- **Overfished and overfishing status could not be determined for the coastwide stock complex**
- **Management actions to reduce total mortality are needed.**
- **Recovery of river herring stocks will need to address multiple factors** (e.g., fish passage, predation, water quality, climate change, etc.) in addition to harvest.

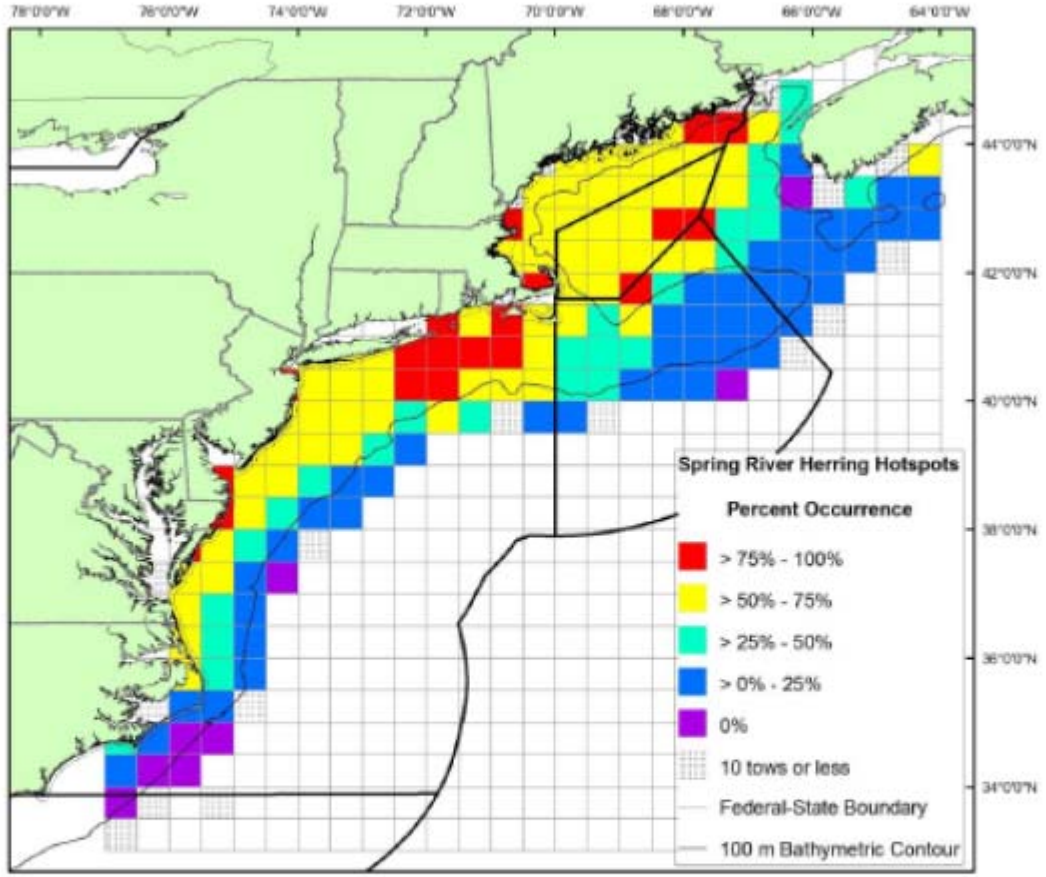


Figure A31: Percent occurrence of river herring in spring research surveys by statistical area ranked from lowest to highest (top). Map of corresponding river herring percent occurrence by quarter degree squares grouped from > 75% - 100% (red), > 50% - 75% (yellow), > 25% - 50% (aqua), > 0 - 25% (blue) and 0% (purple) (bottom). Source: Spring 1968-2008 NMFS bottom-trawl surveys.

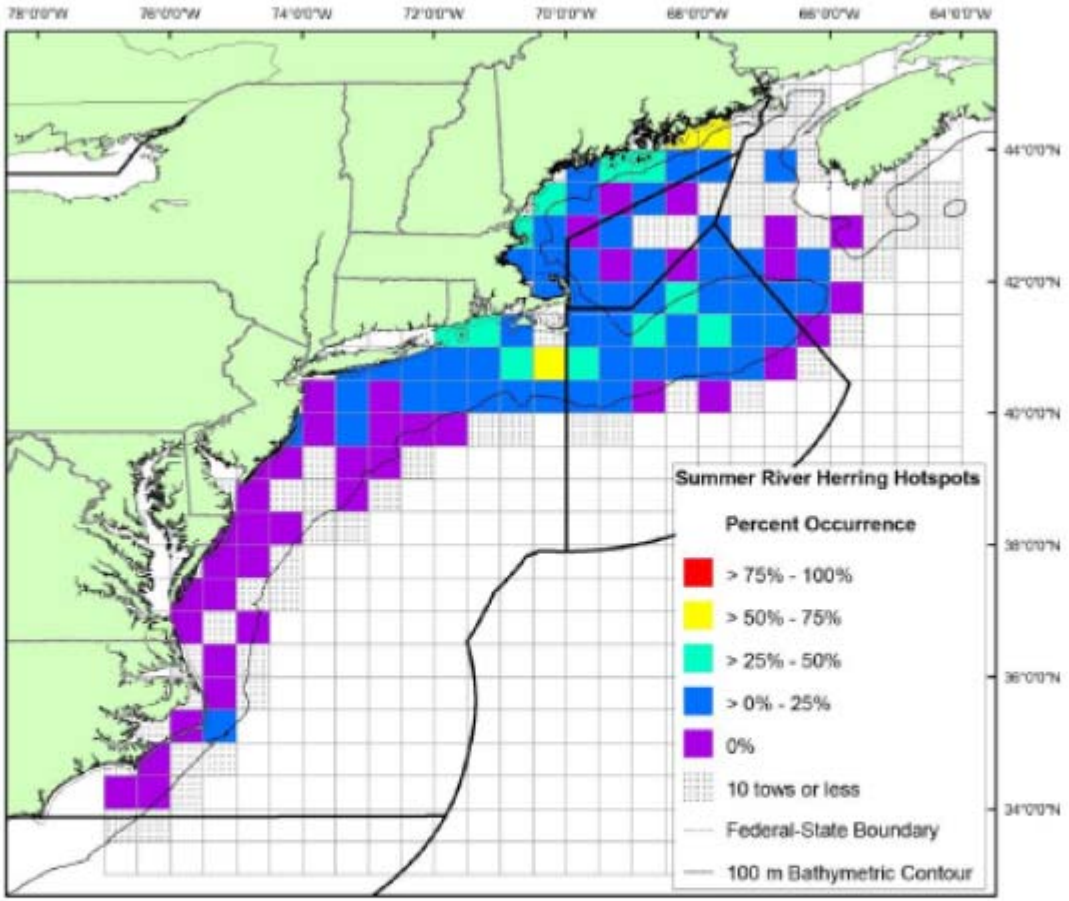


Figure A32: Percent occurrence of river herring in summer research surveys by statistical area ranked from lowest to highest (top). Map of corresponding river herring percent occurrence by quarter degree squares grouped from > 75% - 100% (red), > 50% - 75% (yellow), > 25% - 50% (aqua), > 0 - 25% (blue) and 0% (purple) (bottom). Source: Summer 1948-1995 NMFS bottom-trawl surveys.

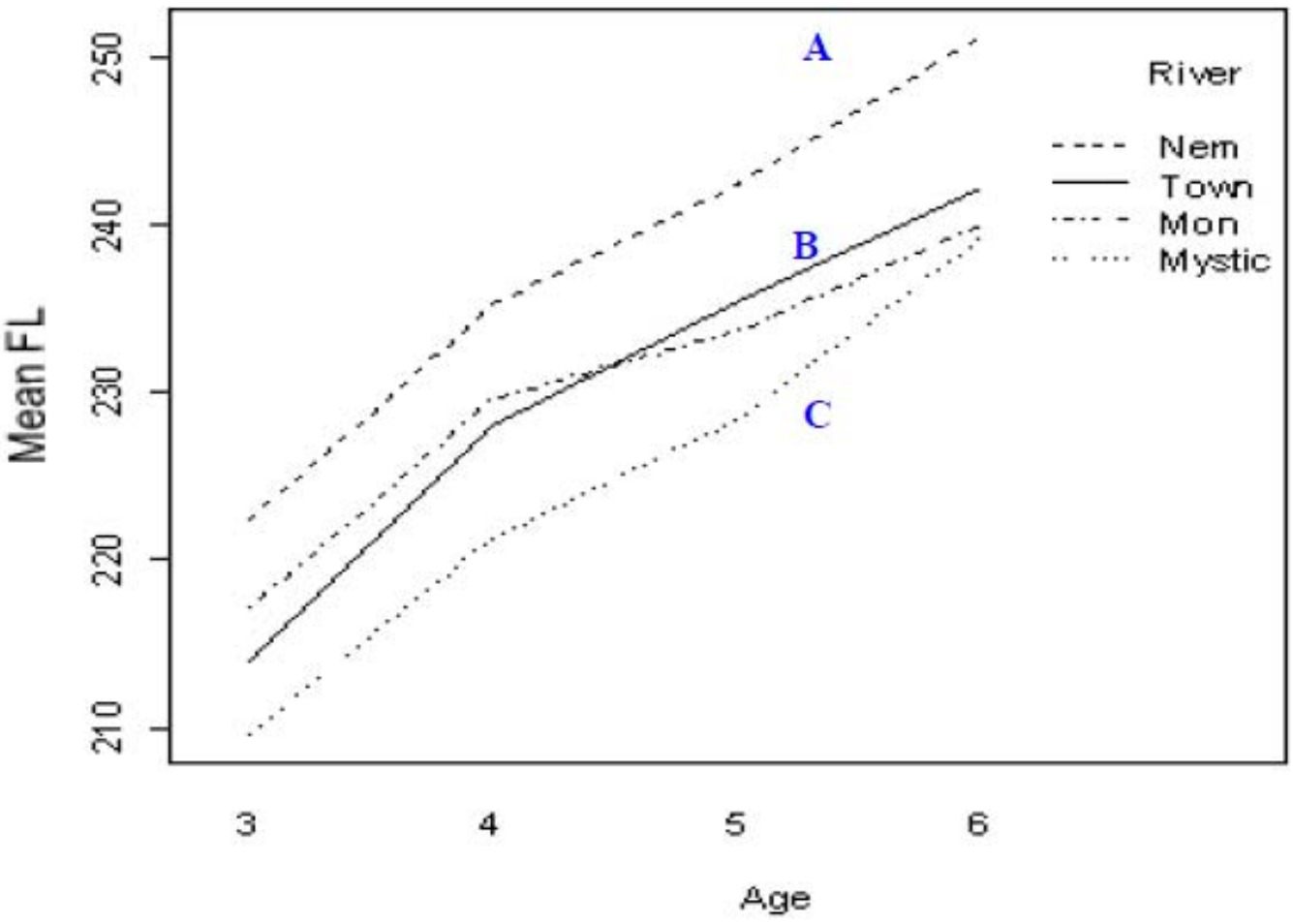
New Hampshire River Herring Stock Designation Information

River Herring Stock Structure Meeting, June 20-22, 2012
NMFS Northeast Regional Office, Gloucester, MA
Kevin Sullivan, New Hampshire Fish and Game Department

Suggestions of Stock Designation Between Rivers:

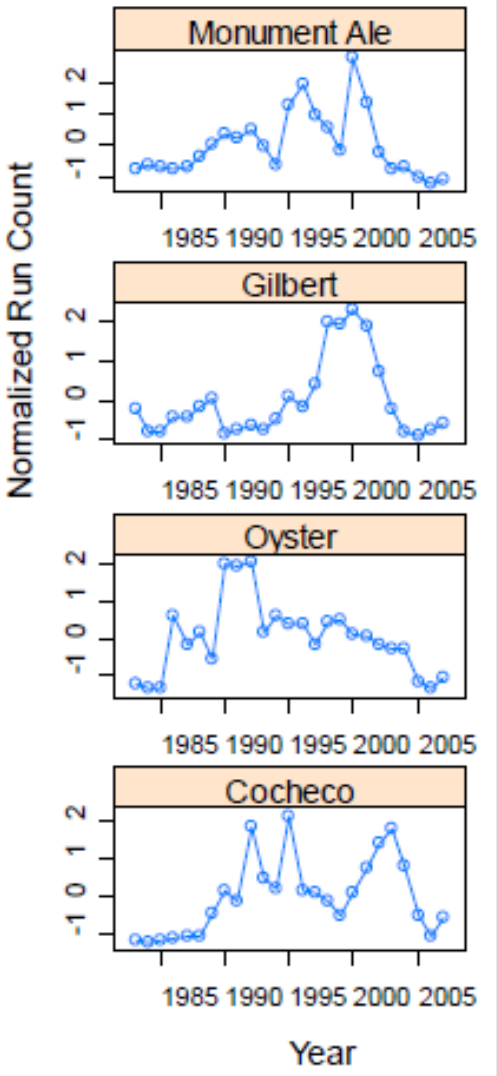
- Return Numbers
  - Run size varies annually across rivers, but fairly independently
- Run Timing
  - None
  - Alewife runs across rivers start nearly simultaneously
  - Blueback runs later, and minimal in most recent years
- Between River Age Distributions
  - None. Similar across rivers with same species dominance
- Between River Length Distributions
  - None. Varies inter-annually across rivers, but similar across rivers within year
  - Follows age distributions

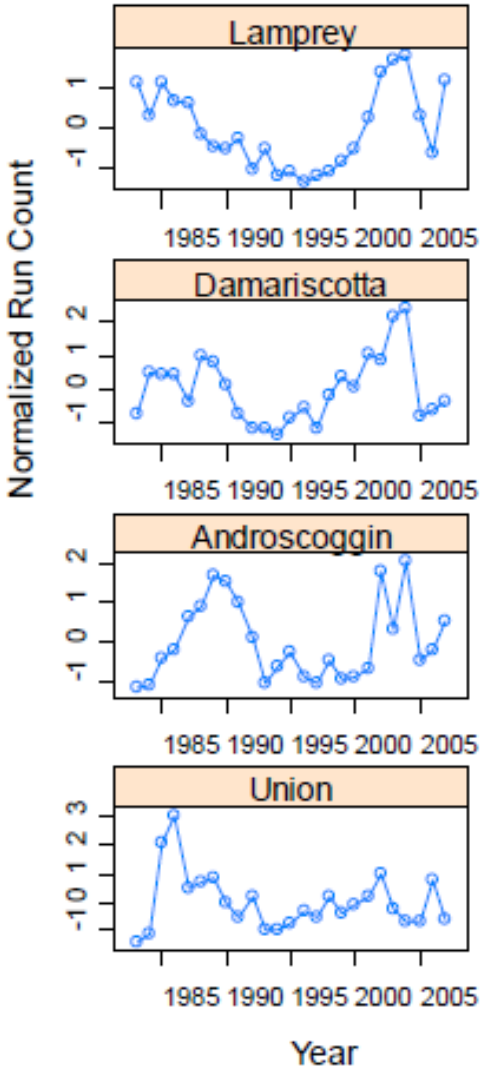
Evidence for fine scale stock structure:
Differences in length at age for alewives in 4 MA rivers

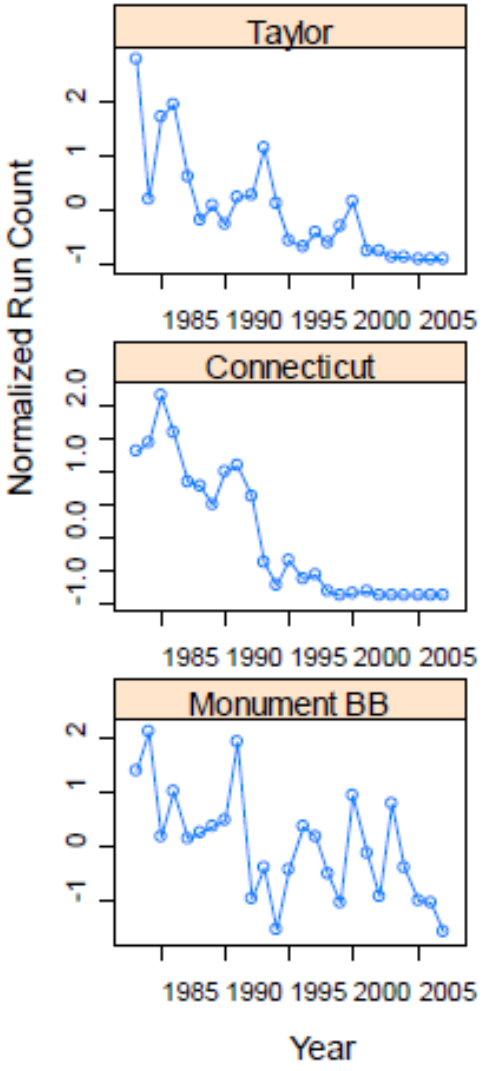


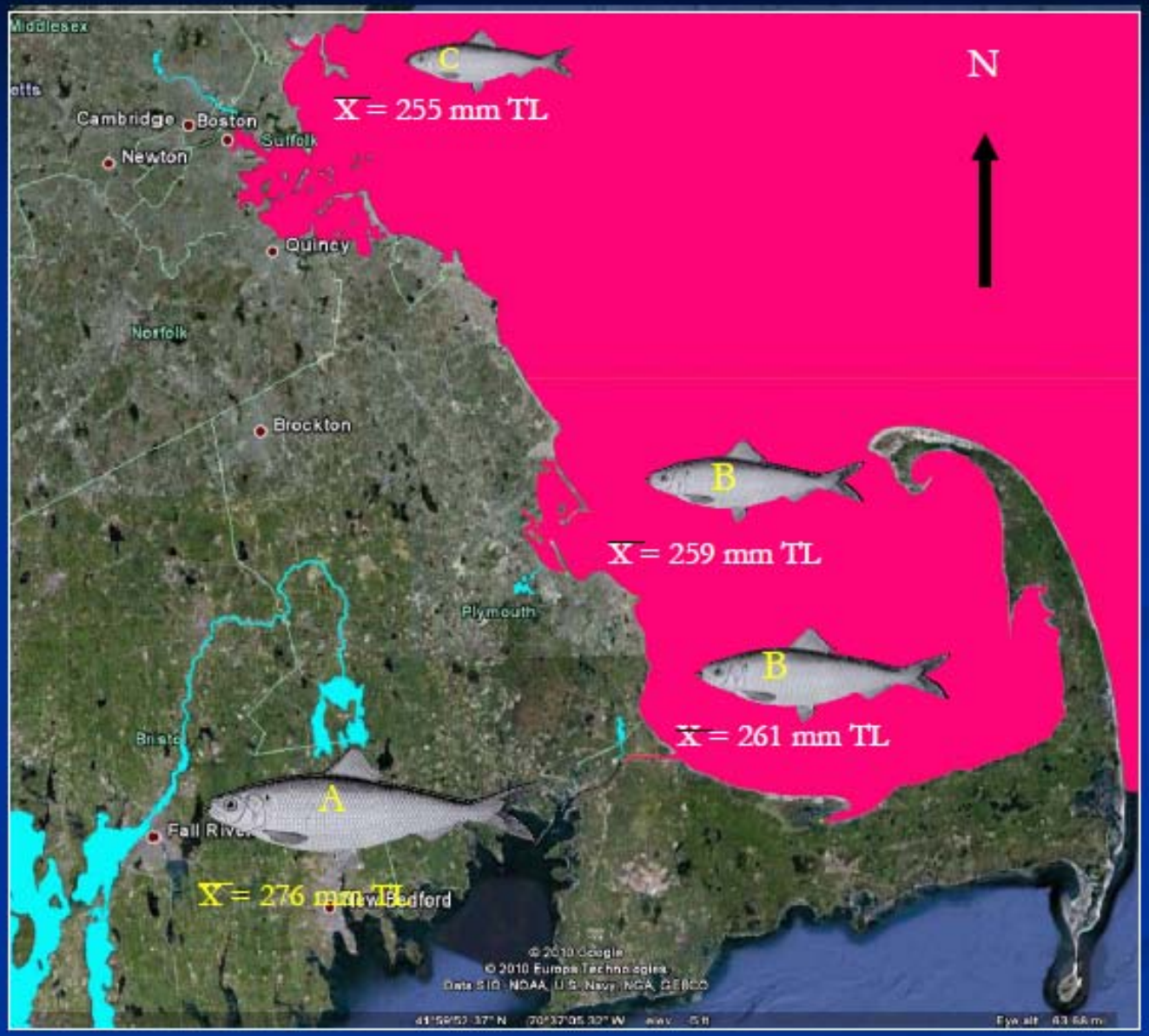
Evidence for Broader Scale Stock Structure

Run Counts 1983-2007





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N
B
$\bar{X}$ = 259 mm TL
B
$\bar{X}$ = 261 mm TL
A
$\bar{X}$ = 276 mm TL
Middlesex
Cambridge
Boston
Suffolk
Newton
Quincy
Norfolk
Brockton
Plymouth
Bristol
Fall River
New Bedford

NMFS River Herring Stock structure workshop

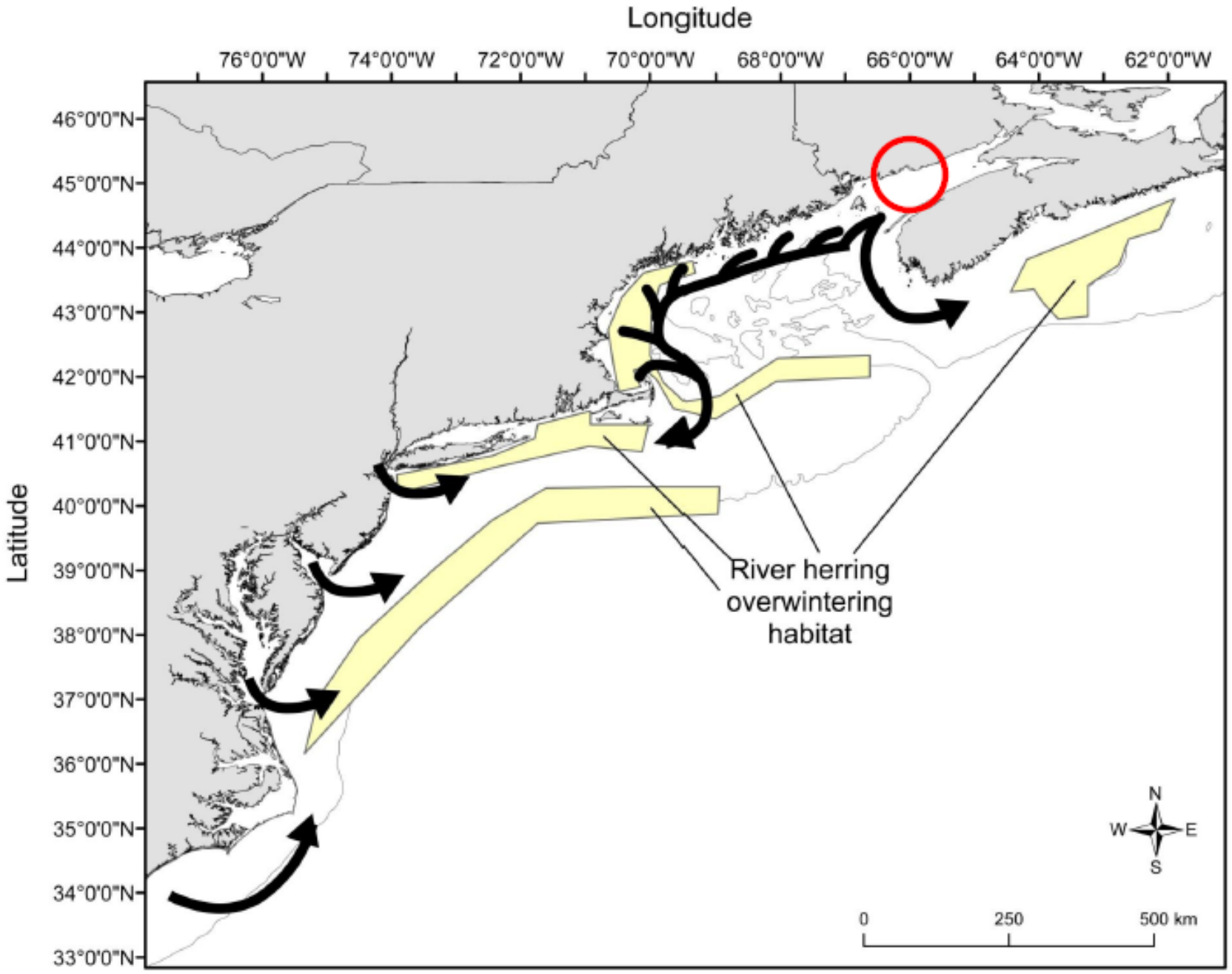
Adrian Jordaan, PhD.

Research Associate
School of Marine and Atmospheric Sciences
Stony Book University
Stony Brook, NY

Assistant Professor (fall 2012)
Department of Environmental Conservation
University of Massachusetts - Amherst
Amherst, MA

River	HerringGB	HerringGOM	HerringSNE	MackLand	StBass	NAO
Union River						
Androscoggin River				(+) 0.001		
Saco River						
Saint Croix River				(+) 0.01		
Damariscotta River				(+) 0.05		
Exeter River		(+) 0.05				
Lamprey River		(-) 0.001			(+) 0.01	
Taylor River	(-) 0.05	(-) 0.001		(-) 0.01	(-) NS	
Cocheco River					(+) 0.01	
Winnicut River				(+) 0.01		
Oyster River		(+) 0.05				
Monument River Alewife		(+) 0.001				
Monument River Blueback						
Mattapoisett River		(-) 0.05		(-) 0.001		
Parker River					(-) 0.01	(+) 0.05
Merrimack River		(+) 0.05		(+) 0.01	(-) 0.01	
Gilbert-Stuart River		(-) 0.05	(+) 0.001			
Nonquit River					(-) 0.001	
Buckeye River						
Connecticut River		(-) 0.01			(-) 0.001	
Chowan River Alewife		(-) 0.01			(-) 0.05	
Chowan River Blueback		(-) 0.05			(-) 0.05	

Jordaan and Kritzer In Prep



Stone, H.H. and B.M. Jessop 1992 Fisheries Bulletin 90: 376-389 (Canadian overwintering area)

Alewife (*Alosa pseudoharengus*) stock structure North of Cape Cod

Dr. Theodore Willis
University of Southern Maine
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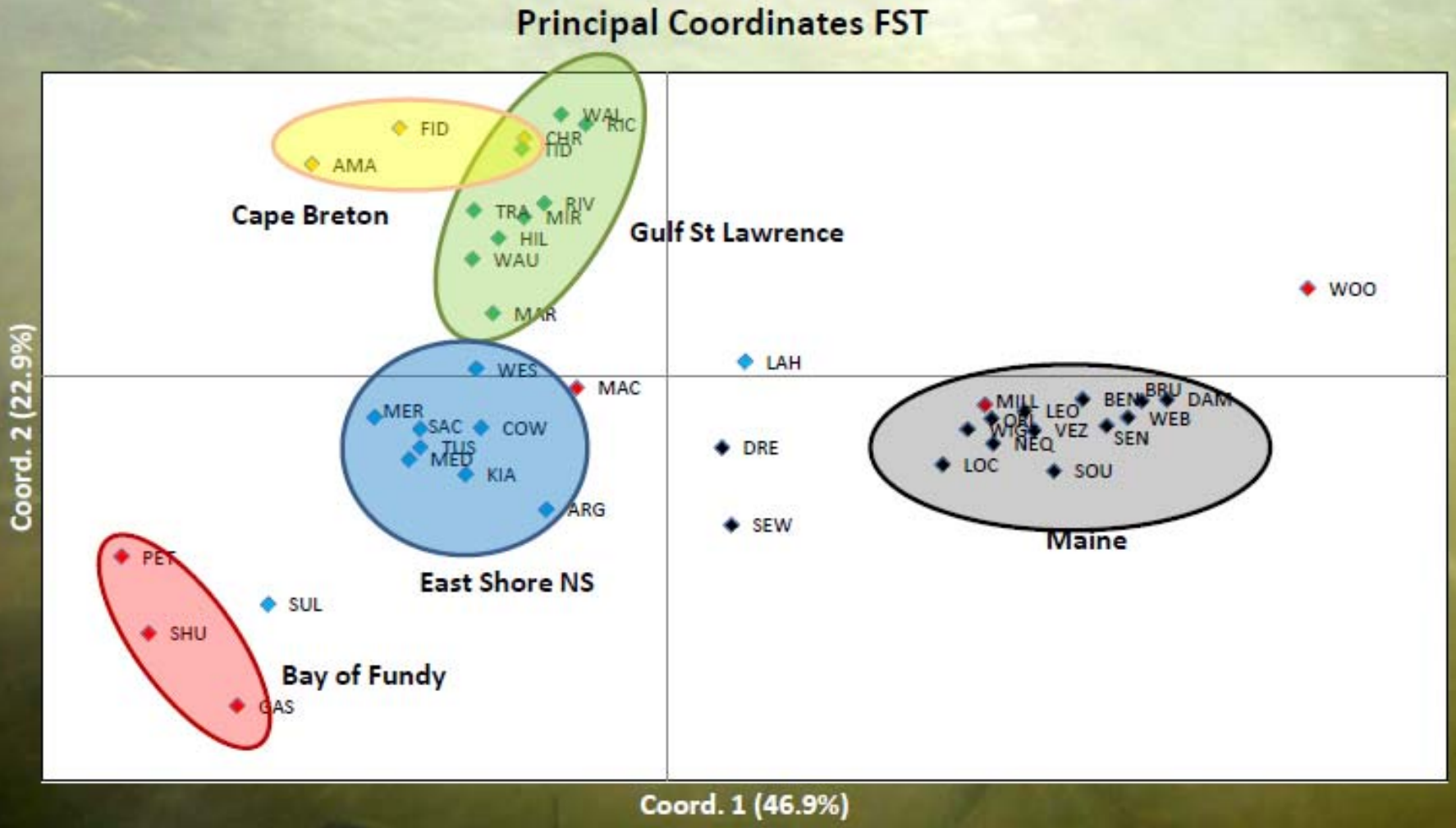
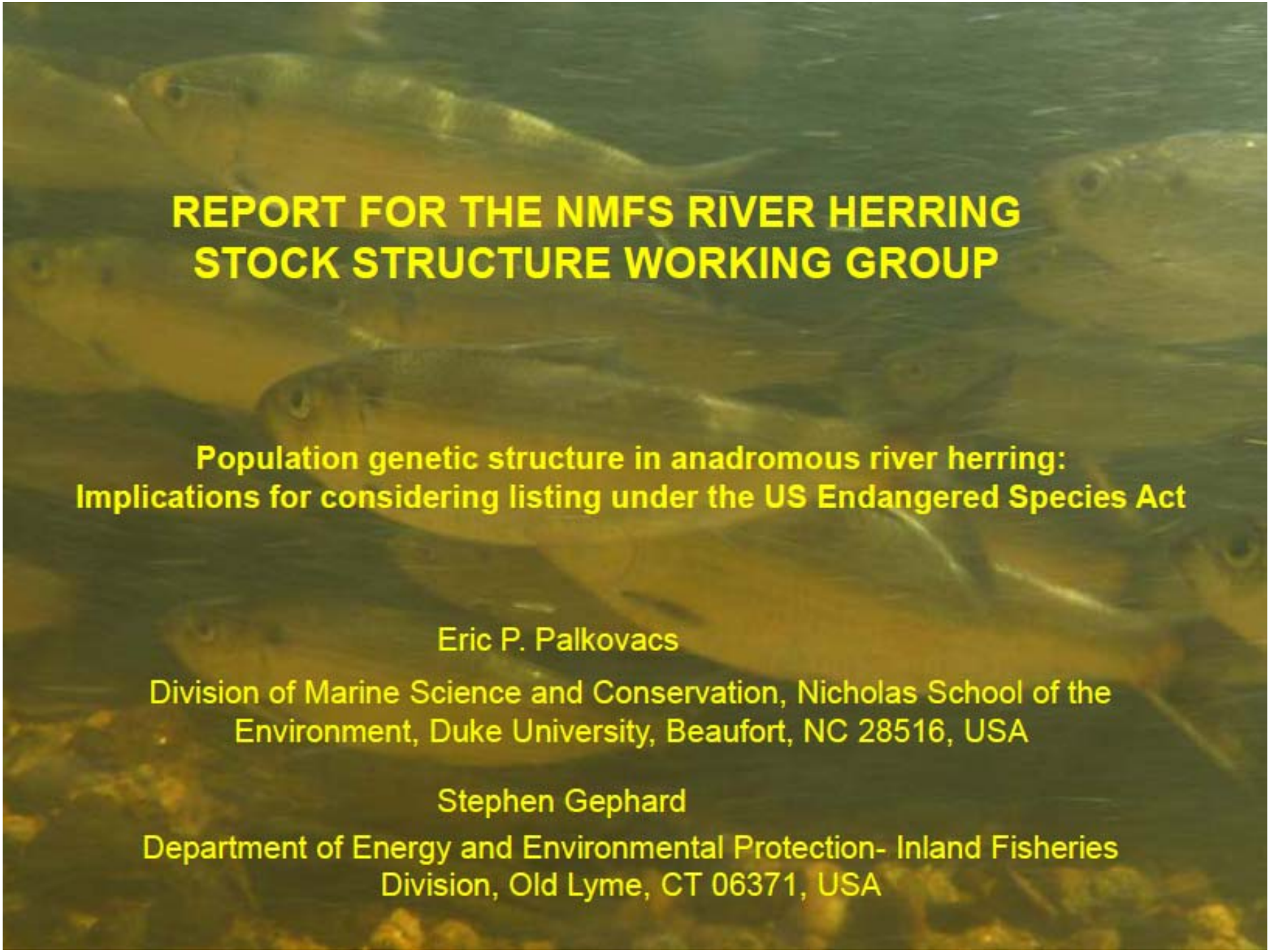
Summary

- **Assess population structure**
  - Evidence of two alewife sub-populations in ME, but no isolation by distance pattern detected
  - ME and Mass outgroup strongly differentiated
  - There may have been East of Penobscot and West of Penobscot sub-populations at one time
- **Estimate regional genetic relationships**
  - Regional isolation by distance pattern with Atlantic Canada populations
  - Differentiation at the sub-region level (100 km+)

Alewife Regional Differentiation



F_{ST}: Pairwise comparison of similarity between sites



REPORT FOR THE NMFS RIVER HERRING STOCK STRUCTURE WORKING GROUP

Population genetic structure in anadromous river herring: Implications for considering listing under the US Endangered Species Act

Eric P. Palkovacs

Division of Marine Science and Conservation, Nicholas School of the Environment, Duke University, Beaufort, NC 28516, USA

Stephen Gephard

Department of Energy and Environmental Protection- Inland Fisheries Division, Old Lyme, CT 06371, USA

Fig. 1: Proposed stock structure in alewife identified using the Bayesian clustering algorithm implemented in BAPS v.5.1 (Corander et al. 2006). The Connecticut Stock is the only stock in either species to be defined by a single river and, therefore, should be treated as tentative until further analyses can be performed.

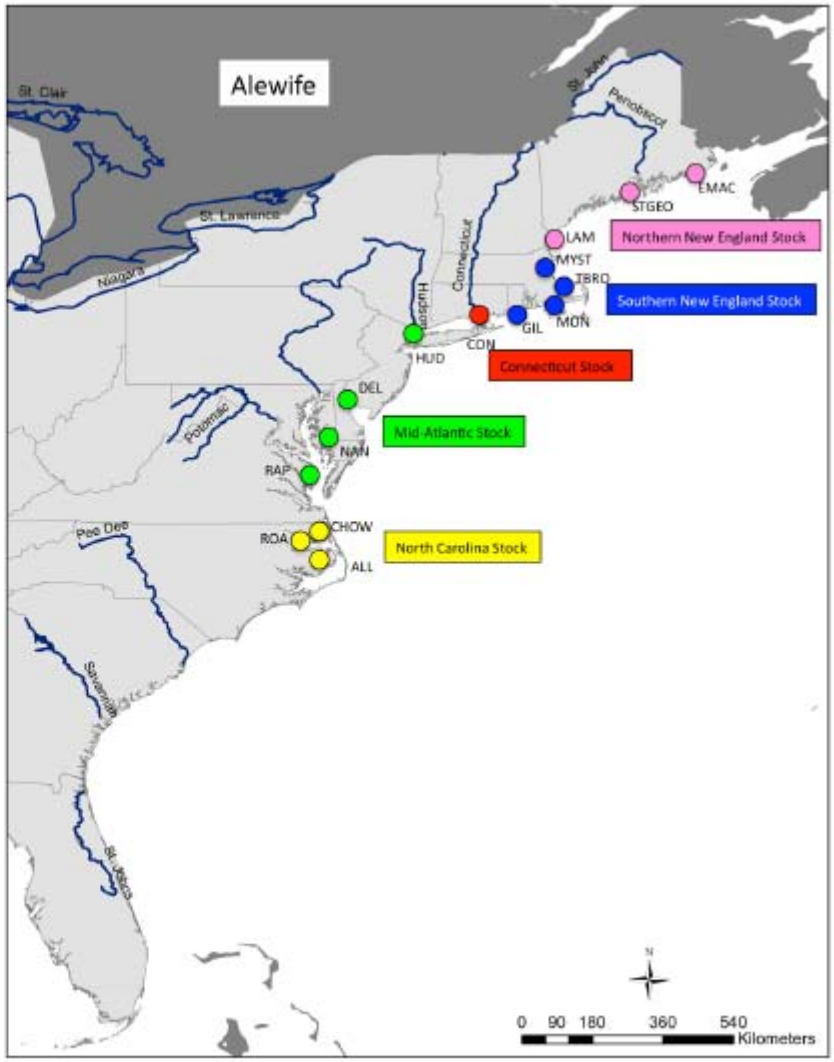
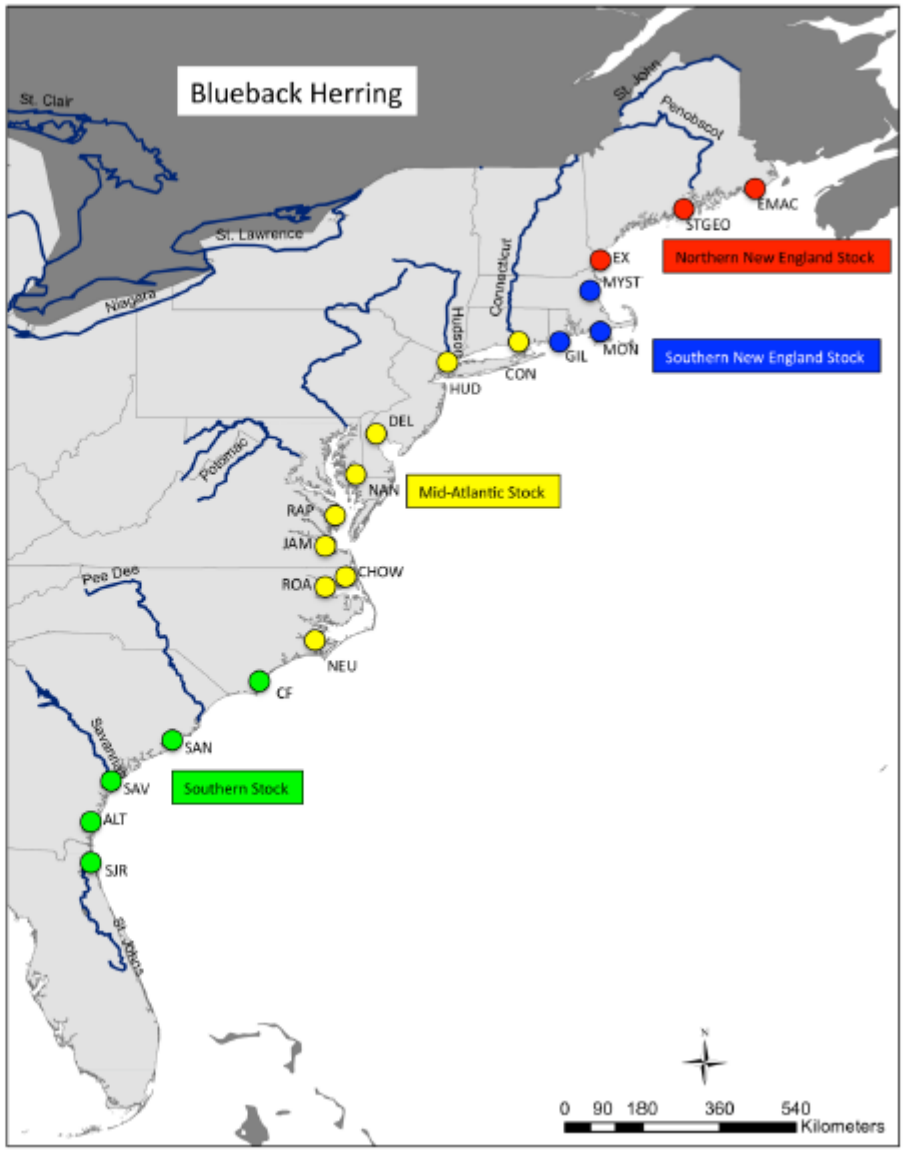


Fig. 2: Proposed stock structure in blueback herring identified using the Bayesian clustering algorithm implemented in BAPS v.5.1 (Corander et al. 2006).



Conclusions:

1. significant differentiation among alewife and blueback herring spawning runs in most cases, suggesting that the major river drainage is the appropriate level of management for these species. [This result supports the findings of the ASMFC Stock Assessment, which found a lack of correlation for population trends in neighboring runs (ASMFC 2012).]

2. in some cases we did not find significant genetic divergence among neighboring rivers. This result suggests that straying among neighboring watersheds has led to some degree of homogenizing gene flow, but within larger-scale geographic boundaries.

3. gene flow is not continuous across all parts of the species' ranges. There are geographic breaks in gene flow that should be recognized, as they represent the major sources of genetic variation.

Data gaps

- Limited information on historic run size, distribution, and trends through time
- Inconsistencies' and uncertainties in the proper identification of alewives and bluebacks in river herring datasets
- Genetic structure of mixed stocks at sea
- Information on movements and migrations at sea
- Longer and finer scale genetic data for returning spawners
- Otolith microchemistry range wide and at a finer scale
- Stray rate data
- Information on hybridization and conditions that contribute to hybridization (e.g. climate change, dams)
- Information on whether the abundance of Atlantic herring differentially affect bluebacks and/or alewives
- Understanding of whether fishways inadvertently select for certain phenotypes
- Understanding the hatchery effects of stocking on genetic diversity

Working Hypothesis for this meeting

- **Alewives**
  - **Hypothesis 1:**
    - One continuous stock complex throughout the entire range from US to Canada
  - **Hypothesis 2**:
    - Six stock complexes
    - Carolina (all alewife rivers south of, and including the Chowan River)
    - Mid-Atlantic (Rappahannock to Hudson River)
    - Long Island Sound (Byram River to Pawcatuck River)
    - Southern New England (Gilbert-Stewart to Mystic River)
    - Northern New England (Lamprey to East Machias)
    - Canada (all Canadian Rivers)
- **Blueback herring**
  - **Hypothesis 1:**
    - One continuous stock complex throughout the entire range from US to Canada
  - **Hypothesis 2**:
    - Five stock complexes
    - Southern (St. John River to Cape Fear River)
    - Mid-Atlantic (Neuse River to Connecticut River)
    - Southern New England (Gilbert-Stewart to Mystic River)
    - Northern New England (Exeter River to East Machias River)
    - Canada (all Canadian Rivers)

“Whether alewives and blueback herring in the ocean migrate and mix with other regional stocks could not be determined; therefore, the ocean phase of alewives and blueback herring should be considered a mixed stock until further tagging and genetic data are available.”