Environmental conditions affecting North American and Penobscot River populations of Atlantic salmon (*Salmo salar*)

Kathy Mills and Andy Pershing  
University of Maine &  
Gulf of Maine Research Institute

David Mountain  
University of Arizona

Tim Sheehan  
National Marine Fisheries Service
Background: Atlantic salmon

North American Pre-Fishery Abundance

- Labrador
- Newfoundland
- Quebec
- Gulf
- Scotia-Fundy
- United States
Background: Atlantic salmon
Background: Oceanography

Colder, fresher water

Phytoplankton

Sm. Copepods

Calanus

+ -

Colder, fresher water

+ +
Background: Oceanography

Arctic origin for cold, low salinity water

Increased outflow through Labrador Sea

Increased transport volume along Scotian Shelf and in Gulf of Maine

Greene and Pershing (2007)
Smith et al. (2001)
Research Question

Could observed oceanographic changes in the Northwest Atlantic explain Atlantic salmon population declines?

Phytoplankton

Colder, fresher water
Research Question

Could observed oceanographic changes in the Northwest Atlantic explain Atlantic salmon population declines?

- Cross-regional declines in Atlantic salmon
- Coherence of timing in declines with oceanographic changes

Phytoplankton

Colder, fresher water
Research Question

Is the oceanographic influence linked to a particular period of salmon’s marine life history?
Research Approach

Correlation analysis:
- Gulf of Maine and North Atlantic zooplankton and phytoplankton indices
- Atlantic salmon abundance and productivity indices
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Statistical details:
• Three lags representing smolt year, at-sea year, and return migration
• Original series, probabilities consider temporal autocorrelation (Pyper and Peterman 1998)
• Pre-whitened series
Preliminary results

Negative correlations between Atlantic salmon and plankton abundance trends
Preliminary results

Negative correlations between Atlantic salmon and plankton abundance trends

Widespread correlations to certain taxa:

- **GOM**—*Calanus I-IV*
- **North Atlantic**—*Pseudocalanus elongatus*, *Paracalanus Pseudocalanus* spp., *Calanus finmarchicus glacialis*, *Metrida lucens*, *Diatoms*
Colder, fresher water

Phytoplankton

Preliminary results
Preliminary results

Few significant correlations between salmon and zooplankton when examine high-frequency variability
Preliminary results

Phytoplankton

Colder, fresher water

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Future directions

Phytoplankton

Colder, fresher water

+ -

Future directions
Future directions

Temperature/”Arcticness”

Colder, fresher water

Phytoplankton

+ -

Future directions

Colder, fresher water

Phytoplankton

+ -

Future directions

Colder, fresher water

Phytoplankton

+ -

Future directions

Colder, fresher water

Phytoplankton

+ -

Future directions
Future directions

Temperature/”Arcticness”

Colder, fresher water

Phytoplankton

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Future directions

Temperature/"Arcticness"

Periodicity of physical vs. biological cycles

Colder, fresher water

Phytoplankton

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Future directions

Colder, fresher water

Phytoplankton

+ 

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Temperature/"Arcticness"

Periodicity of physical vs. biological cycles
Management implications

• Oceanic conditions are dynamic at many temporal and spatial scales.

• Marine ecosystem dynamics cannot be directly controlled.

• Develop predictive capacity built on factors with lagged effects on Atlantic salmon.

• Important to manage for resilience so that populations are strong and adaptable.
Questions or comments?