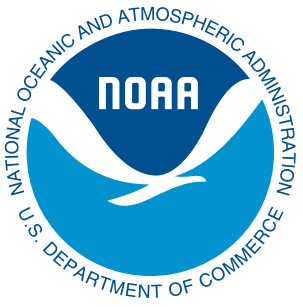

Northeast Fisheries Science Center Reference Document 15-11

doi:10.7289/V5RV0KPJ

Program and Abstracts of the 2014 Atlantic Salmon Ecosystems Forum

Edited by Mark D. Renkawitz
and Tara R. Trinko Lake

Northeast Fisheries Science Center Reference Document 15-11

doi:10.7289/V5RV0KPJ

Program and Abstracts of the 2014 Atlantic Salmon Ecosystems Forum

Edited by Mark D. Renkawitz[1]
and Tara R. Trinko Lake[2]

[1]NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center,
166 Water Street, Woods Hole, MA 02543
[2]NOAA, National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office,
17 Godfrey Drive-Suite 1, Orono, ME 04473

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts
August 2015

Northeast Fisheries Science Center Reference Documents

This series is a secondary scientific series designed to assure the long-term documentation and to enable the timely transmission of research results by Center and/or non-Center researchers, where such results bear upon the research mission of the Center (see the outside back cover for the mission statement). These documents receive internal scientific review, and most receive copy editing. The National Marine Fisheries Service does not endorse any proprietary material, process, or product mentioned in these documents.

All documents issued in this series since April 2001, and several documents issued prior to that date, have been copublished in both paper and electronic versions. To access the electronic version of a document in this series, go to *http://www.nefsc.noaa.gov/publications/*. The electronic version is available in PDF format to permit printing of a paper copy directly from the Internet. If you do not have Internet access, or if a desired document is one of the pre-April 2001 documents available only in the paper version, you can obtain a paper copy by contacting the senior Center author of the desired document. Refer to the title page of the document for the senior Center author's name and mailing address. If there is no Center author, or if there is corporate (*i.e.*, non-individualized) authorship, then contact the Center's Woods Hole Laboratory Library (166 Water St., Woods Hole, MA 02543-1026).

Information Quality Act Compliance: In accordance with section 515 of Public Law 106-554, the Northeast Fisheries Science Center completed both technical and policy reviews for this report. These predissemination reviews are on file at the NEFSC Editorial Office.

This document may be cited as:

Renkawitz, MD, Trinko Lake, TR. 2015. Program and abstracts of the 2014 Atlantic Salmon Ecosystems Forum. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-11; 57 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/publications/
doi:10.7289/V5RV0KPJ

TABLE OF CONTENTS

INTRODUCTION

On January 8-9, 2014 the Seventh biennial Atlantic Salmon Ecosystems Forum (ASEF) was held on the campus of the University of Maine, Orono. NOAA Fisheries, composed of the Northeast Fisheries Science Center (NEFSC) and the Greater Atlantic Fisheries Office (GARFO), partnered with Project SHARE, the Diadromous Species Restoration Research Network, the U.S. Fish and Wildlife Service, The Nature Conservancy, and the Atlantic Salmon Federation to sponsor, coordinate, and host the conference.

As a topically broad-scale ecosystem conference, the ASEF draws a diverse array of participants. Government (state, federal, tribal) researchers and managers, non-government conservation and restoration organizations, university professors and students, industry representatives and landowners (forestry, timber, paper, energy, transportation, aquaculture), and other interested parties. With more than 165 participants, this meeting facilitated information exchange on novel research results and restoration techniques, as well as ideas and concepts pertaining to improving management, conservation and restoration of diadromous species in the Northwest Atlantic.

Over two full days, 40 presentations and 10 posters on diverse topics were delivered in four theme sessions: 1) marine and estuary ecology, 2) diadromous species ecology, 3) freshwater ecology, and 4) application of science to management. A range of original research and management topics related to diadromous species ecology were covered. Specifically, information detailing species distribution and abundance, food-web dynamics, mortality sources, survival, and migration ecology illustrated the substantial diversity of the diadromous fish complex. Topics pertaining to domestic and international management issues, critical habitat assessment and quantification, connectivity and fish passage, river characteristics and morphology, river restoration/remediation and project evaluation, and changing thermal regimes under climate scenarios were substantive and informative. Presentations on marine-derived nutrients and innovative monitoring technology were also delivered.

The keynote address, delivered by Dr. Daniel Schindler (University of Washington), stressed the importance of maintaining connected habitat mosaics, ample genetic variation, and divergent life history strategies in the advent of climate fluctuations to maximize the probability of robust population abundance and persistence into the future. The broad spectrum of presentations and discussions at the conference reflects the evolving movement toward an integrated ecosystem-based approach to research and management, conservation, and restoration at multiple spatial and temporal scales among diverse habitats for maximum impact on target species.

This publication contains the 2014 ASEF agenda and presentation abstracts, and supplements the compilation by MacLean (2012). Titles and presenting author are in bold type. Author contact information at the time of publication is also provided on the individual abstracts.

REFERENCES CITED:

MacLean S. 2012. Programs and abstracts of the Maine Atlantic Salmon Forums 2002-2012. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-12; 232 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/publications/

The Atlantic Salmon Ecosystems Forum
January 8-9, 2014
University of Maine, Orono, Nutting Hall

January 8, 2014

07:00 AM-08:00 AM	**Registration and Continental Breakfast**
08:00 AM-08:15 AM	**Opening Remarks**
08:15 AM-09:15 AM	Myths about Pacific salmon on the west coast: which ones are supported by science? *Daniel Schindler*
	Session I: Estuary and Marine Ecology
09:15 AM-09:30 AM	Prey availability and potential predator abundance in the Gulf of Maine. *Keri Stepanek*
09:30 AM-09:45 AM	Finfish diversity and distribution in Cobscook Bay: Anticipating broad scale changes. *Jeffrey Vieser*
09:45 AM-10:00 AM	Groundfish predation on diadromous fish in the Gulf of Maine. *Christine Lipsky*
10:00 AM-10:15 AM	Annual and seasonal changes in fish presence in the lower Penobscot River, ME, 2010-2012. *Garrett Staines*
10:15 AM-10:30 AM	Pelagic Fish biomass in the Penobscot Estuary. *Justin Stevens*
10:30 AM-11:00 AM	**Morning Break** *Refreshments provided.*
11:00 AM-11:15 AM	Exploring the importance of top-down and bottom-up drivers of mysid shrimp distribution in the Penobscot Estuary. *Rachel Lasley-Rasher*
11:15 AM-11:30 AM	A novel investigation of Atlantic salmon post-smolt ecology during estuary transition. *James Hawkes*
11:30 AM-11:45 AM	Lessons on the migration pathways and mortality points of salmon at sea. *Jonathan Carr*
11:45 AM-12:00 PM	Migration timing of Atlantic salmon smolts from Penobscot Bay to the Scotian Shelf. *John Kocik*
12:00 PM-01:30 PM	**Lunch Break**
	Session II: Diadromous Species Ecology
01:30 PM-01:45 PM	The effects of global weather events on local anadromous fish dynamics: Tambora and the "year without a summer." *Theo Willis*
01:45 PM-02:00 PM	Assessment of coastal and anadromous brook trout in the United States. *Merry Gallagher*
02:00 PM-02:15 PM	Assessing diadromous fish restoration in the Kennebec and Androscoggin Rivers.

Claire Enterline

02:15 PM-02:30 PM Shortnose sturgeon in the Gulf of Maine: migration, critical habitat, and response to dam removal.
Gail Wippelhauser

02:30 PM-02:45 PM Wintering shortnose sturgeon (*Acipenser brevirostrum*) locations and population estimates in the Penobscot River, 2008 - 2013.
Kevin Lachapelle

02:45 PM-03:15 PM **Afternoon Break**
Refreshments provided.

03:15 PM-03:30 PM Presence and distribution of sturgeon in the Damariscotta River estuary.
Kimberly Picard

03:30 PM-03:45 PM Assessing microchemical analysis of dorsal scutes to infer the origins and life histories of shortnose sturgeon.
Matthew Altenritter

03:45 PM-04:00 PM Examining patterns of marine and freshwater habitat use by juvenile blueback herring (*Alosa aestivalis*) through otolith microchemistry.
Molly Payne Wynne

04:00 PM-04:15 PM Coming together to restore river herring throughout their range.
Kim Damon-Randall

04:15 PM-06:15 PM **Reception & Poster Session**
Over ten posters of diverse ecological topics on display
Refreshments provided, cash bar available.

January 9, 2014

07:00 AM-08:00 AM **Registration and Continental Breakfast**

08:00 AM-08:05 AM **Opening Remarks**

08:05 AM-08:15 AM Atlantic salmon and sea-run fish restoration in Maine Website.
Mao Lin

08:15 AM-08:30 AM **Diadromous Species Restoration Research Network (DSRRN)**
Karen Wilson

Session III: Freshwater Ecology

08:30 AM-08:45 AM Survival of Atlantic salmon smolts through a hydropower complex in the lower Penobscot River, Maine USA.
Dan Stich

08:45 AM-09:00 AM Size selection of adult Atlantic salmon at fish passage facilities on the Penobscot River, Maine.
George Maynard

09:00 AM-09:15 AM Hard choices in assessing survival past dams using telemetry.
Joseph Zydlewski

09:15 AM-09:30 AM Release site fidelity and spawning activity of Atlantic salmon translocated to novel headwater habitat within the Penobscot Basin.
Randy Spencer

09:30 AM-09:45 AM Anadromous sea lamprey (*Petromyzon marinus*) as vectors of marine-derived nutrients: implications for dam removal and Atlantic salmon restoration.
Daniel Weaver

09:45 AM-10:15 AM **Morning Break**
Refreshments provided.

10:15 AM-10:30 AM Effects of *D. geminata* on juvenile Atlantic salmon (*Salmo salar*) foraging behavior.
Carole-Anne Gillis

10:30 AM-10:45 AM Environmental drivers of Atlantic salmon growth and survival: building a climate change context with hierarchical models.
Krysztof Sakrejda

10:45 AM-11:00 AM Stream flow and temperature effects on salmonid population dynamics: integrated modeling across scales and data types.
Ben Letcher

11:00 AM-11:30 AM A new class of spatial statistical model for data on stream networks: overview and applications.
Dan Isaak

11:30 AM-01:00 PM **Lunch Break**

Session IV: Applying Science to Management

01:00 PM-01:15 PM Science ... Restoration: Connecting the dots.
Steven Koenig

01:15 PM-01:30 PM What works? A workshop on wild Atlantic salmon recovery programs in North America.
Jonathan Carr

01:30 PM-01:45 PM Applying reconciliation ecology concepts to salmonid habitat restoration and enhancement.
Michael Burke

01:45 PM-02:00 PM Prioritizing Dams at the State level for fish passage projects to benefit diadromous fish.
Stephen Gephard and Sally Harold

02:00 PM-02:15 PM Penobscot River Restoration Project: implementing an ecosystem approach to restoring a full assemblage of diadromous fishes including Atlantic salmon (*Salmo salar*).
George Aponte Clarke

02:15 PM-02:30 PM Coolwater fish in a warming climate: How heat stress events affect wild juvenile Atlantic salmon (*Salmo salar*).
Rick Cunjak

02:30 PM-03:00 PM **Afternoon Break**
Refreshments provided.

03:00 PM-03:15 PM Preliminary observations on the effects of using clam shells for acid rain mitigation in Maine salmon streams.
Mark Whiting

03:15 PM-03:30 PM Assessing the effectiveness of “on river” hatchery reared 0+ “fall parr” to increase juvenile abundance and adult returns on the East Machias River.
Jacob Van de Sande

03:30 PM-03:45 PM “Why bother, we can’t do anything about the ocean anyway.”
Timothy Sheehan

03:45 PM-04:00 PM River Restoration: Art or Science?
Douglas Thompson

04:00 PM-04:30 PM **Panel Discussion: Merging science and on the ground restoration activities using the Narraguagus River as a case study.**
Steven Koenig

04:30 PM-04:45 PM **Closing Remarks**

SESSION I: MARINE AND ESTUARY ECOLOGY

An understanding of the role that environmental and inter-species relationships within estuarine and marine environs have in shaping the population dynamics of Atlantic salmon has emerged over the past two decades. This session aims to bring researchers and managers together to further expand our understanding of these interactions. Presentations covering the physical and biological relationships of all species within these environs are encouraged with the goal of furthering our understanding on how they impact productivity of proximate and distant systems.

Timothy Sheehan, NOAA, Session Moderator

Prey availability and potential predator abundance in the Gulf of Maine.

Keri Stepanek[1] and Sally Sherman[1]
[1]*State of Maine Dept. of Marine Resources, West Boothbay Harbor, ME*

The Maine-New Hampshire Inshore Trawl Survey was initiated in 2000 to fill a significant information gap on nearly two-thirds of the inshore Gulf of Maine, which includes important spawning and nursery habitat for several commercial species. With thirteen complete years and a fourth underway, the ME-NH Inshore Trawl Survey is the longest sustained and comprehensive survey of the inshore Gulf of Maine waters from New Hampshire to the Canadian border. This resource assessment survey provides information on the abundance and distribution of a variety of finfish and invertebrates, as well as information on recruitment, mortality, maturity stage and food habits for selected species. Many of the species encountered by the survey are possible prey for Atlantic salmon post-smolts, and several others are potential predators. This presentation examines the abundance and distribution of some of these species.

Contact: Keri Stepanek, phone: 207-633-9530, email: keri.stepanek@maine.gov

Finfish diversity and distribution in Cobscook Bay: Anticipating broad scale changes.

Jeffrey Vieser[1], Gayle Zydlewski[1], James McCleave[1], and Garrett Staines[1]
[1]*University of Maine, School of Marine Sciences, Orono, ME*

Cobscook Bay is a geographically complex, boreal, and macrotidal bay in eastern Maine. The Dennys River is the largest watershed draining into Cobscook Bay. This river system once supported a robust run (n = 1,000 individuals) of Atlantic salmon, though today it is all but extirpated. Restoring salmon populations in any area requires comprehensive knowledge of the many different ecosystems salmon inhabit and navigate throughout their lives. This includes bays, such as Cobscook Bay, and the organisms that inhabit them. As our knowledge of these systems and how they respond to different environmental conditions increases, so will our ability to understand how salmon populations are affected by them. The physical environment, primary producers, and invertebrate community of Cobscook Bay are well-characterized, but it has not been until recently that the finfish community has been assessed. From 2011-2013 we examined the composition, diversity, structure and annual changes in the finfish community of Cobscook Bay. Sampling occurred in May, June, August and September of 2011, 2012 and 2013 across subtidal and intertidal habitats using seines, fyke nets, and benthic and pelagic trawls. Nearly 50,000 individuals representing 45 species were collected. No Altantic salmon (*Salmo salar*) were captured.

During our assessment the Gulf of Maine experienced an anomalously warm year, in 2012, with temperatures being the highest in recorded history. Cobscook Bay experienced water temperatures in May that were nearly 2°C warmer in 2012 than 2011 and water temperatures were nearly 3°C warmer in both May and June 2012 than in 2013. The diversity and structure of the finfish community seemed to be influenced by these anomalous temperatures. In particular, changes in the developmental state of Atlantic herring (*Clupea harengus*), distribution of alewife, (*Alosa pseudoharengus*), and abundance of butterfish (*Peprilus triacanthus*) were observed. We observed more rapid development and growth of forage species (Atlantic and river herring) and a possible northward shift in species such as butterfish. These observations may be indicators of future change for the coastal waters of eastern Maine. Though they do not demonstrate causality, such observations reveal the role temperature can play in marine ecosystems. All of this underscores the need for improving our ability to predict and mitigate impacts of anthropogenic changes to the environment.

Contact: Jeffrey Vieser, phone: 908-217-3524, email: Jeffrey.vieser@maine.edu

Groundfish predation on diadromous fish in the Gulf of Maine.

Christine Lipsky[1], Brian Smith[2], Stacy Rowe[2], Tim Sheehan[2], and Michael O'Malley[3]
[1]*NOAA Fisheries Service, NEFSC, Orono, ME*
[2]*NOAA Fisheries Service, NEFSC, Woods Hole, MA*
[3]*Integrated Statistics, Falmouth, MA*

Large-scale restoration efforts in the Penobscot River system are expected to enhance the abundance of various diadromous fish species, including river herring (*Alosa pseudoharengus; A. aestivalis*) and American shad (*A. sapidissima*). Historically, these species were important prey items for Atlantic cod (*Gadus morhua*) in the Gulf of Maine. It is hypothesized that this loss of forage exacerbated the decline of nearshore groundfish stocks, and that an increase in diadromous fish will help restore cod and other groundfish. To evaluate the importance of diadromous fish as prey for nearshore groundfish species, we collected stomach from groundfish captured offshore of the Penobscot and Kennebec Rivers in 2010 and 2011. The Kennebec River, which contains a relatively robust diadromous run, was sampled for comparison with the Penobscot River that currently has a minor diadromous run. Our results indicated that groundfish predation on diadromous fish offshore of both rivers was low (although higher in the Kennebec), and river herring were the only diadromous species in the stomach samples. Our food habits work continues, and stomach samples collected during 2012 and 2013 from both systems will be used to further evaluate the importance of diadromous fish as groundfish prey.

Contact: Christine Lipsky, phone: 207-866-4667, email: Christine.Lipsky@noaa.gov

Annual and seasonal changes in fish presence in the lower Penobscot River, ME, 2010-2012.

Garrett Staines[1] and Gayle Zydlewski[1]
[1]*University of Maine, School of Marine Sciences, Orono, ME*

Large rivers are major corridors of fish movement for both resident and non-resident species. Typically, movement of fish in a large river fluctuate based on seasonal changes in prey abundance, diversity, and presence as well as changing life history requirements. In estuarine sections of large rivers, particularly rivers with communities of diadromous fishes, these patterns can be especially pronounced and sometimes even predictable. Environmental features of estuaries, e.g., tides, can influence observed seasonal movement patterns. As such, fish choose optimal times (e.g. flooding tide and low light) to move up or downstream. These choices result in predictable movement patterns that can be used to target sampling at a single location to best characterize fish presence and abundance. In the freshwater tidal section of the lower Penobscot River we deployed sidelooking echosounders on both sides of the river downstream of Bangor, Maine to characterize fish presence. To standardize presence and abundance indices we quantified fish presence during the night, high tide, slack times, which were the least influenced by external conditions that otherwise bias the data collected. Individual fish track analyses from echosounder data were used to determine fish abundance estimates from May-October in each of 2010, 2011, and 2012. An index of abundance was used to characterize annual and seasonal fluctuations in fish presence in this section of the estuary. Known timing of diadromous fish entering and leaving the river will be used to interpret the patterns observed in the hydroacoustics dataset. These data serve as a baseline of fish presence and seasonal fluctuations prior to river restoration activities.

Contact: Garrett Staines, phone: 207-581-4372, email: garrettstaines@gmail.com

Pelagic Fish Biomass in the Penobscot Estuary.

Michael O'Malley[1], **Justin Stevens**[1], Rory Saunders[2], and Timothy Sheehan[3]
[1]*Integrated Statistics, 16 Sumner St., Woods Hole, MA 02543*
[2]*NOAA Fisheries Service Northeast Regional Office, 17 Godfrey Drive Suite 1, Orono, ME 04473*
[3]*NOAA Fisheries Service Northeast Fisheries Science Center, 166 Water Street Woods Hole, MA 02543*

In 2012 and 2013, we used down-looking, multi-frequency mobile acoustic survey techniques (SIMRAD EK60 split-beam 38 and 120kHz) to describe pelagic fish biomass in the Penobscot Estuary, Maine, USA. Acoustic biomass (nautical area scatter coefficient) patterns were similar in both years and fish aggregations occurred in distinct areas at discrete times, revealing predictable species-specific habitat use. Biomass was highest in summer when distinct schools of juvenile Atlantic herring, *Clupea harengus*, were detected in higher salinity areas in the lower estuary. Biomass was more spatially heterogeneous in both spring and autumn, with the greatest biomass occurring in the mixed area of the middle estuary. Most of the acoustic signals in the estuary were small, target strength < -40dB, and mainly comprised juvenile clupeids (confirmed by pelagic trawl sampling). Acoustic signatures of medium-sized fish, target strength -45 to -35dB, occurred primarily in the spring, and reflected concentrations of rainbow smelt, *Osmerus mordax*, and river herring, *Alosa pseudoharengus* and *A. aestivalis*. The abundance of larger fish (i.e., target strength >-35dB) was generally low in the estuary. Total fish biomass varied widely throughout each year, but not over short periods (e.g., weekly). Our results indicate that mobile split-beam hydroacoustics, combined with validation from trawling, is an effective approach for monitoring pelagic fish biomass in estuarine systems.

Contact: Justin Stevens, phone: 207-866-4166, email: justin.stevens@noaa.gov

Exploring the importance of top-down and bottom-up drivers of mysid shrimp distribution in the Penobscot Estuary.

Rachel Lasley-Rasher[1], Alex Jensen [1], Justin Stevens[2], Christine Lipsky[3], Damian Brady[1], and Pete Jumars[1]
[1] *University of Maine, Department of Marine Science, Darling Marine Center, Walpole, ME*
[2] *Integrated Statistics, Woods Hole, MA*
[3]*NOAA's National Marine Fisheries Service, Orono, ME*

Mysid shrimp are small (~ 1-2 cm) omnivorous crustaceans that are important prey species for numerous fishes in estuarine and marine habitats. Mysids are often associated with areas of low light such as deep areas or regions of high turbidity. In clear waters, many mysid species undergo a diel vertical migration, residing near the substrate during the day and rising into surface waters at night. This behavior is likely a result of the competing demands of obtaining valuable food items in surface waters while avoiding detection by visual predators. In high turbidity environments, where low light levels exist during the day, mysids often achieve high densities throughout the water column. The question remains as to whether elevated turbidity levels serve as a refuge from visual predators, a resource hotspot, or both. Also, it remains unknown whether the association between high turbidity and mysid abundance is widespread. Does this association exist in the turbid waters of the Penobscot estuary? Through coupled fish, zooplankton and water quality surveys in the Penobscot estuary, we aim to determine the drivers of mysid abundance and distribution. Preliminary results of this survey as well as possible implications for fish population dynamics will be discussed.

Contact: Rachel Lasley-Rasher, phone: 207-563-8115, email: rachel.lasleyrasher@maine.edu

A novel investigation of Atlantic salmon post-smolt ecology during estuary transition.

James P. Hawkes[1], Mike O'Malley[2], Graham Goulette[1] and Rory Saunders[3]

[1]*NOAA Fisheries Service, NEFSC/Maine Field Station, Orono, ME*
[2]*Integrated Statistics, 16 Sumner St., Woods Hole, MA 02543*
[3]*NOAA Fisheries Service, NERO/Maine Field Station, Orono, ME*

Atlantic salmon smolts experience high mortality as they transition to the marine environment. To determine the behavior, emigration timing, and survival of these fish, we have acoustically tagged smolts in the Penobscot estuary since 2005. Beginning in 2011, we conducted mobile split-beam hydroacoustic surveys ―coupled with environmental monitoring― to obtain information on fish biomass distributions and environmental conditions (salinity, temperature) in the estuary. Analyses of the 2012 and 2013 post-smolt tagging and hydroacoustic survey data indicate that predation mortality on early emigrating smolts was similar in both years (~17%). However, predation mortality on late-emigrating smolts, was markedly lower (5%). Most smolt losses occurred in areas of the estuary having significant salinity mixing and high fish biomass. Post-smolts tended to out-migrate close to the surface (<6m) while other forage species were lower in the salt wedge, resulting in little spatial overlap with more abundant species within the estuary. This leaves post-smolts more susceptible to predation threats.

Contact: James Hawkes, phone: 207-866-7109, email: james.hawkes@noaa.gov

Lessons on the migration pathways and mortality points of salmon at sea.

Jonathan Carr[1], Stephen Tinker[1], and Graham Chafe[1]
[1]*Atlantic Salmon Federation, St. Andrews, NB, Canada*

We used acoustic telemetry to document Atlantic salmon smolt and kelt movements and survival from freshwater to the marine environment. We studied three rivers that empty into the Gulf of St Lawrence: Miramichi, Restigouche, and Cascapédia. The average smolt and kelt survival in freshwater to head of tide ranged from 75% to 90% over a 10-year time period. High smolt losses occurred in the estuary and bay zones. On average, only 17% to 24% of the smolt survived to exit through the Gulf of St Lawrence en route to the ocean feeding grounds off Labrador and Greenland. The Strait of Belle (SOBI) was the preferred exit route for salmon leaving the Gulf. Very few fish were detected passing through the Cabot Strait exit, which was only 350 km from the river estuaries, compared to the 800 km distance to SOBI. Smolt from all rivers travelled together across the SOBI receiver array over a 2-week period each year and reconditioning kelt were observed crossing the array during the time as smolt. The next step is to identify mortality sources in the estuary and bay where the highest smolt losses are occurring. We intend to investigate striped bass and cormorant predator-prey dynamics in the coastal zone and estuaries. Finally, over the past two years, we have also begun using PSATs to track kelt movements out to sea to better understand migration paths, mortality points, and possible causes of mortality.

Contact: Jonathan Carr, phone: 506-529-1385, email: jcarr@asf.ca

Migration Timing of Atlantic Salmon Smolts from Penobscot Bay to the Scotian Shelf.

John F. Kocik[1], James P. Hawkes [1], Daniel Stich [2], Joseph Zydlewski [3,2], Mathieu Dever [4], and Carrie Byron[5]

[1]*NOAA's National Marine Fisheries Service, Northeast Fisheries Science Center, 17 Godfrey Drive Suite 1, Orono, ME 04473 USA.*
[2]*Department of Wildlife Ecology, University of Maine, Orono, ME 04469*
[3]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME 04469*
[4]*Department of Oceanography, Dalhousie University, Halifax, NS B3H 4R2*
[5]*Department of Marine Sciences, University of New England, 11 Hills Beach Road Biddeford, ME 04005*

Low marine survival is limiting recovery of Gulf of Maine Atlantic salmon and a better understanding of migration ecology is key to determining limiting ocean factors. We have collected acoustic telemetry tracks of more than 1,200 wild and hatchery origin smolts since 2005 in the lower Penobscot River. These data have allowed us to document post-smolt movements from outer Penobscot Bay into the Gulf of Maine. Additional monitoring on integrated ocean observing systems, weather buoys, and other platforms has provided additional data on postsmolts in the Gulf of Maine proper. More distant detections along the coast of Nova Scotia from the Ocean Tracking Network's Halifax Line and other coastal Canadian arrays have further extended some of these tracks. We present a synthesis of postsmolt migration timing from Maine to these distant locations for over 125 postsmolts. These data suggest that many post-smolts transit the Gulf of Maine in 10 to 40 days. Thus, potential impacts of near shore development, fisheries, or changing predator fields may occur in a brief migration window from 10 May to 5 June. We used these tracks in conjunction with oceanographic and bioenergetics models to identify probable migration routes. Together these data allow us to identify offshore areas that may be critical for Atlantic salmon post smolt growth and survival.

Contact: John Kocik, phone: 207-866-7341, email: John.Kocik@noaa.gov

SESSION II: DIADROMOUS SPECIES ECOLOGY

Continuing the work of the Diadromous Species Research Restoration Network (DSRRN), this session will focus on all diadromous species and the ecosystems in which they live in the context of restoration efforts. Specifically, we hope to discuss the intended and unintended impacts of restoration projects (dam removals, fish passage) on non-target species and subsequent habitat changes, as well as the recent decision to not list river herring under the Endangered Species Act and the implications for research, management and restoration.

Karen Wilson, DSSRN, Session Moderator
Claire Enterline, MDMR, Session Moderator

The effects of global weather events on local anadromous fish dynamics: Tambora and the "year without a summer."

Theo Willis[1]
[1]*University of Southern Maine, Portland, ME*

Climate change has been linked to sustainability, resilience and robustness of socio-ecological systems. Historical reconstructions around the globe show gradual cooling and warming periods interspersed with rare punctuated cooling events, usually of volcanic origin. Here we examine the anadromous and coastal fisheries of New England north of Cape Cod for signals of a major volcanic eruption in 1815. We correlate Tambora's documented meteorological impacts on the socio-ecology of coastal northern New England using signals in local fish inspection records from the Commonwealth of Massachusetts. Massachusetts Fish Inspectors' Reports document fluctuations in exported catch through the Jefferson Embargo, the War of 1812, and the Tambora eruption, which resulted in the "year without a summer" throughout northern temperate ecosystems in 1816. For New England states bordering the Gulf of Maine, the pre-Tambora period saw intensive commercial anadromous fish exploitation in river systems. After Tambora, the socio-ecological system shifted to a new regime focused on taking schooling pelagic species, particularly herring and mackerel, in weirs and haul seines alongshore. Tambora marked a rapid shift from a riverine to a marine-based export economy. Previous events had affected the balance and magnitude of the colonial fish export market, but Tambora produced a pronounced and prolonged depression of fish resources that, in combination with social, economic and ecological events of the time, resulted in dramatic market changes. While coastal inhabitants in the early 19th century had always focused their diet on locally-caught fish, and could redirect their catch to encompass more marine species, it is not clear what impact such a climatic event would have in the present social-biological-economic system. Understanding how complex human and natural systems once operated under sudden external stresses may show us how to sustain coupled systems in an uncertain future.

Contact: Theo Willis, phone: 207-780-5065, email: theowillis06@aim.com

Assessment of Coastal and Anadromous Brook Trout in the United States.

Daniel C. Dauwalter[1], Joseph McGurrin[2], **Merry Gallagher**[3], and Steve Hurley[4]
[1]*Trout Unlimited, 910 Main Street, Suite 342, Boise, ID 83702*
[2]*Trout Unlimited, 1300 North 17th Street, Arlington, VA 22209*
[3]*Maine Department of Inland Fisheries and Wildlife, 650 State Street, Bangor, ME 04401*
[4]*Massachusetts Division of Fisheries and Wildlife, 195 Bournedale Road, Buzzards Bay, MA 02532*

Brook Trout *Salvelinus fontinalis* in New England coastal streams can exhibit partial anadromy, but the status of Brook Trout and anadromous behavior is unknown for much of the region. We conducted a sub-watershed-scale (~12,000 ha) assessment of coastal and anadromous Brook Trout from Maine to Long Island, New York using data from regional fisheries professionals. Across 184 subwatersheds, the status of coastal Brook Trout, and the presence of anadromous behavior, is highly variable and uncertain across New England. Brook Trout are thought to be extirpated from, or the status is unknown in, 81 (44%) subwatersheds. There was low certainty regarding current status in 78 (42%) sub-watersheds, with a majority occurring in Maine. The status of Brook Trout was known with moderate-high certainty in at least some sub-watersheds in all states. The certainty of anadromy was low for 157 (85%) sub-watersheds, and was high for only two sub-watersheds in Massachusetts and four in Maine. This assessment can be used with other local information to initiate a regional anadromous Brook Trout conservation program focused on habitat protection and restoration, and for reducing the uncertainty of the status of coastal and anadromous Brook Trout through further targeted assessments.

Contact: Merry Gallagher, phone: 207- 941-4381, email: merry.gallagher@maine.gov

Assessing diadromous fish restoration in the Kennebec and Androscoggin Rivers.

Claire Enterline[1], Gail Wippelhauser[1], Nate Gray[1], Paul Christman[1], Karen Wilson[2]
[1]*Maine Department of Marine Resources, Division of Sea-Run Fisheries and Habitat, Hallowell, ME*
[2]*University of Southern Maine, Department of Environmental Science, Portland, ME*

The goal of the Kennebec River Diadromous Fish Restoration Project is to restore Maine's native diadromous fishes to their historic range and abundance in the watershed. Since 1987, the Maine Dept. of Marine Resources (DMR) has been working together with the Kennebec Hydro Developers Group (KHDG) and other partners to improve and establish fish passage. Major projects have included the removal of Edwards, Fort Halifax, and Madison Electric Works hydropower dams; breaching of Guilford Dam; installation of fish lifts at Lockwood, Benton Falls, and Burnham hydropower dams; and installation of fishways at Sebasticook Lake, Plymouth Pond, Stetson Pond, and Webber Pond. In addition to passage projects, we have actively worked to increase the abundance of diadromous species through the stocking of alewife into historical habitat, of adult and larval American shad into the mainstem Kennebec and Sebasticook rivers, and active salmon stocking and management. These efforts have led to measurable successes. Specifically, river herring populations have responded quickly and positively when allowed access to habitat. Since the removal of the Ft. Halifax Dam on the Sebasticook River, we have seen an increase in adult river herring spawning population from 68,990 adults in 2006 to over 3 million adults in 2011. While few adult American shad are encountered at monitored fishways, there is evidence that populations below the Brunswick Dam on the Androscoggin River have expanded to over 20,000 individuals. On the Kennebec River where the Edwards Dam was removed, a steady rise in American shad angling and angler success indicates a potential increase in Kennebec shad stocks. It is not uncommon for experienced anglers to land as many as 30 shad on a successful outing. Since 2006, 162 adult salmon have passed Lockwood on the Kennebec River and 5 adult salmon have passed Benton Falls on the Sebasticook River. The restoration effort is being carried out by the Maine DMR in partnership with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the Kennebec Coalition (Natural Resources Council of Maine, Kennebec Valley Chapter of Trout Unlimited, Atlantic Salmon Federation, and American Rivers), under cooperative agreement with KHDG. The KHDG is comprised of several power companies with facilities in the Kennebec and Androscoggin watershed, including Brookfield Power, Benton Falls Associates, Merimil Limited Partnership and Kruger Energy.

Contact: Claire Enterline, phone: 207-624-6341, email: claire.enterline@maine.gov

Shortnose sturgeon in the Gulf of Maine: migration, critical habitat, and response to dam removal.

Gail S. Wippelhauser[1], Gayle B. Zydlewski[2], Micah Kieffer[3], James Sulikowski[4], and Michael T. Kinnison[5]
[1]*Maine Department of Marine Resources, State House Station #172, Augusta, ME 04333*
[2]*School of Marine Sciences, University of Maine, 5741 Libby Hall, Orono, ME 04469*
[3]*U.S. Geological Survey, Conte Anadromous Fish Research Center, One Migratory Way, Box 796, Turners Falls, MA, 01376 USA*
[4]*Marine Science and Education center, University of New England, 11 Hills Beach Rd, Biddeford, ME 04005*
[5]*School of Biology and Ecology, University of Maine, Murray Hall, Orono, ME 04469*

Shortnose sturgeon (*Acipenser brevirostrum*) are thought to have occurred historically in several large river systems in the Gulf of Maine. The species currently is listed under the Endangered Species Act, and identifying extant populations, locating critical habitat, and restoring habitat or access to habitat are important steps in its protection and recovery. In the Kennebec River System (Kennebec System), Edwards Dam blocked sturgeon from 29 km of habitat for 162 years until it was removed in 1999. Between 2007 and 2012, shortnose sturgeon captured and tagged in four Gulf of Maine river systems were detected by an acoustic receiver array in the Kennebec System. Twenty (29%) of 68 shortnose sturgeon tagged in the Penobscot, 14 (35%) of 40 tagged in the Merrimack, one (50%) of two tagged in the Saco, and one (25%) of four tagged in the Kennebec System moved to previously identified or historical spawning habitat in the Kennebec System. Spawning was inferred from the fish location, season, water temperature, discharge, fish behavior and sexual status, and was confirmed by the capture of larvae in some years. We have provided the first evidence that shortnose sturgeon spawn in habitat that became accessible when Edwards Dam was removed in 1999, and that use of this site is not trivial. Of the tagged sturgeon that went to a spawning area, 42% went to the Upper Kennebec Estuary, 31% to the Androscoggin Estuary, 19% to the Kennebec River, and 8% visited both the Upper Kennebec Estuary and the Kennebec River.

Contact: Gail S. Wippelhauser, phone: 207-624-6349, email: gail.wippelhauser@maine.gov

Wintering Shortnose Sturgeon (*Acipenser brevirostrum*) Locations and Population Estimates in the Penobscot River, 2008 – 2013.

Kevin Lachapelle[1]**,** Gayle Zydlewski[2], Matt Altenritter[3], Michael Kinnison[3], Michael Bailey[4], and Kate Beard-Tisdale[5]
[1]*University of Maine, Ecology & Environmental Science Program, Orono, ME*
[2]*University of Maine, School of Marine Sciences, Orono, ME*
[3]*University of Maine, School of Biology & Ecology, Orono, ME*
[4]*U.S. Fish & Wildlife Service, Orono, ME*
[5]*University of Maine, Department of Spatial Information and Engineering, Orono, ME*

Shortnose sturgeon (*Acipenser brevirostrum*) in Maine spend nearly half of each year wintering. Wintering shortnose sturgeon behavior is characterized by the aggregation of individuals within a river into one or a few distinct groups that remain relatively stationary until river temperatures and velocities increase in spring. Shortnose sturgeon do not feed while wintering, and remain within 1-2 body lengths of other wintering sturgeon in the group. Wintering shortnose sturgeon in the Penobscot River have been monitored annually from 2008 - 2013, with a focus on wintering site location, timing and duration of wintering site use, and wintering population size. Monitoring involved a combination of acoustic telemetry and direct observation through the use of an underwater sonar (DIDSON). While wintering population size estimates for the Penobscot River have been comparable to mark/recapture estimates, the location of the aggregation and the timing of transition into and out of wintering behavior have been variable. Sturgeon typically use the same location for wintering each year, as was the case for the Penobscot's wintering sturgeon during the 2008-2009 through 2010-2011. However, the wintering aggregation has relocated upstream of the previous year's location each winter since. It is not completely understood how or why wintering sturgeon aggregations select their annual location, why the Penobscot population has been incrementally moving its wintering location upstream, or what caused the Penobscot sturgeon to stop using the initially documented annual wintering location and begin their upstream relocations. Potential factors could include increased human developments adjacent to the initial location, or changes in passage for sturgeon at the Bangor Dam remnants. This could also be "normal" behavior for a population when examined in the context of a larger time scale, and we have yet to document enough years to complete the picture. Although there are many questions that remain surrounding wintering behavior, the fact that the wintering site has been moving upstream for the past three years is made even more interesting when considering population-level responses to the Veazie Dam removal.

Contact: Kevin Lachapelle, phone: 207-232-2525, email: Kevin.Lachapelle@umit.maine.edu

Presence and Distribution of Sturgeon in the Damariscotta River Estuary.

Kimberly Picard[1] and Gayle B. Zydlewski[1]
[1]*School of Marine Sciences, University of Maine, Orono, ME*

Little is known about the presence of sturgeon in small coastal rivers of Maine. We explored the presence and distribution of two sturgeon species in the Damariscotta River estuary in 2012. From Apr-Dec, three acoustic tag receivers were placed in the estuary to record signals opportunistically from transmitters in animals of the region, knowing that shortnose sturgeon, *Acipenser brevirostrum* and Atlantic sturgeon *Acipenser oxyrinchus* were tagged in adjacent rivers. During the expected fall migration period, Sep-Nov, weekly surveys of surface and bottom temperature, salinity, dissolved oxygen, and depth were conducted and a mobile acoustic receiver was used to record sturgeon presence. During surveys, 23 PONAR grabs were conducted to document prey availability. There was a 3^{o}C drop in temperature after Oct 2. Data suggest that species richness and diversity of sturgeon prey was higher before the temperature drop. Two Atlantic sturgeon and five shortnose sturgeon were present in the estuary in 2012. Five were present during warmer conditions, May-Oct 2, and two were present during colder conditions, Oct 17–28. Four of the seven sturgeon travelled further upriver (8.2 km) than the others. One shortnose sturgeon spent more than a month in the estuary; most sturgeon spent a day or less. This is the first contemporary documentation of Atlantic sturgeon (second for shortnose) and potential prey in this estuary. These results should be used to manage sturgeon species in small coastal rivers of Maine.

Contact: Gayle Zydlewski, phone: 207-581-4365, email: gayle.zydlewski@maine.edu

Assessing microchemical analysis of dorsal scutes to infer the origins and life histories shortnose sturgeon.

Matthew Altenritter[1], Michael Kinnison[1], Gayle Zydlewski[2], Joseph Zydlewski[3], and Martin Yates[4]
[1]*Univserity of Maine, School of Biology and Ecology, Orono, ME*
[2]*University of Maine, School of Marine Sciences, Orono, ME*
[3]*U.S. Geological Survey, Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME*
[4]*School of Earth and Climate Sciences, University of Maine, Orono, ME*

Determining individual origins, movements and life histories of individuals within complex population networks is often important in understanding how such networks function as a whole. In the Gulf of Maine, shortnose sturgeon move extensively among multiple river systems, though successful spawning has only been observed in the Kennebec River complex. Spawning and rearing habitats may differ, and characterization through standard field approaches is difficult. Microchemical analysis of hard structures (such as otoliths and fin spines) provides a well characterized alternative method for retrospectively inferring life history movements in many species. We investigated the use of dorsal scutes in shortnose sturgeon as potential tissue that could be used for such a chronological analysis. To test this tissue, dorsal scutes and pectoral fin spines were collected from wild Gulf of Maine (n = 9) and hatchery reared (n = 15) individuals and compared. Both structures were thin sectioned, polished and used to estimate age. On these same structures, an electron microprobe was used to quantify strontium:calcium ratios, a measure commonly used to infer “freshwater” and “seawater” residence. Preliminary analysis suggests the number of growth zones (presumptive annuli) observed in dorsal scutes corresponds to the number of annuli in pectoral fin spines. The strontium:calcium ratio in scutes from hatchery fish is stable and low over time, reflecting stable fresh water conditions. In contrast, strontium: calcium ratios in scutes and fin spines from wild individuals varied by annuli with the lowest ratios (fresh water) observed in the first and second years. Strontium:calcium ratio generally increased in later years (indicating sea water residence) before declining. These results suggest that scutes provide an ontogenetic record of an individual’s environmental exposure and can be used to infer movements. Using this information, the next step in the project will include the micromill based collection of material from growth zones in dorsal scutes for analysis of δC^{13} and δO^{18} to assess capacity for assignment of exposure group identity.

Contact: Matthew Altenritter, phone: 810 962-3231 , email: matthew.altenritter@maine.edu

Examining patterns of marine and freshwater habitat use by juvenile blueback herring (*Alosa aestivalis*) through otolith microchemistry

Molly Payne[1] and Karen Wilson[2]
[1]*University of Southern Maine, Department of Biological Sciences, Portland, ME*
[2]*University of Southern Maine, Department of Environmental Science, Gorham, ME*

Blueback herring *(Alosa aestivalis*) are anadromous fish which utilize a variety of freshwater, estuary and nearshore marine habitats. Rapid declines in abundance and a recent petition for listing status under the US Endangered Species Act (2012) have ushered an immediate need for information about life histories and corresponding habitat use. Understanding which habitat types are utilized by juvenile blueback herring and the duration of this use is critical to management efforts since recruitment to spawning age is vital to population sustainability. In this project, we predicted juveniles with access to greater areas of freshwater/estuarine habitat would show evidence of increased time spent in these locations due to potential advantages (i.e., decreased predation, increased resources). We used otolith microchemistry and ambient concentrations of Ca, Ba and Sr within fresh, estuarine and marine waters to identify habitat use by 131 individuals in five Maine river systems. Returning adult fish were collected in 2010 and 2012 during spawning runs. Total area of available estuarine habitat of study sites ranged from approximately 204 to 3395 ha. The ambient water concentration of Sr in each habitat was strongly correlated with salinity (R2 = 0.90) and was used as the primary marker of habitat use (in ratio with Ca), with a rapid increase in Sr:Ca interpreted as migration into seawater. Results showed variable individual migration histories, e.g., some fish showed evidence of greater freshwater residency time while others moved quickly out to sea. Patterns of habitat use were distinct among several river systems although estuary size does not appear to be important. Evidence of alternative life history strategies within several river systems was also found. Results from this study illustrate the importance of estuaries as juvenile habitat and suggest that anthropogenic impacts on estuaries such as diminished water quality and dredging will have direct implications on the survival of the species.

Contact: Molly Payne, phone: 315-749-6182, email: molly.payne@maine.edu

Coming together to restore river herring throughout their range.

Kim Damon-Randall[1], Diane Borrgaard[1], Dan Kircheis[2], and Tara Trinko Lake[2]
[1]*National Marine Fisheries Service, Northeast Regional Office, Gloucester, MA*
[2]*National Marine Fisheries Service, Maine Field Office, Orono, ME*

In August 2013, NMFS published a not warranted Endangered Species Act listing decision for alewife and blueback herring in response to a petition to list these species as threatened throughout their range. This talk will briefly outline the decision making process used to arrive at this decision including use of expert workgroups, threats analysis, and extinction risk analysis results. Through this process, the most up to date information on alewife and blueback herring stock structure and population trajectories into the foreseeable future was compiled. Several significant research gaps (e.g., marine migration patterns and the effects of climate change on both species) and uncertainty associated with some datasets were identified as important issues. Thus, in the ESA listing decision, NMFS committed to working to fill some of the research gaps, address uncertainty in the data, and revisit the status of both species within the next 5 years. NMFS has partnered with the Atlantic States Marine Fisheries Commission as well as the Mid-Atlantic and New England Fisheries Management Councils to develop an online dynamic proactive conservation plan for river herring. The Plan will identify important conservation efforts that can be implemented to help restore river herring throughout their entire range from Canada to Florida, track the implementation of these efforts, identify research needed to fill in some of the critical data gaps for these species, and monitor the progress of restoring these important species.'

Contact: Kim Damon-Randall, phone: 978-282-8485, email: kimberly.damon-randall@noaa.gov

SESSION III: FRESHWATER ECOLOGY

The habitats of diadromous fish have been altered and degraded through impoundments, water quality, climate change and restoration actions. This session will explore how these migratory fish and their communities respond to rapidly changing river systems. The goals of this session are to bring together scientists looking at ecological impacts, and investigating their mechanisms. This will facilitate information flow between researchers, resource managers and other stakeholders, and provide regional context for local efforts and findings.

Jed Wright, USFWS, Session Moderator

Survival of Atlantic salmon smolts through a hydropower complex in the lower Penobscot River, Maine USA.

Daniel S. Stich[1], Michael M. Bailey[2], and Joseph D. Zydlewski[3,1]
[1]*Department of Wildlife Ecology, 5755 Nutting Hall, University of Maine, Orono, ME*
[2]*U.S. Fish and Wildlife Service, Central New England Fishery Resource Office, Nashua, NH*
[3]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, 5755 Nutting Hall, University of Maine, Orono, ME*

This study evaluated Atlantic salmon *Salmo salar* smolt survival through the lower Penobscot River, Maine USA and characterized relative differences in proportional use and survival through the main-stem of the river and an alternative migration route, the Stillwater Branch. This work was conducted prior to removal of two main-stem dams and operational changes in hydropower facilities in the Stillwater Branch. Survival and proportional use of migration routes were estimated from multi-state models based on six years of acoustic-telemetry data from 1,669 smolts and two years of radio-telemetry data from 190 fish. A small proportion (0.11, 95% CI = 0.06 ― 0.25) of smolts used the Stillwater Branch, and mean survival through the two operational dams in this part of the river was relatively high (1.00 and 0.97). Survival at Milford Dam, the dam that will remain in the main-stem of the Penobscot River, was relatively low (0.91), whereas survival through two dams that were removed was relatively high (0.99 and 0.98). Smolt survival could decrease in the Stillwater Branch with the addition of two new powerhouses. The effects of removing two dams in the main-stem are expected to be negligible for smolt survival based on high survival observed from 2005 to 2012at those locations. Survival through Milford Dam was been well below current regulatory standards, and thus improvement of passage at this location offers the best opportunity for improving overall smolt survival in the lower river.

Contact: Dan Stich, phone: 207-581-2821, email: daniel.stich@maine.edu

Size selection of adult Atlantic salmon at fish passage facilities on the Penobscot River, Maine.

George A. Maynard[1] and Joseph D. Zydlewski[2,1]
[1]*University of Maine, Department of Wildlife Ecology, Orono, ME*
[2]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME*

Fish way entry and passage success of adult Atlantic salmon were investigated in the lower Penobscot River using PIT telemetry. Fish were trapped and tagged at the most seaward dam (Veazie Dam) and released upstream from 2002-2004 and 2010-2012 (n = 4,610). PIT antennas placed at the bottom and top of dam fish ways allowed arrival and passage success for each fish to be monitored at passage facilities farther up river. Generalized linear modeling was used to test relationships between factors hypothesized to influence passage and observed success at each dam. Consistent with previous research, environmental variables such as water temperature and flow (gauge height) and arrival date influenced passage success. Interestingly, passage success was negatively related to fork length at several dams. These data suggest a size-selective pressure on Atlantic salmon in the Penobscot River against larger fish. In a wild spawning scenario, cumulative size selection against larger fish through multiple dams could lead to significant population-level effects.

Contact: George Maynard, phone: 207-631-8558, email: george.maynard@maine.edu

Hard choices in assessing survival past dams using telemetry.

Joseph Zydlewski[2,1] and Daniel Stich[2]
[1]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME*
[2]*University of Maine, Department of Wildlife Ecology, Orono, ME*

Advances in telemetry technology and in analysis techniques have led to widespread use of mark recapture models to assess survival of migrating salmon smolts past dams. Survival through a given reach with a dam has two components that contribute to the overall estimate of reach survival; the probability of survival through a reach of the system without the dam, and the added risk associated with the structure. Resolving the actual impact of the structure from the "background" signal has been the focus of many pioneering efforts. These efforts involve the release of a significant number of tagged fish below the structure of interest. The idea is that the survival of tagged fish below the dam closely represents the interval survival of fish moving through that reach, without the dam related mortality. This paired release approach removes the mathematical bias associated with simply estimating interval survival and attributing all loss to the dam. This benefit is well characterized and supported by numerous studies. There is, however a down side of this approach. In order to apply this correction, a significant fraction of tagged fish must be released below the dam and, all things being equal, the standard error of survival through that interval increases by having fewer tags available to assess survival. Applying this method also results in a mathematical increase in standard error. Increasing the number of tags reduces the problem at an obvious direct cost. Thus there is an inherent tradeoff between bias and error in survival estimate approaches. In this study, we used an idealized system with a single dam to model this tradeoff using "mean squared error" as criteria to compare scenarios. Simulations were run under various conditions of dam induced mortality, number of tags used, background mortality and detection probability to characterize the conditions under which use of the paired release produced a theoretical advantage in minimizing mean squared error.

Contact: Joseph Zydlewski, phone: 207-581-2853, email: jzydlewski@usgs.gov

Release site fidelity and spawning activity of Atlantic salmon translocated to novel headwater habitat within the Penobscot Basin.

Randall Spencer[1], Justin Stevens[1], Kevin Gallant[1], and Denise Buckley[2]
[1] *Bureau of Sea Run Fish and Habitat, Maine Dept. of Marine Resources, Bangor ME*
[2]*United States Fish and Wildlife Service, Craig Brook National Fish Hatchery, East Orland ME*

We investigated adult salmon translocation as a method of increasing spawning in headwater habitat. Sea-run adult salmon (hatchery smolt returns) were captured in a head tide fishway in early summer and held at the Craig Brook National fish Hatchery until early October; then trucked 156 km above head tide (bypassing seven dams) and released into superior spawning habitat. Fish were released 10 days prior to the expected spawning date to minimize post-release homing to the original smolt stocking sites near head tide. Translocations occurred in 2009 (57 females, 47 males) 2010 (79 females, 40 males) and 2011 (109 females, 57 males). Radio tags were implanted in female salmon (2009 – 29 females; 2010 – 44 females; 2011 – 42 females) to monitor post release movement and redd counts were conducted to assess spawning activity. Most fish (87.5 ± 2.9%, mean± se) moved downriver immediately after release but 45.7 ± 1.0% remained in the non-imprinted habitat and spawned within 4.2 ± 1.9 km of the release location. Adult translocation produced a fourfold increase in spawning in the targeted habitat relative to volitional "free-swim" spawning alone.

Contact: Randall Spencer, phone: 207-941-4454, email: randy.spencer@maine.gov

Anadromous sea lamprey (*Petromyzon marinus*) as vectors of marine-derived nutrients: implications for dam removal and Atlantic salmon restoration.

Daniel Weaver[1], Stephen Coghlan[1], and Joseph Zydlewski[2, 1]
[1]*University of Maine, Department of Wildlife Ecology, Orono, ME*
[2]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME*

Historically, many freshwater systems in Maine were linked to the marine environment by spawning migrations of adult anadromous fishes and subsequent seaward migration of juveniles. These fish were important vectors of marine-derived nutrients (MDN) that fertilized otherwise oligotrophic freshwater systems until populations declined. We examined the effects of Sea Lamprey *Petromyzon marinus* carcass addition on Sedgeunkedunk Stream, a 3rd – order tributary to the Penobscot River. We measured chlorophyll *a* biomass downstream and upstream of carcass addition using four treatments of nutrient diffusing substrata: control, nitrogen addition (0.50M NH_4NO_3), phosphorous addition (0.25M KH_2PO_4), and nitrogen + phosphorous combined (0.5M NH_4NO_3 + 0.25M KH_2PO_4). Replicates of each treatment were sampled at 1, 2, and 3 weeks post carcass-addition and measured for chlorophyll *a* using spectrophotometry. We observed chlorophyll *a* biomass increase 57 – 71% in response to carcass additions, alleviating stream nitrogen limitations. To supplement our field experiment, we examined decay rates and corresponding water enriching effects of decomposing Sea Lamprey at 15, 20, and 25°C over a 45-day period in a controlled laboratory experiment. We found that the majority of total soluble phosphorous leached from carcasses within one week, and ammonium within three weeks. It is evident that MDN from decomposing carcasses are vital for primary productivity in oligotrophic streams and are likely assimilated by other aquatic organisms. This research adds to a growing body of knowledge that may help predict the effects of sea lamprey recovery on aquatic communities and aid management decisions for Atlantic salmon and fish passage restoration.

Contact: Daniel Weaver, phone: 703-595-3644, email: daniel.weaver@maine.edu

Effects of *D. geminata* on juvenile Atlantic salmon (*Salmo salar*) foraging behavior

Carole-Anne Gillis[1] and Normand E. Bergeron[1]
[1]*Institut national de la recherche scientifique, Centre Eau Terre Environnement, Quebec City, QC Canada*

Since 2006, nuisance growths of *Didymosphenia geminata* (didymo) have been occurring in eastern North America. This alga forms thick and extensive benthic layers in stable flow oligotrophic rivers. In a previous study, Gillis and Chalifour (2010) showed that the presence of didymo caused significant shifts in macroinvertebrate community structure and prey abundance. Despite an increase in overall prey production, prey location and availability may be altered by dense didymo mats. Therefore, the presence of didymo is suspected of altering juvenile Atlantic salmon foraging behavior and habitat selection through food web interactions. Research objectives aimed at evaluating the effects of didymo on juvenile salmon by assessing their foraging behaviour as well as prey availability in didymo-affected and didymo-free sites. Feeding behaviour data was collected in the Patapedia River by focal-animal sampling of young-of-the-year salmon conducted by one person while snorkelling. Each YOY was observed for a period of 15 minutes and all observed behaviours were recorded. Drift nets were set for a period of 24 hours in order to assess prey availability at each observation site. Results show a significant positive relationship between proportion of benthic forays vs. drift forays and increasing didymo cover ($R2 = 0.54$, $p < 0.001$). Laboratory analysis is underway to examine whether the shift in foraging behaviour is triggered by limited prey availability induced by the didymo mats or if didymo presence enhances profitability. Further results, currently under analysis, will be presented and mechanisms by which *D. geminata* alters Atlantic salmon habitat will be discussed.

Contact: Carole-Anne Gillis, phone: (+1)418-750-5314, email: carole-anne.gillis@aquaconfluence.com

Environmental drivers of Atlantic salmon growth and survival: building a climate change context with hierarchical models.

Krzysztof Sakrejda[1], Michael Morrissey[2], Keith Nislow[3], and Ben Letcher[4]
[1]*University of Massachusetts, Organismic and Evolutionary Biology, Amherst, MA*
[2]*University of St. Andrews, School of Biology, St. Andrews, Fife, UK*
[3]*US Forest Service, Northeastern Research Station, Amherst, MA*
[4]*USGS, Conte Anadromous Fish Research Center, Turners Falls, MA*

We analyze a long-term mark-recapture data set (n=7804, >20k recaptures, 10 cohorts) from a single stream (Whately, MA). We jointly model age-specific survival, growth, and size-dependent survival in response to variation in flow and water temperature using a Cormack-Jolly-Seber survival model and a log-normal growth model. Responses to flow and temperature are strongly seasonal and age-specific, but we observed large effects of stream temperature and flow on in-stream survival even under the current environmental conditions. The effect of size on survival tended to be negative, though in some seasons it was difficult to distinguish survival from emigration despite smolt trapping and PIT tag antennas. The hierarchical model allowed us to characterize temporal environmental variation but also highlighted the opportunity for combining data sets from a broader geographic area for understanding population responses to environmental variation.

Contact: Krzysztof Sakrejda, phone: 413-325-6555, email: sakrejda@cns.umass.edu

Stream flow and temperature effects on salmonid population dynamics: integrated modeling across scales and data types.

Benjamin H. Letcher[1], Yoichiro Kanno[1], Keith H. Nislow[2], Paul Schueller[1,3], Ronald Bassar[1], Ana Rosner[1], Jason A. Coombs[2], Krzysztof Sakrejda[1,3], Michael Morrissey[1], Douglas Sigourney[1], Andrew Whiteley[4], Matthew O'Donnell[1], and Todd Dubreuil[1]
[1]*S.O. Conte Anadromous Fish Research Center, US Geological Survey/Leetown Science Center, Turners Falls, MA 01376 USA*
[2]*Northern Research Station, USDA Forest Service, University of Massachusetts, Amherst, MA 01003-4210 USA*
[3]*Program in Organismic and Evolutionary Biology, University of Massachusetts, Amherst, MA 01003-4210 USA*
[4]*Department of Environmental Conservation, University of Massachusetts, Amherst, MA 01003-4210 USA*

A major challenge in ecology is developing robust models of population response to environmental change that work well across space. In the last decade, researchers have begun developing so-called integrated models that attempt to bridge the gap between specificity and generality by combining data sources into a single modeling framework. We present results from an integrated effort aimed at understanding how brook trout respond to variation in stream flow and temperature. Integrating data from presence/absence surveys, abundance surveys and mark-recapture studies, we identified that dynamics are dominated by egg/fry survival and that high flow in the autumn and low flow in the winter increase recruitment. Also, adult survival was positively correlated with spring temperature. Results from all three data sources generally agreed in magnitude and direction of environmental effects, strengthening confidence in inferences. These relationships between environmental variation and population dynamics generate response surfaces that can be used to forecast future population dynamics in response to environmental change.

Contact: Benjamin H. Letcher, phone: 413-522-9417, email: bletcher@usgs.gov

A New Class of Spatial Statistical Model for Data on Stream Networks: Overview and Applications.

Daniel J. Isaak[1], Erin Peterson[2], and Jay Ver Hoef[3]

[1]U.S. Forest Service, Rocky Mountain Research Station, Boise, ID 83702
[2]CSIRO Division of Mathematics, Informatics, and Statistics, Dutton Park, Queensland, Australia
[3]NOAA National Marine Mammal Laboratory, Fairbanks, AK

Streams and rivers host a significant portion of Earth's biodiversity and provide important ecosystem services for human populations. Accurate information regarding the status and trends of stream resources is vital for their effective conservation and management. Most statistical techniques applied to data measured on stream networks were developed for terrestrial applications and are not optimized for streams. A new class of spatial statistical network model (SSNM), based on valid covariance structures for stream networks, can be used with many common types of stream survey data (e.g., water chemistries, habitat conditions, biological attributes) to develop accurate information at river network scales. The SSNMs account for spatial autocorrelation (i.e., non-independence) among measurements, which allows their application to databases with clustered, non-random measurement locations. Large amounts of stream survey data exist in many areas where spatial statistical analyses could be used to develop novel insights, improve predictions at unsampled sites, and aid in the design of efficient monitoring strategies at relatively low cost. SSNMs require larger sample sizes than non-spatial models ($n > 50$ or 100 observations) and are computationally demanding (both for data preprocessing and estimation) but provide significant advantages for many stream applications. Here, we briefly review the topic of spatial autocorrelation and its effects on statistical inference, demonstrate the use of spatial statistics with datasets relevant to common research and management questions, and discuss additional applications and development potential for SSNMs. Free software for implementing the spatial models has been developed that enables custom applications with many stream databases. More information and example datasets are available at the SSN/STARS website (http://www.fs.fed.us/rm/boise/AWAE/projects/SpatialStreamNetworks.shtml) and the Spatial Stream Networks (SSN) package for R is also available from the CRAN website (http://cran.r-project.org/web/packages/SSN/index.html).

Contact: Dan Isaak, phone: 208-373-4385, email: disaak@fs.fed.us

SESSION IV: APPLYING SCIENCE TO RESTORATION

Presenters will relate their knowledge of specific threats to Atlantic salmon survival to habitat restoration actions. The session will conclude with a panel discussion critiquing current restoration activities and recommendations for future actions.

Steve Koenig, Project SHARE, Session Moderator

Science... Restoration: Connecting the dots.

Steve Koenig[1]
[1]*Project SHARE, 14 Boynton Street, Eastport, ME*

This session, “Connecting the Dots”, is a new addition added to the 2014 forum. Simply stated connecting the dots is about how we collectively take information accumulated by the “science” side of salmon restoration and apply it on the “restoration” side of recovery with a feedback loop. Some practitioners may look at it as another form of Adaptive Management. The presentation will be an attempt to demonstrate from the perspective of Project SHARE: 1. The need for connecting the dots, 2. Examples of how it is and can be done, and 3. A suggestion of how we might try to do it better.

Contact: Steve Koenig, phone: 207-853-0931, email: skoenig@salmonhabitat.org

What Works? A Workshop on Wild Atlantic Salmon Recovery Programs in North America.

Jonathan Carr[1]
[1]*Atlantic Salmon Federation, St. Andrews, NB Canada*

Wild Atlantic salmon populations are becoming severely depressed, especially across the southern range of the species. Recovery programs that utilize various stocking strategies to restore these populations have had varying success. The Atlantic Salmon Federation hosted a workshop in September 2013 that brought together stakeholder groups, scientists, and managers to collate data on Atlantic salmon recovery programs in eastern North America. Case studies provided examples of successes, failures, and best practices for rebuilding depleted and threatened wild salmon populations. Discussion during the workshop wrap-up concentrated on identifying how the role of hatcheries and other supportive rearing programs have changed and the constraints and limiting factors that must be addressed to make progress in salmon recovery. I will provide an overview of the workshop findings, including recommendations on appropriate recovery strategies for Atlantic salmon that are based on the knowledge obtained from these proceedings.

Contact: Jonathan Carr, phone: 506-529-1385, email: jcarr@asf.ca

Applying reconciliation ecology concepts to salmonid habitat restoration and enhancement.

Michael Burke[1], Nick Nelson[2], Greg Koonce[3], Manny DaCosta[2], and Marty Melchior[4]
[1]*Inter-Fluve, Inc., Damariscotta, ME*
[2]*Inter-Fluve, Inc., Cambridge, MA*
[3]*Inter-Fluve, Inc., Hood River, OR*
[4]*Inter-Fluve, Inc., Madison, WI*

Nearly all aquatic ecosystems have been impacted moderately to substantially by a broad array of ongoing anthropogenic impacts. Impacts include damming and regulation, changes to land use and watershed characteristics, channelization, water and sediment quality impacts, and introduction of alien species, among others. This has led to unprecedented assemblages of organisms in many ecosystems, whose true restoration to prior undisturbed native conditions may be unattainable or even inadvisable. Moyle (2013) articulated the concept of reconciliation ecology which describes the need to embrace the reality of our currently altered and evolving ecosystems, and the constraints they impose on conservation of critical species. By accepting this new ecological paradigm, restoration efforts to not strive to restore native ecosystems, but rather foster novel ecosystems with desirable attributes that include robust populations of native species. Reconciliation concepts apply equally to both the physical processes of the ecosystems as to the biological processes, which together define the ecosystem characteristics. These concepts underscore the challenges faced in planning salmonid habitat restoration and enhancement in many fluvial systems. Most successful aquatic restoration efforts today recognize how critical it is to understand the current physical and biological conditions of the system, in order to plan enhancements that coincide with the likely trajectories of the system. In some instances, habitat enhancement requires affecting the physical system towards a new trajectory in order to achieve the enhancement goals. Often, true restoration may not be possible, with the focus instead on developing normative conditions that provide critical habitat in the locations, timing and extents that support the critical life history needs for salmonids. This presentation provides examples from several case studies to demonstrate the application of these concepts in process-based salmonid habitat restoration and enhancement.

REFERENCES:
Moyle, P.B., 2013. Novel aquatic ecosystems: the new reality for streams in California and other Mediterranean climate regions. River Research and Applications, DOI: 10.1002/rra.2709.

Contact: Michael Burke, phone: 207-563-1332, email: mburke@interfluve.com

Prioritizing Dams at the State Level for Fish Passage Projects to Benefit Diadromous Fish.

Stephen Gephard[1] and **Sally Harold**[2]
[1]*CTDEEP/Inland Fisheries Division, Old Lyme, CT*
[2]*TNC/Connecticut Chapter, New Haven, CT*

The Northeast Aquatic Connectivity Assessment Tool Project (NCAT) completed its three year task of developing a ranking system for dams in the northeastern U.S. (Maine to Virginia) during 2011. The end product provided a ranking of over 13,000 dams based upon, in part, the benefit that would be realized to anadromous fish if fish passage was provided. This list is useful to regional planners and funders who wish to target high priority projects in the Northeast but remains intimidating to workers in individual states, where responsibility for most fish passage projects lies. We wished to examine the list of 1,700 dams in Connecticut that were assessed, apply some quality control checks to the database, and develop prioritized short lists based upon the dams' impact on diadromous fish runs to help guide strategic planning in Connecticut. The process included sorting or assignment of all dams into one of several categories, including high priority dams, which were then scored using parameters not considered in the NCAT process. The initial results created a prioritized list of 83 high priority dams and 141 dams for which more information is needed. We also created field forms for recording information when "need to know more" dams are visited.

Contact: Stephen Gephard, phone: 860-447-4316, email: steve.gephard@ct.gov

Penobscot River Restoration Project: implementing an ecosystem approach to restoring a full assemblage of diadromous fishes including Atlantic salmon (*Salmo salar*).

George Aponte Clarke[1] and Laura Rose Day[1]
[1]*Penobscot River Restoration Trust, Augusta, ME*

The Penobscot River's native diadromous fish species (DFS) populations exist today as only small fractions of their historic numbers, underscoring the need for resilience in the ecosystem. Up and downstream passage inefficiencies for Atlantic salmon (ATS) are well documented, and little evidence exists that traditional fishways effectively pass co-evolved species, critical to ATS recovery1, such as alewives, shad, and blueback herring. Other DFS that do not use fishways well are blocked from their full habitat range. Factors contributing to the reduction in DFS numbers include the cumulative impact of multiple dams, a significant known yet unaddressed impact. 23 At the same time, the Penobscot River holds great potential for DFS recovery, with recognition for the benefits of strategic removal of dams that block migration, especially lower watershed dams.45 The National Research Council identified actions to prevent ATS extinction, noting that: "Since most Maine salmon are now in the Penobscot River, that population should be a primary focus for rehabilitating the species in Maine." The Penobscot River Restoration Trust works with many private and public partners to implement the Penobscot River Restoration Project, an agreed upon plan to help restore DSF through a combination of dam removal, fish passage improvements and reconfigured hydro operations to vastly improve habitat access while maintaining energy generation. This ecosystem-focused effort addresses the full assemblage of 11 native DFS by strategically reducing the number of dams that fish must pass on their way to and from spawning grounds, and improving fish passage technology at remaining dams. Both direct and indirect, immediate and long-term benefits for Penobscot fisheries are anticipated primarily by improving access to key habitat, re-establishing the full assemblage of DFS, restoring ecosystem functions and interactions, and enhancing connectivity watershed-wide while also maintaining hydropower and creating opportunities for other restoration and recovery efforts within the basin. The Project also offers chances for fisheries agencies, managers, the scientific community, and the general public to better understand the ecological dynamics of large scale dam removals and assess the range of benefits from multi-species restoration. The Penobscot Trust, working with NOAA, has engaged cooperating investigators to document pre-dam removal baseline physical and biological conditions. This presentation highlights recent Project accomplishments and summarizes efforts to document post-removal outcomes.

REFERENCES::
[1] Saunders, R, M Hachey, and C Fay. November, 2006. Maine's Diadromous Fish Community: Past, Present, and Implications for Atlantic Salmon Recovery. Fisheries, Vol. 31, No 11.
[2] Laser, M. 2009. Operational plan for the restoration of diadromous fishes to the Penobscot River. Maine DMR and IF&W. p. 84.
[3] National Research Council, Committee on Atlantic Salmon in Maine. 2004. Atlantic Salmon in Maine.
[4] Atlantic Salmon Biological Review Team. Status review for anadromous Atlantic salmon in the U. S.
[5] USFWS, NOAA, 2008. Proposed endangered status for the Gulf of Maine Distinct Population Segment of Atlantic salmon.

Contact: George Aponte Clarke, phone: 207-232-9996, email: George@penobscotriver.org

Coolwater fish in a warming climate: How heat stress events affect wild juvenile Atlantic salmon (Salmo salar).

Rick Cunjak[1], Emily Corey[1], and Tommi Linnansaari[1]
[1]*Canadian Rivers Institute and Department of Biology, University of New Brunswick, P.O. Box 4400, Fredericton, New Brunswick, Canada E3B 5A3*

Rivers of eastern North America are warming. Maximum summer water temperatures now regularly exceed 25oC in rivers from Maine to New Brunswick and Quebec. Our previous research in the Miramichi River, the largest producer of wild Atlantic salmon in North America, showed that juvenile Atlantic salmon (Salmo salar) demonstrate a physiological stress response when water temperatures exceed 23ºC. Once temperatures approach ~27ºC, wild juveniles manage their metabolism via behavioural thermoregulation. Territorial behaviour is abandoned in favour of an aggregated response in areas of cooler water (thermal refugia). In this presentation, I will present the results of ongoing research on the movement and distribution of juvenile salmon (parr) in a warming river. Passive Integrated Transponder (PIT) tags were utilized over two summers (2009 & 2010) to monitor the temperature-related movements of 635 1+ and 2+ parr. In 2010, 33.6% of tagged parr were observed aggregating, when mid-day temperatures remained >23ºC for 4-consecutive days (max 31.0ºC). Some parr traveled >10km to locate refugia during this period. Concurrent wide scale mortality was observed in all age-classes. For a similar warm period in 2012, juvenile abundance in areas proximal to known thermal refugia was significantly greater than in areas lacking refugia. Future research will assess the thermal tolerance and physiology of parr subjected to natural thermal patterns in a laboratory setting. Implications for salmon population dynamics, especially growth, and future fisheries management will be discussed.

Contact: Rick Cunjak, phone: 506-452-6204, email: cunjak@unb.ca

Preliminary Observations on the Effects of Using Clam Shells for Acid Rain Mitigation in Maine Salmon Streams.

Mark Whiting[1]
[1]*Maine Dept. Environmental Protection, 106 Hogan Rd, Suite 6, Bangor, ME 04401*

Acid rain and intensive forest management have depleted base cations from the soils of Maine's most sensitive watersheds, resulting in significant losses of stream buffering capacity (Miller 2006). Project SHARE is using clam shells as a calcium carbonate supplement to mitigate stream acidity and restore brook trout and Atlantic salmon. Since 2010, eight small headwater streams have received between 1 and 10.5 tons of shells that were dispersed lightly on the stream bed. So far, in streams that have achieved a full dose, water chemistry has improved by approximately one pH unit. Atlantic salmon and brook trout densities have increased 2-6 times. Leafpack processing rates have improved and macroinvertebrate communities have more mayflies, stoneflies and caddisflies (EPT taxa). By adding carbonate alkalinity, stream carrying capacity has improved while fish condition remains good.

REFERENCES:
Miller, Eric. 2006. Assessment of Forest Sensitivity to Nitrogen and Sulfur Emissions in Maine. Conference of New England Governors and Eastern Canadian Premiers Forest Mapping Group.

Contact: Mark Whiting, phone: 207-357-5977, email: mark.c.whiting@maine.gov

Assessing the effectiveness of "on river" hatchery reared 0+ "fall parr" to increase juvenile abundance and adult returns on the East Machias River.

Jacob van de Sande[1], and Kyle J. Winslow
[1]*Downeast Salmon Federation, Columbia Falls, ME*

For the past 20 years the Atlantic salmon (*Salmo salar*) stocking program in the Downeast Maine has been focused on "unfed" fry and limited smolt stocking, but success has been limited. Research suggests that unnatural rearing conditions in hatcheries inhibit the ability of stocked fish to transition to the wild, resulting in high mortality. To address the limited success of the stocking program, Downeast Salmon Federation, in collaboration with federal, state, and NGO partners, is implementing a project to assess the effectiveness of rearing 0+ "fall parr" in an on-river hatchery to increase juvenile abundance and adult returns in the East Machias River. The 0+ parr are being reared in an "enhanced" rearing setting. Utilizing unfiltered river water, substrate incubators, dark colored tanks, natural feed, and water velocity manipulation, the DSF is producing a more natural, physically fit, and more cryptic 0+ parr. All parr were stocked in the fall after river temperatures were below 7^{o}C. Stocking densities have been increased to well above historic stocking levels. The project includes rigorous assessment of all life stages. Along with changes in rearing techniques, age at stocking, and stocking densities, there is a collaborative focus on addressing connectivity, adding large woody debris, and low pH mitigation in the East Machias watershed. This project is a new model for salmon recovery in the Downeast region.

Contact: Jacob van de Sande, phone: 207-460-9555, email: jacob@mainesalmonrivers.org

“Why bother, we can’t do anything about the ocean anyway.”

Tim Sheehan[1]
[1]*National Marine Fisheries Service, NEFSC, Woods Hole, MA*

Major advances in our understanding of marine phase Atlantic salmon have been made in recent years. Mixed–stock fishery sampling in distant waters, capture and release of fish with electronic tags, high seas surveys and long-term freshwater and salt water production monitoring programs are examples of novel activities that have yielded insights into marine dynamics of the species. Scientists and managers focused on the marine phase of Atlantic salmon have done a poor job of communicating the benefits these seemingly esoteric activities bring to salmon management. These efforts are often erroneously perceived as resource intensive with little practical application to the restoration of the species. On the contrary, marine studies are both cost effective and timely. Data from high seas sampling programs provide managers with the information necessary for the responsible harvest of mixed populations. Detailed migration data allow for knowledge-based ESA permit reviews, and marine surveys facilitate evaluation of different hatchery stocking strategies. Marine research activities have increased our knowledge of the marine ecology of Atlantic salmon and provide tangible benefits to ongoing restoration efforts. Scientists and managers need to do a better job of communicating the utility of these accomplishments to the larger community to garner support for their continuation.
Contact: Tim Sheehan, phone: 508-495-2122, email: tim.sheehan@noaa.gov

River Restoration: Art or Science?

Douglas M. Thompson[1]
[1]*Goodwin-Niering Center for the Environment, Connecticut College, New London, CT*

River restoration is often described as a combination of both art and science. However, careful review of current and historic practices demonstrates a consistent failure in many projects to conduct hypothesis testing fundamental to the scientific method. The history of channel restoration contains a myriad of examples of lack of objectivity in evaluating projects, lack of monitoring and data collection to test research hypotheses, and limited reporting of failed restoration attempts (Thompson, 2006). Although the terms experimental and demonstration are often used to describe current efforts, projects that fail to test hypotheses with monitoring results are not true experiments, and projects that fail to collect data are incapable of demonstrating any scientific merit (Thompson, 2013). Meanwhile, restoration projects often rely heavily on the aesthetic appeal of the structures used and the final river layout. During the infancy of the stream improvement movement in the 1930s, aesthetic values reflected newly established scientific management ideals with a desire to bring order to the supposed inefficiency of natural ecosystems. Engineered devices, called instream structures, often relied on geometric designs and straight lines. These obvious human devices and a variety of man-made materials eventually were relied upon in failed attempts to improve on nature. The environmental movement of the 1960s and 1970s brought a renewed awareness of human's negative impacts on landscapes. As a result, aesthetic values changed and designs began to mimic natural channels in appearance. Instream structures now use more rounded elements and natural materials that blend more seamlessly with the environment. However, the aesthetic attainment of more natural-looking forms does not ensure successful incorporation of natural functions. Today many channel designs appear to imitate natural ecosystems, but these projects merely reflect an old emphasis of form over function. Static instream structures are designed to prevent natural channel change, which ignores the sustainability of long-term ecosystem functions dependent on erosional and depositional processes. Lateral river migration that creates loading of large woody debris is one prime example of a natural process critical in habitat creation, which is inhibited in many modern restoration designs. Consequently, many current and historic projects fail to meet physical and biologic objectives. A review of river restoration through time reveals that the value of river restoration has never been demonstrated with enough scientific merit to justify the current widespread adoption of restoration techniques, especially the use of instream structures, without corresponding evaluation to judge project success. A new effort focused on independent monitoring and evaluation of each and every restoration project is needed to ensure that all projects feed our scientific understanding of these complex ecosystems to avoid the pitfalls of our past failures.

REFERENCES:

Thompson, D.M., 2006. Did the pre-1980 use of instream structures improve streams? A reanalysis of historic data. Ecological Applications, 16: 784-796.

Thompson, D.M., 2013. The Quest for the Golden Trout: Environmental Loss and America's Iconic Fish. University Press of New England, Hanover, NH, 311 pp.

Contact: Doug Thompson, phone: 860-439-5016, email: doug.thompson@conncoll.edu

POSTER SESSION

When is a smolt not a smolt? Identifying predation in the Penobscot River estuary using acoustic telemetry.

Graham S. Goulette[1], James P. Hawkes[1], Joe Zydlewski[2,3]
[1]*NOAA Fisheries Service, NEFSC/Maine Field Station, Orono, ME*
[2]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME*
[3]*University of Maine, Department of Wildlife Ecology, Orono, ME*

Acoustic telemetry is a widely used tool that has proved effective in characterizing fish behavior and assessing survival over various spatial and temporal scales. In the Penobscot River, a network of stationary receivers has been used since 2005 to study the downstream migration of wild and hatchery origin Atlantic salmon smolts. To date, this network has produced thousands of smolt movement tracks. Appropriate interpretation of these data, however, depends upon exclusion of any spurious or erroneous information. While some obvious specious track data can be readily excluded, other tracks that appear "abnormal" or "inconsistent" with previously observed patterns are problematic. These observations could be either novel information or unrepresentative data (indicative of mortality or a predation event). Analysis of individual smolt tracks has allowed us to infer when predation events occur. Using additional knowledge of the system's geography and potential smolt predators (e.g. striped bass and cormorants), we have been able to assess predation on smolts through circumstantial evidence. Our findings indicate that between 5% and 20% of tagged smolts suffer predation mortality in the Penobscot River Estuary. Here we illustrate methods used to discriminate between smolt movements, and tracks with predation events.

Contact: Graham Goulette, phone: 207-866-7378, email: Graham.Goulette@noaa.gov

Differential vitellogenic responses to common endocrine disruptors in brook trout, Atlantic salmon and Atlantic sturgeon.

Meghan Nichols[1], Tara A. Duffy[1,2], **Barbara Arter**[3] and Stephen D. McCormick[1]
[1]*Conte Anadromous Fish Laboratory, Turners Falls, MA, USA*
[2]*Louisiana Universities Marine Consortium, Chauvin, LA, USA*
[3]*BSA Consulting, Steuben, ME, USA*

Atlantic salmon (*Salmo salar*) and Atlantic sturgeon (*Acipenser oxyrhincus*) are endangered anadromous fish with life-history strategies that may expose them to endocrine disrupting compounds (EDCs) during early development, potentially reducing long-term fitness and survival. Current whole effluent toxicity (WET)-test methods utilize surrogate species, such as brook trout (*Salvelinus fontinalis*), to address acute toxicity of wastewater effluent to aquatic organisms. However, the WET-test is often based solely on significant mortality and changes to growth and ignores other physiological changes. To compare sensitivity to common EDCs among a surrogate species and two endangered species, we carried out long-term (21-day) aqueous exposures using two doses each of nonylphenol (NP), and 17α-ethinylestradiol (EE2) on juvenile Atlantic salmon and Atlantic sturgeon and brook trout. Estrogenic response was compared using vitellogenin (Vtg, a precursor egg protein) gene transcription, mortality and growth. No EDC-related mortality occurred in any species and impacts to growth were minimal. Vtg mRNA was elevated in a dose-dependent manner in brook trout and salmon, but sturgeon Vtg showed no significant response to these EDCs at any dose. These results suggest that brook trout may be an appropriate surrogate for understanding impacts to young Atlantic salmon but not Atlantic sturgeon, and that current WET-test methods may not be an appropriate measure of potential EDC impacts on these animals.

Contact: Dr. Tara Duffy, phone: 216-408-9564, email: taraannduffy@gmail.com

Diet and prey availability of sturgeon in the Penobscot River, Maine.

Matthew P. Dzaugis[1], **Gayle B. Zydlewski**[2], Matthew E. Altenritter[3] , Michael Kinnison[3]
[1]*Marine Science Institute, The University of Texas at Austin, Port Aransas, TX*
[2]*School of Marine Sciences, University of Maine, Orono, ME*
[3]*School of Biology and Ecology, University of Maine, Orono, ME*

Although vital to the protection and conservation of species listed under the U.S. Endangered Species Act, critical habitat of shortnose sturgeon and Atlantic sturgeon in the Penobscot River, Maine have not yet been described. Critical habitat includes food availability as well as the physical characteristics of foraging habitat. To characterize seasonal availability of benthic prey, a ponar grab was used to collect over 125 benthic samples between 21 May and 8 October 2012. Samples were stratified throughout the river and broadly categorized by sediment type. All organisms within samples were identified to the family level. To characterize diet, stomach contents were collected from eight Atlantic sturgeon and sixteen shortnose sturgeon using gastric lavage. Fifty-six percent of shortnose sturgeon and 33% of Atlantic sturgeon had empty stomachs. In the upper river, characterized by a freshwater environment, all of the lavaged sturgeon had empty stomachs. No successful ponar grabs were taken in the upper river because of compacted sediment and cobbles obstructing the grab. In the middle river there were no sturgeon caught and the benthic community had more freshwater benthic organisms than marine organisms. In the lower river, characterized by a brackish water environment and brackish water benthic community, only 7% of the lavaged sturgeon had empty stomachs. In the lower river 81% of ponar grabs were successful and no seasonal differences in species diversity were apparent. Spionid polychaetes were not only the most available prey in substrate samples (over 75% by abundance) but also in the diet (over 75% for both species). The distribution and abundance of spionid worms may provide an indication of critical foraging habitat for these species.

Contact: Gayle Zydlewski, phone: 207-581-4365, email: gayle.zydlewski@maine.edu

Assessment of Sea Lice Infestations on Wild Fishes of Cobscook Bay.

Alexander Jensen[1], Gayle Zydlewski[1], Sarah Barker[2]
[1]*School of Marine Sciences, University of Maine, Orono, ME*
[2]*Aquaculture Research Institute, University of Maine, Orono, ME*

Sea lice are ectoparasitic copepods on fishes and can negatively impact aquaculture operations. Little work on sea lice, specifically *Lepeophtheirus salmonis* and*Caligus elongatus*, has occurred in the northwest Atlantic. This project characterized sea lice infestations on wild fishes in Cobscook Bay during 2012. Trawling, seine netting, and fyke netting occurred from March to November. Netting sites were selected to sample the bay's three regions: Outer, Central, and Inner Bay. Visual examinations of fish were used to identify wild hosts and characterize sea lice life stage abundances, attachment locations, and infection prevalence and intensity. DNA sequencing was used to identify sea lice species. *Caligus elongatus* was the only identified sea lice species, and was found on 12 fish species. Threespine sticklebacks (*Gasterosteus aculeatus*), blackspotted sticklebacks (*Gasterosteus wheatlandi)*, and winter flounder (*Pseudopleuronectes americanus*) were prominent hosts with the most infestations (n = 204, n = 32, n = 9). Over 95% of sea lice were in the non-motile chalimus stages, which were predominantly attached to the fish fins. Infection intensity and prevalence on threespine sticklebacks varied significantly between months, reaching maximal values during June. Infection prevalence on threespine and blackspotted sticklebacks differed spatially, with lower levels in Inner Bay than in Central and Outer Bay. Infection prevalence and intensity differed among threespine sticklebacks (12.26%), blackspotted sticklebacks (1.98%), and winter flounder (2.07%), indicating differences in host suitability and importance. These results establish a baseline for sea lice dynamics in Cobscook Bay and inform future sea lice surveys.

Contact: Gayle Zydlewski, phone: 207-581-4365, email: gayle.zydlewski@maine.edu

On river hatchery rearing of 0+ fall parr to increase adult Atlantic salmon returns to the East Machias River, a collaborative model for salmon recovery.

Kyle Winslow[1] and Jacob van de Sande [1]
[1]*Downeast Salmon Federation, East Machias Aquatic Research Center, East Machias, ME*

For the past 20 years the focus of the stocking program in the Downeast rivers has been "unfed" fry and limited smolt stocking, but success has been limited. Research suggests that un-natural rearing conditions in hatcheries inhibit the ability of stocked fish to transition to the wild resulting in high mortality. To address the limited success of the stocking program Downeast Salmon Federation, in collaboration with federal, state, and NGO partners, is implementing a project to assess the effectiveness of "on river" hatchery reared 0+ "fall parr" to increase juvenile abundance and adult returns. The 0+parr are being reared in an "enhanced" rearing setting. Utilizing unfiltered river water, substrate incubators, dark colored tanks, natural feed, and water velocity manipulation the DSF is producing a more natural, physically fit, and more cryptic 0+ parr. All parr will be stocked in the fall after river temperatures are below 7C. Stocking densities will also be increased to well above historic levels. The project will include rigorous assessment of all life stages. Along with changes in rearing techniques, age at socking, and stocking densities, there will be a collaborative focus on addressing connectivity, adding large woody debris, and low pH mitigation in the East Machias watershed. This project is a new model for salmon recovery in the Downeast region.

Contact: Kyle Winslow, phone: 207-263-7072, email. kyle@mainesalmonrivers.org

Marine-derived nutrient cycling in the St. Croix River, Maine

Betsy Irish[1], Joseph Zydlewski[1,2], Rick Cunjak[3]
[1]*University of Maine, Department of Wildlife Ecology, Orono, ME*
[2]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME*
[3]*University of New Brunswick, Canadian Rivers Institute, Fredericton, NB Canada*

Fish ways at main stem dams on the St Croix River in northern Maine have been closed to diadromous fish passage since the late 1980s by the State of Maine. The recent reopening of these fish ways is anticipated to allow alewife back into historic upriver spawning habitat, reconnecting the freshwater and marine ecosystems. A study was initiated in 2013 using stable isotopes to assess the potential changes in the flow of marine nutrients into the freshwater system, as well as shifts in the trophic structure. Water samples were taken from ten sites within the watershed, including lakes, impoundments, and the main stem of the river. For these sites, samples for stable isotope analysis were also collected. Fish were sampled through boat electrofishing and muscle and liver tissues were collected. Invertebrates were collected by kick sampling, making efforts to collect several species from each functional group of insects (i.e. filter feeders, detritivores, herbivores/grazers, predators, etc.). Zooplankton was sampled using a Wisconsin net. All samples for stable isotope analysis were frozen for subsequent analysis. These data will be used as the baseline to which future years, with greater alewife input, can be compared.

Contact: Betsy Irish, phone: 207-263-8713, email: Betsy_Irish@umit.maine.edu

Assessing the influence of stocking location and salinity acclimation in the Penobscot River on smolt to adult return.

Cory Gardner[1] and Joseph Zydlewski[2,1]
[1]*University of Maine, Department of Wildlife Ecology, Orono, ME*
[2]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME*

During migration, Atlantic salmon smolts can incur significant direct or indirect mortality (e.g. predation) at dams due to injury or delay. Downstream, successful transition of smolts from freshwater into the marine environment is thought to be optimized when physiological condition is synchronous with seawater entry. This migratory period is also important for imprinting a fish to its natal river, thus minimizing straying. For hatchery smolts, release into the lower river may bypass upriver mortality, but impaired performance at seawater entry or high straying may negate theoretical survival gains. In order to optimize smolt stocking with respect to these factors, a cooperative effort with NOAA Fisheries, U.S. Fish and Wildlife Service and Maine Department of Marine Resources was initiated. From 2009 to 2011, approximately 30,000 marked smolts were acclimated in "imprinting pools" at West Enfield Dam on the Penobscot River. These fish were held for 10 days before they were trucked to Verona Island and released at night on an outgoing tide. Adult returns from these fish was compared with returns from upriver releases from 2011-2013. There was no apparent difference in returns between treatments in any year. Beginning in 2014, a smolt stocking strategy will be initiated that will transfer smolts directly into the estuary and allow a 3 day period for salinity acclimation in a net pen. This comparison will help to assess if the poor survival of smolts may be linked to impaired osmoregulation upon seawater entry. By systematically assessing specific stocking strategies, smolt to adult survival can be optimized with regard to limitations of in river loss, straying and seawater performance.

Contact: Joseph Zydlewski, phone: 207-581-2853, email: jzydlewski@usgs.gov

Climate velocity in streams: what does it mean for fish?

Dan Isaak[1] and Bruce Rieman[1]
[1]*U.S. Forest Service, Rocky Mountain Research Station, Boise, ID 83702*

Climate velocity is the rate at which a temperature isotherm shifts within a stream or river. To ensure persistence this century, species distributions must track the locations of isotherms that delimit thermally suitable habitat as they move upstream with climate warming. Here, we develop the equations for calculating isotherm shift rates (ISRs) in streams that can be used to represent historic or future warming scenarios and be calibrated to individual streams using local measurements of stream temperature and slope. A set of reference equations and formulas are provided for application to most streams. Example calculations for streams with lapse rates of 0.8 °C/100 m and long-term warming rates of 0.1–0.2 °C decade indicate that isotherms shift upstream at 0.13–1.3 km decade in steep streams (2–10% slope) and 1.3–25 km decade in flat streams (0.1–1% slope). Used more generally with global scenarios, the equations predict isotherms shifted 1.5–43 km in many streams during the 20th Century as air temperatures increased by 0.6 °C and would shift another 5–143 km in the first half of the 21st Century if midrange projections of a 2 °C air temperature increase occur. Variability analysis suggests that short-term variation associated with inter-annual stream temperature changes will mask long-term isotherm shifts for several decades in most locations, so extended biological monitoring efforts are required to document anticipated distribution shifts. Resampling of historical sites could yield estimates of biological responses in the short term and should be prioritized to validate bioclimatic models and develop a better understanding about the effects of temperature increases on stream biotas.

Contact: Dan Isaak, phone: 208-373-4385, email: disaak@fs.fed.us

Upstream passage of anadromous species in the lower Penobscot River; assessing the Milford fish lift using Dual Frequency Identification Sonar (DIDSON).

Lisa Izzo[1] and Joseph Zydlewski[2,1]

[1]*University of Maine, Department of Wildlife Ecology, Orono, ME*

[2]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, University of Maine, Orono, ME*

As part of the Penobscot River Restoration Project, Great Works and Veazie Dams have been removed from the Penobscot River leaving Milford Dam as the first impediment to upstream fish migration. The removal of these dams (along with other fish passage improvements) is expected to increase habitat access for federally endangered Atlantic salmon (*Salmo salar*) and other anadromous species such as American shad (*Alosa sapidissima*) and alewife (*A. psuedoharengus*). This anticipated increase in access is inextricably linked to successful passage at the Milford Dam through a fish lift that is currently under construction. Beginning in 2014, we will use a Dual Frequency Identification Sonar (DIDSON) to observe the behavior of fish as they approach the lift. This acoustic camera provides near video-quality sonar images that can be used to identify fish species, characterize fish behavior near the fish way entrance, and characterize lift entry success. Additionally, time spent in sections of the lift entrance and direction of fish movement will be measured to examine behavior in the lift entrance. These observations may be of use in optimizing fish way performance.

Contact: Lisa Izzo, phone: 484-678-6729, email: lisa_izzo@umit.maine.edu

Demographics and movement patterns of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) in the Penobscot River, Maine.

Megan Altenritter[1]**,** Gayle Zydlewski[1], Matthew Altenritter[2], Michael Kinnison[2], Joseph Zydlewski [3,4]
[1]*School of Marine Sciences, University of Maine, 5471 Libby Hall, Orono, ME 04469-5471*
[2]*School of Biology and Ecology, University of Maine, 5751 Murray Hall, Orono, ME 04469-5751*
[3]*U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, 5755 Nutting Hall, Orono, ME 04469-5755*
[4]*Department of Wildlife Ecology, University of Maine, 5471 Libby Hall, Orono, ME 04469-5755*

Although Atlantic sturgeon abundance and movements have been studied throughout its range, little is known about this species in the Gulf of Maine. Between 2006 and 2012, one hundred fifty two Atlantic Sturgeon were caught via gill netting in the Penobscot River. Morphometric measurements made included length and mass for all individuals. In addition, all fish received PIT tags and either carlin or floy tags prior to release. Basic demographics such as mass vs. length, size distribution of captured fish, and growth were analyzed from the captured and 11 recaptured fish. The majority of Atlantic sturgeon were likely sub-adults based on size (mean total length 123.8 cm and mean mass of 11.6 kg). Forty-three of these individuals were internally tagged with acoustic transmitters and tracked using passive acoustic receivers located between the Veazie Dam and Penobscot Bay. In general, Atlantic sturgeon tended to move into the lower river from the ocean in mid to late spring, moving among the freshwater and estuarine sections of the river throughout the summer and early fall. A very specific area of the estuary is used for the majority of the year; this stretch is characterized as having salinities fluctuating from 0 to 15.5, being approximately 10 m deep and especially abundant in spionid worms. This area hosted between 42 and 76% of the acoustically tagged Atlantic sturgeon during the summer months of 2011, before most fish moved into the ocean by mid to late fall. The intensive use of the specific river habitat by sub-adults suggests that this is likely a foraging area. Together, these data suggest that a relatively discrete section of the Penobscot River Estuary may be critical habitat for growth of sub adults of this federally threatened species.

Contact: Megan Altenritter, phone: 207-581-4356, email: megan.cookingham@maine.edu

Procedures for Issuing Manuscripts in the *Northeast Fisheries Science Center Reference Document* (CRD) Series

Clearance

All manuscripts submitted for issuance as CRDs must have cleared the NEFSC's manuscript/abstract/webpage review process. If any author is not a federal employee, he/she will be required to sign an "NEFSC Release-of-Copyright Form." If your manuscript includes material from another work which has been copyrighted, then you will need to work with the NEFSC's Editorial Office to arrange for permission to use that material by securing release signatures on the "NEFSC Use-of-Copyrighted-Work Permission Form."

For more information, NEFSC authors should see the NEFSC's online publication policy manual, "Manuscript/abstract/webpage preparation, review, and dissemination: NEFSC author's guide to policy, process, and procedure," located in the Publications/Manuscript Review section of the NEFSC intranet page.

Organization

Manuscripts must have an abstract and table of contents, and (if applicable) lists of figures and tables. As much as possible, use traditional scientific manuscript organization for sections: "Introduction," "Study Area" and/or "Experimental Apparatus," "Methods," "Results," "Discussion," "Conclusions," "Acknowledgments," and "Literature/References Cited."

Style

The CRD series is obligated to conform with the style contained in the current edition of the United States Government Printing Office Style Manual. That style manual is silent on many aspects of scientific manuscripts. The CRD series relies more on the CSE Style Manual. Manuscripts should be prepared to conform with these style manuals.

The CRD series uses the American Fisheries Society's guides to names of fishes, mollusks, and decapod crustaceans, the Society for Marine Mammalogy's guide to names of marine mammals, the Biosciences Information Service's guide to serial title abbreviations, and the ISO's (International Standardization Organization) guide to statistical terms.

For in-text citation, use the name-date system. A special effort should be made to ensure that all necessary bibliographic information is included in the list of cited works. Personal communications must include date, full name, and full mailing address of the contact.

Preparation

Once your document has cleared the review process, the Editorial Office will contact you with publication needs – for example, revised text (if necessary) and separate digital figures and tables if they are embedded in the document. Materials may be submitted to the Editorial Office as files on zip disks or CDs, email attachments, or intranet downloads. Text files should be in Microsoft Word, tables may be in Word or Excel, and graphics files may be in a variety of formats (JPG, GIF, Excel, PowerPoint, etc.).

Production and Distribution

The Editorial Office will perform a copy-edit of the document and may request further revisions. The Editorial Office will develop the inside and outside front covers, the inside and outside back covers, and the title and bibliographic control pages of the document.

Once both the PDF (print) and Web versions of the CRD are ready, the Editorial Office will contact you to review both versions and submit corrections or changes before the document is posted online.

A number of organizations and individuals in the Northeast Region will be notified by e-mail of the availability of the document online.

Research Communications Branch
Northeast Fisheries Science Center
National Marine Fisheries Service, NOAA
166 Water St.
Woods Hole, MA 02543-1026

MEDIA MAIL

Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

NOAA Technical Memorandum NMFS-NE -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

Northeast Fisheries Science Center Reference Document -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review and most issues receive copy editing.

Resource Survey Report (formerly *Fishermen's Report*) -- This information report is a regularly-issued, quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. This report undergoes internal review, but receives no technical or copy editing.

TO OBTAIN A COPY of a *NOAA Technical Memorandum NMFS-NE* or a *Northeast Fisheries Science Center Reference Document*, either contact the NEFSC Editorial Office (166 Water St., Woods Hole, MA 02543-1026; 508-495-2350) or consult the NEFSC webpage on "Reports and Publications" (http://www.nefsc.noaa.gov/nefsc/publications/). To access *Resource Survey Report*, consult the Ecosystem Surveys Branch webpage (http://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/).

ANY USE OF TRADE OR BRAND NAMES IN ANY NEFSC PUBLICATION OR REPORT DOES NOT IMPLY ENDORSEMENT.