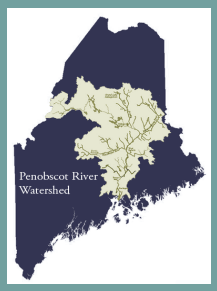

Penobscot River Research Newsletter

Volume 1, Issue 1 Summer 2010

Inside this issue:

Welcome From the Editor

Welcome to the first edition of the Penobscot River Annual Research Newsletter!

The primary purpose of this newsletter is to share research from the Penobscot River with agencies, organizations, and academic institutions in order to strengthen partnerships and opportunities among the broader fisheries and river restoration community.

Inside you will find abstracts from a variety of sources including state agencies, federal agencies, conservation organizations and academic institutions. Funding, status, and contact information are given for all projects so that you can easily follow up with any researcher.

At 8,570 square miles, the Penobscot is Maine's largest watershed and New England's second largest. This newsletter originated from the Penobscot Science Exchange which meets twice annually to discuss river research plans and results. The Exchange is a collaboration with the Diadromous Species Restoration Research Network (DSRRN), a five-year, NSF-funded collaborative research effort to advance the science of diadromous fish restoration. For information about the Exchange or DSRRN, please visit our website (www.umaine.edu/searunfish) or contact the Editor at barbara.s.arter@umit.maine.edu

We hope you enjoy the newsletter !

~Barbara S. Arter,
Editor and Science Information Coordinator

Message from the Penobscot River Restoration Trust

The Penobscot River Restoration Project is a collaborative effort between industry, the Penobscot Indian Nation, seven conservation groups, and state and federal agencies to restore Atlantic salmon, American shad, river herring, and seven other species of sea-run fish to the Penobscot watershed while maintaining hydroelectric energy production.

The Penobscot River Restoration Trust (the Trust) is the non-profit organization charged with implementing the core aspects of the restoration effort, including purchase and removal of the two lowermost dams on the river at Veazie and Great Works, and purchase and decommissioning of a third dam at Howland where a fish bypass will be constructed.

The Trust, with assistance from its member organizations, the National Oceanic and Atmospheric Administration (NOAA) and other partners, has identified core environmental monitoring parameters that will allow us to document restoration outcomes. These monitoring priorities are further influenced by two guidance documents: a conceptual monitoring framework developed by the Penobscot River Science Steering Committee, and a Gulf of Maine Council protocol for stream barrier removal monitoring.

In June 2009, the NOAA Restoration Center announced a major investment in the Project with funding from the American Recovery and Reinvestment Act of 2009. This award has allowed the Trust to begin implementation of its monitoring program. Component studies are being implemented by cooperating investigators from the University of Maine, the U.S. Geological Survey, the Gulf of Maine Research Institute, and private consulting companies. Several of these investigations are among the abstracts included in this watershed research newsletter.

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Penobscot River
By Bridget Besaw

Shortnose Sturgeon (*Acipenser brevirostrum*): Searching for Spawning Habitat in the Penobscot River, Maine by **Gayle Zydlewski,** University of Maine School of Marine Sciences, Orono, ME, (207) 581-4365, gayle.zydlewski@maine.edu; Matthew Wegener, University of Maine School of Marine Sciences; and Michael Kinnison, University of Maine School of Biology and Ecology.

Shortnose sturgeon typically move upstream to spawn in the spring from their wintering location. A preliminary estimate of the Penobscot River's overwintering population is 701 (95% CI: 445-1033). Although females with developed eggs winter in the Penobscot River, spawning behavior has not been documented. In 2008 and 2009, unsuccessful attempts were made to collect eggs and/or larvae. Acoustic tracking and a two dimensional bathymetric model will be used to select sample sites in spring 2010.

Shortnose Sturgeon.
By Kevin Lachapelle.
Photo pursuant to ESA permit #1595.

Sampling gear will include artificial substrates and modified ichthyoplankton nets. Gear will be set downstream of fish actively tracked moving upstream and in likely locations based on depth, velocity, and substrate. Detailed habitat characteristics will be collected in the spawning area if eggs or larvae are captured. Due to a lack of salinity tolerance, young of the year sturgeon cannot exit their river of origin and are preyed upon in freshwater by other species. Therefore, between June and October gut contents of predatory fish between Veazie Dam and the salt wedge will be examined for young of the year sturgeon. Documentation of spawning in the Penobscot River will lead to a better understanding of regional sturgeon population dynamics and advise conservation and management strategies.

This project is ongoing and funded by the Penobscot River Restoration Trust through the NOAA Restoration Center and the American Recovery and Reinvestment Act.

Quantifying the Effects of Dam Removal on the Structure and Function of Fish Assemblages in the Penobscot River by **Ian Kiraly**, University of Maine Department of Wildlife Ecology, 5755 Nutting Hall, Room 202 Orono, ME 04469 Phone: (607) 435-1050 ian.kiraly@umit.maine.edu; Stephen M. Coghlan, Jr. University of Maine Department of Wildlife Ecology; and Joseph Zydlewski, USGS Fish and Wildlife Cooperative Research Unit.

The Penobscot River drains the largest watershed in Maine, and once provided spawning and juvenile rearing habitats to migratory fish. The construction of dams blocked migrations of these fish and changed the structure and function of fish assemblages throughout the river. The removal of two main-stem dams and improved fish passage at a third dam is anticipated to increase passage of sea-run and resident fishes, and thus fish assemblages should change significantly.

Sampling Fish on the Penobscot
By Brandon Kulik

Quantitative assessment of the effects of dam removal on fish assemblages in large rivers is inadequate due to a lack of comparative pre- and post-removal data. The purpose of this study is to quantify pre-removal fish assemblage characteristics and to track changes within fish assemblages during and after dam removal. Survey methods include boat electrofishing and beach seining.

Pre-removal electrofishing data were collected at established sites by Kleinshmidt Associates in 2008 and 2009 as part of a separate study; data collection will continue at those sites and at additional sites chosen for random-stratified sampling.

This project is in progress, with data collection starting during the 2010 field season. Sources of funding through the Penobscot River Restoration Trust include NOAA Restoration Center, the American Recovery and Reinvestment Act, Maine Department of Inland Fish and Wildlife, University of Maine, and the Maine Cooperative Fish and Wildlife Research Unit.

River Restoration in the Northeast: What are the Implications for River Bird Assemblages? by **Erynn Call**, University of Maine Department of Wildlife Ecology, 5755 Nutting Hall, Orono, ME, 04469-5755, Phone (906) 630-0266, erynn.call@maine.edu and Malcolm Hunter, University of Maine Department of Wildlife Ecology.

This project will provide a better understanding of how river bird assemblages (RBA) interact with dams, habitat, and marine prey. Point count surveys along the Penobscot and other rivers will offer insight into how habitat metrics (within-river, surrounding landscape, and barriers [dams, falls]) relate to RBA. Using Penobscot sites we can directly measure changes before and after dam removal and monitoring sites on other rivers can serve as a comparison to the restored watershed.

One consequence of the dam removal on the Penobscot River will be to open passageways for spawning sea-run fish. The relative importance of marine and freshwater prey to birds within the context of impounded river systems is not well known. Stable isotope analysis of birds and their prey will provide insight into food resource linkages. These data will also provide a baseline to compare to a future restored watershed where marine fish may represent a more significant food source to river foraging birds.

Research for this project was initiated in the fall of 2008 and will continue in the short-term through fall 2012 and long-term approximately 10 years post-dam removal. Funding for this project comes from McIntyre-Stennis funds of the University of Maine and the Eastern Maine Conservation Initiative.

Bald Eagle with Fish Prey
By Kirk Rogers

Monitoring Changes in Resident Fish Communities and Anadromous Sea Lamprey in Sedgeunkedunk Stream (Penobscot Co., Maine) after Low-Head Dam Removal by **Cory Gardner**, University of Maine Department of Wildlife Ecology, 5755 Nutting Hall, Orono, ME 04469-5775 Phone: (207)581-1340, cory.gardner@umit.maine.edu; Stephen M. Coghlan Jr., University of Maine Department of Wildlife Ecology; Joseph Zydlewski, USGS Fish and Wildlife Cooperative Research Unit; and Rory Saunders, NOAA National Marine Fisheries Service.

Sedgeunkedunk Stream is a third-order tributary to the Penobscot River. Two dams were removed as part of a restoration project to improve fish passage and restore anadromous fishes. The upper dam was replaced with a rock-ramp fish-way in 2008. The lower dam was removed in August of 2009. Starting in 2008, Sedgeunkedunk Stream was electrofished twice a year, in order to collect data on all fish species present.

Data show consistent trends of lower fish abundance and species richness, above the lowest dam, compared to below. Sampling immediately following dam removal detected a drop in fish abundance and richness below the dam, and a rise in fish abundance above the dam. This confirmed our ability to detect changes in the system.

Monitoring of sea lamprey, the only prominent anadromous species present in the stream, began in 2008. Adults were captured entering in the stream and PIT tagged. Sea lamprey activity was monitored and abundance was estimated using MARK. This restoration will serve as a model for other small streams in the Penobscot watershed and elsewhere targeted for dam removal, and our results will help guide monitoring efforts for future restorations. This work was funded by NOAA, University of Maine Department of Wildlife Ecology and the USGS-Maine Cooperative Fish and Wildlife Research Unit and is ongoing.

Sampling on the Sedgeunkedunk Stream, Maine.
By Steve Coghlan

Katahdin Iron Works and its Effect on the Water Quality of the West Branch of the Pleasant River by **Mark Whiting**, Maine Department of Environmental Protection, 106 Hogan Road, Suite 6, Bangor, ME 04401Phone (207) 356-5977, Mark.C.Whiting@maine.gov

Katahdin Iron Ore Pit
By Mark Whiting

Katahdin Iron Works (KIW) was active from 1840-1890 and included a smelting operation on the banks of the West Branch of the Pleasant River (a tributary of the Penobscot). The ore was mined from nearby Iron Mountain. The ore weathers to form acid mine drainage which is evident in Blood Brook. This stream is listed as impaired due to "legacy pollutants" from the mining and smelting. Blood Brook flows into the West Branch, one of the more productive Atlantic salmon rivers in the western Penobscot watershed. State fishery biologists wanted to know if the West Branch has been impacted. Maine Department of Environmental Protection (DEP) collected water samples for lab analysis during the 2007 and 2009 field seasons. The water chemistry of Blood Brook is compared with upstream and downstream sites on the West Branch and on four control sites. Blood Brook is clearly affected by acid mine drainage, and aluminum and nickel exceed state standards for protecting aquatic communities. However, the West Branch and control sites maintained healthy water chemistry even in extreme flows, with one exception (right at KIW on only one date). No remedial action is recommended at this time.

This project was funded by Maine DEP and a final report will be posted at http://www.maine.gov/dep/blwq/docmonitoring/salmon/index.htm

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Alewife Population Structure in the Gulf of Maine by **Theodore Willis,** University of Southern Maine, 350 Commercial St., Portland, Maine 04101, Phone (207) 228-1673, theowillis06@aim.com

The need for in-depth investigations of river herring behavior and life history is vitally important now as many believe bycatch, directed harvest, and habitat loss have pushed these species to the edge of collapse. Stock assessment data point to declines of 90% in the last 20 years in the river herring commercial fishery. Past experience in the Kennebec River watershed (Edwards Dam 1999) demonstrated the value of alewives as a low effort, high return, high visibility species for restoration. However, there is a risk of losing remnant genetic distinctness and associated phenotypic adaptations to local conditions with any extensive stocking effort. Knowing the current regional (Gulf of Maine) genetic population structure, as well as what effects stocking (or lack of) has had on the local population structure will allow managers to evaluate the effects of past stocking and consider the long-term effects of stocking vs. natural recolonization in planning future Alosa restoration projects.

River Herring
By Theodore Willis

The primary objective of this study is to determine whether selecting individuals from multiple genetically distinct populations may result in a loss of fitness due to outbreeding depression because of incompatibility among distinct, locally adapted gene complexes. Ultimately, this study will provide sufficient information for managers to develop restoration scenarios along a gradient of maximized maintenance of genetic structure and project effectiveness.

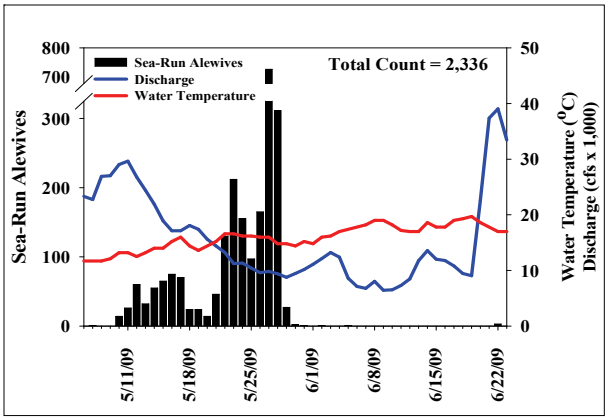
This project is a cooperative effort between NOAA Fisheries Service, US Fish and Wildlife Service, and the University of Southern Maine to analyze the genetic diversity and structure of Alosa populations in the Gulf of Maine (GOM) using DNA microsatellites. Fifty tissue samples will be collected for genetic analysis from locations in the GOM, primarily along the Maine coast, including the Penobscot and the Kennebec rivers. Individuals will be genotyped at 6-10 microsatellite loci. The genotypic data will be used to characterize genetic diversity in each population, determine the relationships of populations, and estimate long and short-term rates of mixing among populations and the genetic effective size of populations.

Penobscot River Alewife Upstream Migration Study, 2009 by **Kevin Dunham**, Maine Department of Marine Resources Bureau of Sea Run Fisheries and Habitat, 650 State Street, Bangor, Maine 04401, Phone: (207) 941-4486, kevin.dunham@maine.gov and Oliver Cox and Gail Wippelhauser, Maine Department of Marine Resources, Bureau of Sea Run Fisheries and Habitat.

Information on sea-run alewife (*Alosa pseudoharengus*) escapement and passage above the Veazie Dam, Penobscot River, is currently deficient. The original fishway trap was not designed to hold small-bodied fishes. Alewives have been documented to pass the fishway and through the trap. To capture alewives, the trap was modified by attaching 2.54 cm coated wire mesh to the interior sides and floor.

A total of 2,336 alewives were captured between May 7, and June 22, 2009. In 2008, before modification, only 2 alewives were caught. A total of 199 alewives were implanted with passive integrated transponder tags and released in the Veazie head pond to establish whether alewives were able to migrate above the Milford Dam. No tags were detected at the Milford fishway.

Several possibilities exist for the attrition of alewives. Passage beyond Great Works Dam would have been difficult given the flow conditions. Alewives could have migrated up Blackman Stream towards Chemo Pond; however, prior to 2010 there was no passage into Chemo Pond. Another alternative was the use of Great Works Stream to access a dead water area above an impoundment with passage. It is also possible the alewives spawned in the Veazie Head pond. Funding was provided by NOAA Marine Fisheries Service.



Daily sea run alewife (*Alosa pseudoharengus*) counts at the Veazie Fishway Trap, Penobscot River, Veazie, Maine.

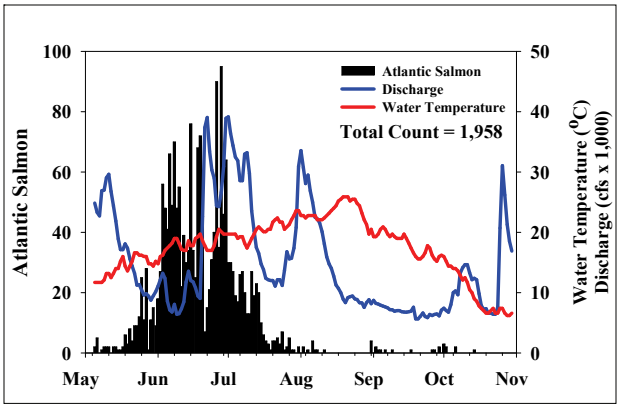
Penobscot River Adult Atlantic Salmon Trap at Veazie Dam, 2009 Summary by **Kevin Dunham**, Maine Department of Marine Resources Bureau of Sea Run Fisheries and Habitat, 650 State Street, Bangor, Maine 04401, Phone: (207) 941-4486, kevin.dunham@maine.gov and Mitch Simpson and Oliver Cox, Maine Department of Marine Resources Bureau of Sea Run Fisheries and Habitat.

The Veazie Dam Fishway Trap was operated by Maine Department of Marine Resources (DMR) daily from May 4 through October 30, 2009. The objectives were to enumerate Atlantic salmon returns, collect biological data (e.g. age, origin, fork length, and fin condition), observe hatchery marks and tags applied prior to release as smolts or parr, and to collect brood stock for the U.S. Fish and Wildlife Service.

A total of 1,958 Atlantic salmon (945 females, 815 males, 197 grilse, and 1 unknown; 1871 hatchery origin and 87 naturally reared) returned to Veazie. We released 1,278 salmon back to the Penobscot River. Six hundred and seventy nine salmon were transported to Craig Brook National Fish Hatchery. Of those, 575 remained on station as brood and 104 were subsequently released into the Upper Piscataquis in October as part of an adult telemetry study . The median capture date was June 18, the earliest median return date on record for the Veazie trap.

During late October and November, DMR documented 340 redds as part of our limited survey (Mainstem, 1; Pleasant Drainage, 152; Piscataquis, 142; Mattawamkeag, 7; and other tributaries, 38).

Funding for the operations of the Veazie Fishway Trap was provided by NOAA-Fisheries Service.



Daily Atlantic salmon (*Salmo Salar*) counts at the Veazie Fishway Trap in 2009, Penobscot River, Veazie, Maine.

Penobscot River Restoration: Monitoring Marine-Freshwater Food Web Linkages Using Stable Isotopes by **Karen Wilson**, University of Southern Maine Department of Environmental Sciences, 106 Bailey Hall, 37 College Ave, Gorham, ME 04038, Phone (207) 780-5395, kwilson@usm.maine.edu; Graham Sherwood, Gulf of Maine Research Institute; Jonathan Grabowski, Gulf of Maine Research Institute; Theodore Willis, University of Southern Maine; and Joshua Royte, The Nature Conservancy.

Sampling for Benthic Invertebrates By Karen Wilson

The objective of the Penobscot River Restoration Project is to improve diadromous fish passage between the upper reaches of the river and the nearshore marine environment (in Penobscot Bay). In order to observe linkages between these two systems and how increased connectivity may benefit different species, we have begun collecting samples for a stable isotope analysis as a means to estimate energy flows before and after dam removals/modifications. Stable isotope studies are useful because isotope signatures of consumers reflect the isotope values of their prey, which in turn can be used to infer habitat associations and level in the food chain. Our approach will provide trophic position of key predators and percent reliance on energy from migratory fish in response to Penobscot restoration activities. We will focus our efforts on alewife, as a diadromous species that has the capability to recover quickly, and top fish predators in the marine (e.g., cod) and freshwater (e.g., smallmouth bass) systems.

Sampling began in 2009 funded by The Nature Conservancy and will continue in 2010 with funding from the Penobscot River Restoration Trust and made possible by the NOAA Restoration Center and the American Recovery and Reinvestment Act.

Evaluating Changes in Diadromous Species Distributions and Habitat Accessibility Following the Penobscot River Restoration Project by **Tara Trinko,** NOAA Fisheries Service, Maine Field Station, 17 Godfrey Dr. Suite 1, Orono, ME, 04473, Phone (207) 866-4238 tara.trinko@noaa.gov; Kyle Ravana, University of Maine Department of Wildlife Ecology; and Rory Saunders, NOAA Fisheries Service.

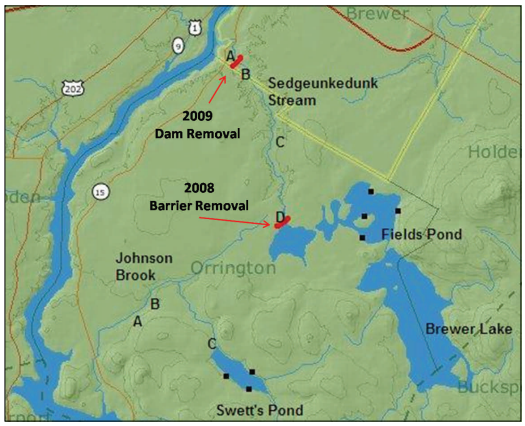
Penobscot River at Milford Dam By Tara Trinko

The Penobscot River Restoration Project (PRRP) is a multimillion-dollar endeavor that aims to restore native sea-run fish through the removal of two mainstem dams and improved fish passage at a third dam on the Penobscot River. We used geographic information systems (GIS) to quantify changes in species distribution and habitat accessibility for 11 diadromous species in the Penobscot Basin following the PRRP. Using previously compiled accounts of historic range and barrier survey data, we modeled species-specific distributions and river access for 11 species following the proposed dam removals and compared these against the current ranges and accessibility. For some species such as Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), the PRRP will provide access to 100% of their historic freshwater habitat. However, for alewives (*Alosa pseudoharengus*), approximately 66% of historic spawning and rearing habitat will remain inaccessible due to the presence of other passage barriers. These results demonstrate that the PRRP is an important step toward ecosystem recovery in the Penobscot Basin, but other restoration activities will be needed in order to realize the full potential of the PRRP. This project is near completion and funding was provided by NOAA Fisheries.

Barrier Removal in Sedgeunkedunk Stream: Sea Lamprey Re-colonization and Implications for Atlantic Salmon Habitat Restoration by **Robert S. Hogg,** University of Maine Department of Wildlife Ecology 5755 Nutting Hall, Orono, ME, 04469, (207) 581-1340, Robert_Hogg@umit.maine.edu; Stephen M. Coghlan Jr., Cory Gardner, and Silas Ratten, University of Maine Department of Wildlife Ecology; Joseph Zydlewski, USGS Fish and Wildlife Cooperative Research Unit; and Kevin Simon, University of Maine School of Biology and Ecology.

Sedgeunkedunk Stream, a tributary to the Penobscot River, historically supported several anadromous fish species including sea lamprey and endangered Atlantic salmon. Several small dams constructed in the late 1800s reduced or eliminated spawning runs entirely. As of late 2009, a small population of sea lamprey used the accessible portion of Sedgeunkedunk regularly for spawning and rearing. Efforts to restore marine-freshwater connectivity in the system have included the construction of a rock-ramp fishway in 2008 and the removal of a dam in 2009. We anticipate that sea lamprey will re-colonize newly accessible habitat and provide an influx of marine-derived nutrients. Furthermore, we hypothesize that sea lamprey may "condition" degraded habitat via physical modification of substrate during spawning. Lamprey were tracked in the system prior to barrier removals in 2008, and collections of substrate and productivity metrics were initiated in 2009. Data collection will continue throughout the 2010 and 2011 field seasons. Comparing lamprey abundances, stream productivity, and fine-scale habitat changes before and after barrier removals will allow us to test our hypotheses.

Funding has been provided by Maine Sea Grant, Atlantic Salmon Federation, NOAA, USGS, and University of Maine.



Sedgeunkedunk Stream, Maine
By Robert Hogg

Penobscot River Fish Assemblage Survey by **Brandon Kulik**, Senior Fisheries Scientist. Kleinschmidt Associates, 141 Main Street Pittsfield, ME. Phone (207) 487-3328, Brandon.Kulik@KleinschmidtUSA.com

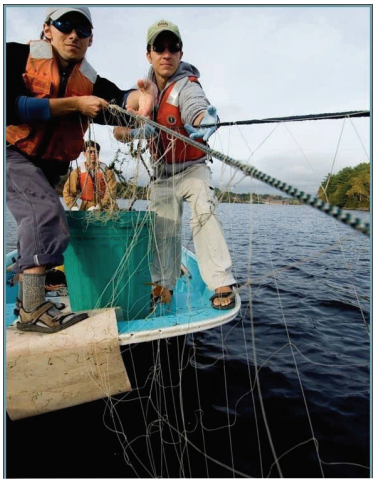
Removal of a number of significant migration barriers on the Penobscot River, Maine will have implications for restoration for anadromous Atlantic salmon, alosid, and other native diadromous species presently surviving as relict populations. Two hydroelectric dams in the lower river will be removed, and enhanced fish passage will be provided at two additional dams. Shifts in mesohabitat structure, habitat connectivity, predator-prey relations, and re-influx of marine nutrients are expected to include restructuring of riverine fish communities.

This study involves multi-year monitoring of the pre- and post-project fish community, and use of IBI metrics to index the ecological changes. A total of 20 stations were established throughout the lower 40 miles of the mainstem and on six major tributaries. Each site is surveyed annually during June and September to document pre-project seasonal changes in fish assemblage structure due to reproduction and migration. Reaches of the river presently inhabited by anadromous species were surveyed more frequently to better document the transient spring migrations. The study establishes a quantitative pre-project baseline throughout key segments of the river and provides a template so that ongoing monitoring after the physical restoration is completed can measure the ecological response.

The project is ongoing and funded by The Nature Conservancy and the Penobscot River Restoration Trust with funds from the American Recovery and Reinvestment Act via the NOAA Restoration Center, NOAA Fisheries.

Electrofishing on the Penobscot
By Brandon Kulik

Movement Patterns of Shortnose Sturgeon in Coastal Maine Waters by **Gayle Zydlewski**, University of Maine School of Marine Sciences, Orono, ME, (207) 581-4365, gayle.zydlewski@maine.edu; Phillip Dionne, University of Maine School of Marine Sciences; Gail Wipplehauser, Maine Department of Marine Resources; Joseph Zydlewski, USGS Fish and Wildlife Cooperative Research Unit; and Michael Kinnison, University of Maine School of Biology and Ecology.



Sampling for Shortnose Sturgeon. By Bridget Besaw Photo pursuant to ESA permit #1595.

Although marked shortnose sturgeon (*Acipenser brevirostrum*) have been captured in rivers adjacent to their original capture site and in coastal waters, movements between river systems are considered rare. Based on this assessment of their life history, shortnose sturgeon are managed under the U.S. ESA as 19 river-specific, distinct population segments. In 2007, 42% of 28 acoustically tagged shortnose sturgeon captured in the Penobscot River were documented moving to the Kennebec River, a distance of over 150 km. Since 2008, acoustic monitoring efforts have been expanded to six additional coastal rivers to determine whether these rivers are also used by shortnose sturgeon. Of the eight rivers monitored, shortnose sturgeon have been documented in six. Data collected from these rivers describes the timing and direction of coastal movements. The high degree of coastal mobility and exchange we have observed introduces new questions about population dynamics in the region, new challenges for researchers studying this species, and new concerns about the importance of these previously over looked river systems to the recovery of this species. Future research efforts in this region will include sampling and tagging in multiple river systems, and analyzing microchemistry of scutes to determine river of origin. This is an ongoing study currently funded by the NOAA Fisheries through the Maine Department of Marine Resources.

Funding for the Penobscot River Research Newsletter and The Penobscot Science Exchange is a collaborative effort from the following sources:

THE UNIVERSITY OF MAINE

PENOBSCOT RIVER RESTORATION TRUST

CAN RIVERS ~ ATLANTIC SALMON FEDERATION ~ MAINE AUDUBON ~ NATURAL RESOURCES COUNCIL OF MAINE ~ PENOBSCOT NATION ~ THE NATURE CONSERVANCY ~ TROUT UNLIMITED

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NOAA

Visit the Penobscot Science Exchange Website
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Gulf of Maine Stream Barrier Removal Monitoring Guide
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