CONNECTICUT RIVER BASIN ANADROMOUS FISH RESTORATION:

Coordination and Technical Assistance

F-100-R-29

Federal Aid Progress Report

October 1, 2011 - September 30, 2012

U.S. Fish and Wildlife Service
Connecticut River Coordinator's Office
Kenneth Sprankle Project Leader
103 East Plumtree Road
Sunderland, MA 01375-9138

Executive Summary

Federal Aid Project #F-100-R-29

States: Connecticut, Massachusetts, New Hampshire and Vermont

Project Title: Connecticut River Basin Anadromous Fish Restoration: Coordination and Technical Assistance

Period Covered: October 1, 2011 - September 30, 2012

Objectives:

- Coordinate the Connecticut River Anadromous Fish Restoration Program as a unified effort of State and Federal fishery agencies
- Provide technical assistance to the fishery agencies and other program cooperators
- Identify fishery program priorities, design and implement field projects to address issues, plans, and opportunities
- Administer several different federal grant programs to address fish habitat, fish passage, and research projects

Accomplishments:

Program Coordination:

- Coordinated two Connecticut River Atlantic Salmon Commission (CRASC) and two CRASC Technical Committee meetings
- Organized a CRASC Shad Studies Subcommittee meeting
- Organized the Atlantic Salmon Egg Rearing Program Teacher's Workshop for Western Massachusetts
- Assisted in compilation of the U. S. Atlantic Salmon Assessment Committee Report
- Coordinated American shad transfers from Holyoke Fish Lift, MA

Technical Assistance:

- Provided program information and requested data to cooperators, researchers, and the public, including two Freedom Of Information Act requests from the law firm representing Vermont Yankee
- Implemented second year of main stem American shad movement and survival study for 2012, Old Lyme, CT to Vernon Dam, VT that included extensive partner support and cooperation with U. S. Geological Survey Conte Laboratory
- Conducted spring fish population assessments targeting river herring in Connecticut and Massachusetts
- Mounted adult sea-run Atlantic salmon scales for age and growth analysis and completed aging and data analyses
- Maintained adult Atlantic salmon return and stocking databases
- Maintained fish passage databases
- Conducted sea lamprey nest surveys in lower portions of tributaries (MA)
- Conducted juvenile shad assessments in main stem river
- Downloaded basin wide temperature loggers, 20 units, (Old Lyme, CT to Wilder Dam, VT) and redeployed
- Entered data from all fish population assessment work and transfers into databases or spreadsheets
- Participated on Vermont Yankee Environmental Advisory Committee
- Participated in subcommittee meetings of the CRASC Technical Committee Salmon Studies, Shad Studies (lead), Fish Passage, Fish Culture, and Sea Lamprey
- Participated in pre-relicensing agency meetings for five main stem hydro-electric projects
- Completed a cooperative agreement to support Trout Unlimited culvert replacement and small dam removal in the Westfield River (MA).
- Provided technical and project assistance on the Fall River dam spillway removal project (Gill/Greenfield, MA)
- Assisted the S. O. Conte Fish and Wildlife refuge with its draft Comprehensive Conservation Plan specific to fish and aquatic habitat
- Administered ten grant agreements with towns, non-government organizations, state, and federal grantees for a variety of habitat restoration and fish passage projects
- Assisted in spawning of Atlantic salmon sea-run fish at Richard Cronin National Salmon Station

Summary of select program results:

- A total of 54 adult sea run Atlantic salmon were documented returning to the Connecticut River basin (2012)
- A total of 4.940 million Atlantic salmon eggs produced (Sept. – Nov. 2011)
- A total of 1.732 million Atlantic salmon fry released with volunteer help (spring 2012)

- A total of 71,018 Atlantic salmon smolts (viable) stocked, smolt assessment project continued by CTDEEP, with an additional 14,567 parr stocked
- 500,905 adult American shad counted at basin fishways
- A record 10,300 American shad were passed upstream of the first dam (West Springfield Dam) on the Westfield River (MA)
- Preliminary study results of the 2011 Migration and Survival of Connecticut River American Shad, coupled with CRASC, Fish Passage Subcommittee new fishway inspection protocols, led to the identification of Vernon Dam fish ladder issues (Spring 2012). Working with TransCanada, issues were resolved, and shad upstream passage improved dramatically from what had been observed for the preceding seven years.
- USFWS radio/PIT tagged 165 American shad with an additional 109 shad receiving only a single PIT tag. Fixed station radio receiver locations were expanded along the 120 miles of river monitored in 2012 with additional mobile tracking events.

Acknowledgements

I would like to thank the many people who have contributed to the accomplishments that are contained in this annual report, most importantly my Office Assistant, Darleen Cutting who continued to make many important contributions over the year that increased office productivity and efficiency. My single field employee, Student Conservation Association Intern, Sheila Kelliher, did an excellent job over her nine month appointment on a diversity of projects, particularly the American Shad Migration and Survival Study. Jeffrey Mosher (USFWS, Berkshire National Fish Hatchery) also provided a considerable amount of expert field assistance in both the spring and fall that was in addition to his job duties at the Berkshire National Trout Hatchery. Dr. Ted Castro-Santos (USGS, Conte Laboratory) provided strong partnership support for all phases of the Shad Study and made this cooperative study possible, including the large amount of work in data analyses that continues.

The S.O. Conte National Fish and Wildlife Refuge continued to support the Coordinator's Office with use of a refuge boat/trailer for the shad study and other on-river work, truck and boat storage space, intern housing, and refuge staff assistance in field activities.

The National Fish and Wildlife Foundation grant award #2011-0015-001 for the USGS/USFWS Migration and Survival of Connecticut River American Shad (November 2011) through the Bring Back the Natives Program, was critical for completing the second year of this study. The $60,000 grant award was used to purchase radio tags, PIT tags, additional radio receivers, antennas, batteries, nets, and other equipment. In addition, United Technologies Corporation-Middletown, CT, Wesleyan College, U.S. Geological Survey (CT), Ahlstrom Industries, City of Chicopee (MA) Waste Water Treatment, Holyoke Gas and Electric, Red Cliffe Canoe Club, Town of South Hadley Water Department, Town of Sunderland (MA) Waste Water Treatment, Town of Montague (MA) Waste Water Treatment, First Light Power Resources, Tom Shearer

(landowner Northfield, MA), Patterson Brothers Farms (Gill, MA), Northfield Mount Hermon School, and TransCanada, all provided access with fixed radio receiver equipment installments. I thank TransCanada for, again in 2012, contributing substantial funds to the study (approximately $35,000, equipment, staff, and inkind) enabling the purchase of additional tags and use of additional radio receivers.

Other thanks for assisting in the accomplishments over this report period are offered to:

USFWS -

- Staffs at Richard Cronin National Salmon Station, White River National Fish Hatchery, Dwight D. Eisenhower National Fish Hatchery, North Attleboro National Fish Hatchery and the Northeast Fishery Center's Fish Health Unit, Genetics Unit, and Population Dynamics Unit, Central New England Fishery Resources Office, John Warner (New England Field Office, FERC Hydropower Projects), Martha Naley (habitat project assistance including completion of Westfield River TU grant and assistance with Conte Refuge CCP), Melissa Grader (fish passage projects, habitat, sea lamprey subcommittee, hydropower relicensing, and Vermont Yankee), and the Wildlife and Sport Fish Restoration Program staff who administer this grant.

State fishery agencies -

- Connecticut: Steve Gephard, Jacque Benway, Tim Wildman, Dave Ellis, Bruce Williams and their staff of seasonal, particularly in assisting the Service on Atlantic salmon related activities
- Massachusetts: Caleb Slater, Dan Marchant and their staff
- New Hampshire: Matt Carpenter, Gabe Gries, and Jason Carrier
- Vermont: Ken Cox, Lael Will and seasonals

The Anadromous Fish Program and The Connecticut River Atlantic Salmon Commission

The administration of the interjurisdictional cooperative effort to restore Atlantic salmon and other diadromous fish species, including American shad and river herring, to the Connecticut River basin is accomplished through the Connecticut River Atlantic Salmon Commission (the Commission). The importance of this formally-structured, coordinating and regulatory body to the restoration program was recognized in 1983 when Congressional consent was given to the Connecticut River Basin Atlantic Salmon Compact, Public Law 98-138. The enabling legislation was re-authorized for another 20 years in 2002. This law (posted on the Connecticut River Coordinator's Office website), originally passed by the legislative bodies in each of the four basin states, created the Commission and conveys Congressional support to an interstate compact for the restoration of Atlantic salmon to the Connecticut River Basin. The Commission is comprised of ten Commissioners (Table 1) including a high-level government employee and a public sector representative appointed by the governor of the appropriate state, and the Northeast Regional Directors of both the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS).

The Commissioners act on policy matters and are advised on scientific and technical matters by a Technical Committee. The Technical Committee is comprised of senior staff biologists from each Commission member agency, the U.S. Forest Service (USFS), and the Massachusetts Division of Marine Fisheries (Table 2). To effectively address numerous technical issues related to the restoration program, the Technical Committee created several standing subcommittees with specific areas of responsibility (Salmon Studies, American Shad Studies, Fish Passage, Fish Culture, Smolt Studies, and Genetics). Other experts and cooperators from the member agencies, the U.S. Army Corps of Engineers, U.S. Geological Survey – Conte Laboratory (USGS), University of Massachusetts Cooperative Fish and Wildlife Research Unit, private industry, and conservation groups cooperate with the subcommittees and Technical Committee as needed and are invited to participate in meetings. The Connecticut River Coordinator (Coordinator), an employee of the USFWS, acts as the Executive Assistant to the Commission and the Secretary for the Technical Committee. The Coordinator also serves as a member on all the Technical Committee's subcommittees, the Vermont Yankee Nuclear Power Station's Environmental Advisory Committee, and the U.S. Atlantic Salmon Assessment Committee.

The Coordinator is responsible for coordination of state and federal activities, providing technical expertise, project development and implementation of fisheries studies and management programs at the population and habitat level, and advocacy and outreach of the multi-agency cooperative diadromous fish restoration program in the Connecticut River watershed (Figure 1). The Coordinator organizes necessary meetings, provides program assessment and planning documents, and maintains contact with interested parties. In addition, the Coordinator identifies management, assessment, and restoration needs or opportunities, developing and implementing activities to achieve objectives. The Coordinator also provides technical assistance primarily by managing program data in central program data bases.

Information is distributed to all the cooperators and the public.

In addition to salmon restoration, other species are under restoration and enhancement in the Connecticut River basin, including American shad, blueback herring, sea lamprey, American eel, and alewife, primarily addressed by efforts to provide passage to historic habitats and provide safe downstream passage. During the period from 1967-1984 (prior to the Commission), restoration of anadromous fish (e.g. salmonids and clupeids, primarily Atlantic salmon, *Salmo salar*, and American shad, *Alosa sapidissima*) on the Connecticut River was guided by the Policy Committee and the Technical Committee for Fisheries Management of the Connecticut River Basin with structures and memberships that have been carried over to the Commission. These earlier committees remain in place today, and serve to address diadromous fish restoration issues. The Technical Committee's standing subcommittees provide the Commission with a mechanism to address charges and advance on other diadromous fish restoration and management measures. In January of 2012, the Technical Committee proposed a restructuring of its Subcommittees to more clearly define these areas, which included new Subcommittees (*) and the combining of similar ones (e.g., Genetics and Smolt Studies under Salmon). A total of nine Subcommittees were suggested; Shad (includes American and hickory), River Herring*, Salmon, Sturgeon (shortnose and Atlantic)*, American Eel*, Sea Lamprey*, Habitat*, Fish Passage, and Fish Culture. The new Subcommittee structure was approved by the Commission at their July 2012 meeting.

The Commission meets at least twice each year and the Technical Committee meets as frequently as needed. This report period, the Commission met on November 10, 2011 and on July 10, 2012. The Technical Committee met on January 24, 2012, and June 26, 2012. Scheduled meetings are open to the public. Interested citizens are given the opportunity to provide input into the decision-making process. Area news publishers are notified of scheduled Commission meetings. Minutes of both Commission and Technical Committee meetings are produced and distributed by the Coordinator's Office once approved. Approved Minutes were posted on the Connecticut River Coordinator's Office website. In addition to serving as an historic record, these minutes describe the progress and status of restoration efforts. Program reporting occurs in other forms such as the U.S. Atlantic Salmon Assessment Committee which produces a summary document each year for all of New England available online (http://www.nefsc.noaa.gov/USASAC/Reports/).

At the Commission's November 11, 2011 meeting, Mr. William Hyatt was voted in as the new Chair of the Commission. Mr. Wayne MacCallum remains as the Vice Chair of the Commission. In July of 2012, Mr. Richard Shelton's appointment as the Public Member for the State of New Hampshire expired. Mr. Shelton's service to the Commission is greatly appreciated. The Governor of New Hampshire (and Council) subsequently appointed Mr. Duncan McInnes to this position. Mr. McInnes is a retired New Hampshire Fish and Game Department fisheries biologist, supervisor and administrator and served on both this Commission and its Technical Committee for well over a decade. The Commission's Massachusetts Public Sector member remains vacant. In the summer of 2012, NOAA Fisheries, Northeast Regional Office, had a new Director selected, Mr. John Bullard. Mr. Bullard identified his alternates as

well as a new official Technical Committee member for his agency, Mr. William McDavitt.

During this reporting period, the Commission was faced with confirmation that the U. S. Fish and Wildlife Service White River National Fish Hatchery was damaged beyond any short-term repair and had to be depopulated of its remaining Atlantic salmon broodstock. At the November 2011 CRASC meeting the Commission addressed several short-term concerns including the approval of the donation of the remaining broodstock at that facility to Federal Indian Tribes.

At the July 10, 2012 Commission meeting, the U. S. Fish and Wildlife Service informed the Commission that it would conclude its fish culturing operations for the Salmon Program. It was noted that the Service highly values the Commission's role in the fish restoration for the basin, but due to a combination of factors including continued low return rates of adult salmon, assessment and research information that indicates no change in depressed marine survival, the continuing development of other emerging Northeast Region priority needs, and a challenging fiscal environment with the shut-down of White River National Fish Hatchery, this decision was deemed necessary. The Service would complete the rearing of a remaining smolt cohort at Dwight D Eisenhower National Fish Hatchery for stock out in 2013, which will be the final smolt stocking. The Service would maintain and spawn the existing sea-run population at Richard Cronin Salmon Station, but egg rearing would need to occur at State operated facilities. Following that statement, the Commission charged the Technical Committee with determining what resources remain for use in the Salmon Program, what are the options for maintaining a Salmon Program with these resources, and what are the likely outcomes of these options. The Salmon Studies Subcommittee addressed these charges and a report was provided back to the Commission at their October 2, 2012 meeting (outside of this reporting period). Several Commissioners stated the fact that multiple age classes exist in the basin as parr and at sea as adults and continued monitoring and assessment must be priority. The Service confirmed that it would assist in continuing to provide technical support in this area as well as with fish health testing by its Northeast Fish Technology Center.

While outside of this reports time period, the Technical Committee Report on Program options recognized a greatly diminished stocking effort in the future will occur with a number of uncertainties that would have substantial bearing on the future of the Program. The Service offered to consider the use of Richard Cronin National Salmon Station (RCNSS) for the holding and spawning of sea-run fish after evaluation of a number of factors (e.g., other priority uses of facility, cost, and state support) during the winter of 2012/2013. As of this report, it is unknown if this will be a viable option in 2013. Spawning of sea-run salmon at RCNSS was completed and domestic salmon at both State of Connecticut and Massachusetts hatcheries were also completed in the fall of 2012.

Lastly, in November 2012, the Massachusetts Division of Fisheries and Wildlife (MADFW) Board was provided a report and a recommendation by MADFW to conclude its Atlantic salmon culturing activities at Roger Reed Fish Hatchery, following the spring 2013 fry stocking. The MADFW stated this recommendation was the result of the USFWS decision. The MADFW

Board approved this recommendation. Limited information is available on further details at the time of this report.

Table 1. Connecticut River Atlantic Salmon Commission Membership (as of September 2012).

Connecticut River Atlantic Salmon Commission	
Federal	**U.S. Fish and Wildlife Service** *Wendi Weber* Regional Director, Region 5 *Jaime Geiger, alternate*
	National Marine Fisheries Service *John Bullard* *Kimberly Damon-Randall, alternate*
Connecticut	**Connecticut Dept. of Energy and Environmental Protection** *William Hyatt* Chief, Bureau of Natural Resources *Stephen Gephard, alternate*
	Public Sector Representative *Robert A. Jones*
Massachusetts	**Massachusetts Division of Fisheries and Wildlife** *Wayne F. MacCallum* Director *Mark Tisa, alternate*
	Public Sector Representative *Vacant*
New Hampshire	**New Hampshire Fish and Game Department** *Glenn Normandeau* Executive Director *Scott Decker, alternate*
	Public Sector Representative *Duncan McInnes (replacing) Richard C. Shelton*
Vermont	**Vermont Department of Fish and Wildlife** *Patrick Berry* Commissioner *Eric Palmer, alternate*
	Public Sector Representative *Peter H. Basta*

Table 2. Connecticut River Atlantic Salmon Commission Technical Committee Membership.

Connecticut River Atlantic Salmon Commission Technical Committee	
Federal	**U.S. Fish and Wildlife Service** *William Ardren*
	National Marine Fisheries Service *William McDavitt*
	U.S. Forest Service *Dan McKinley*
Connecticut	**Connecticut Dept. of Energy and Environmental Protection** *Stephen R. Gephard*
Massachusetts	**Massachusetts Division of Fisheries and Wildlife** *Caleb Slater* Chair
	Massachusetts Division of Marine Fisheries *Mike Armstrong*
New Hampshire	**New Hampshire Fish and Game Department** *Matthew Carpenter*
Vermont	**Vermont Department of Fish and Wildlife** *Lenny Gerardi*

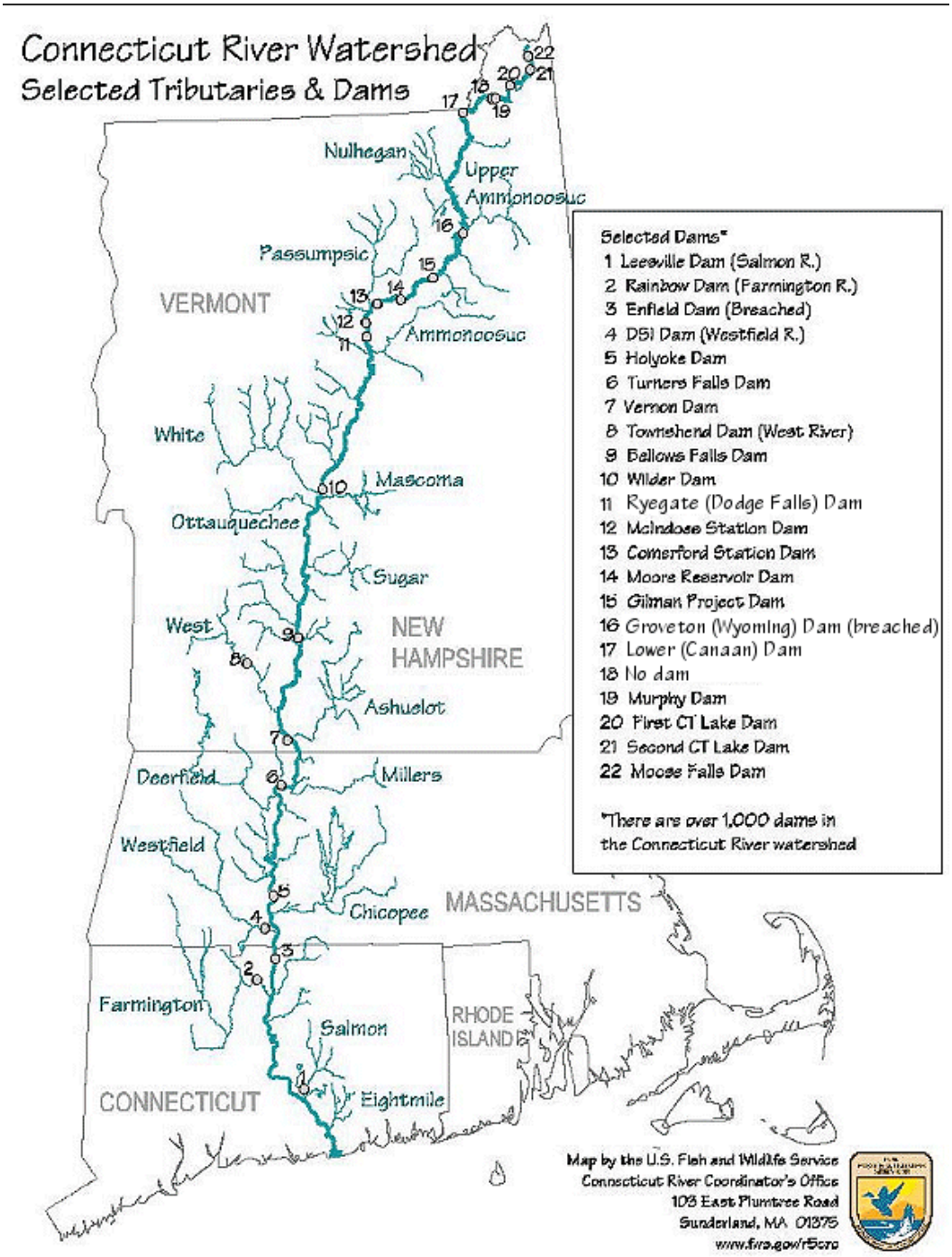

Figure 1. Connecticut River basin with major tributaries and main stem dams shown.

Coordination and Technical Assistance Funding

The Connecticut River Coordinator's Office, under Federal Aid Project No. F-100-R-29, received $20,000 from the four states, to coordinate the Program and provide technical assistance through the Sport Fish Restoration Program. The project was assessed an administrative overhead fee leaving $18,864 available. The USFWS utilized the Federal Aid funds, including base funding and fish passage and habitat restoration funding (pass through grant agreements to partners, listed later) that totaled $242,872 to ensure that planned objectives were accomplished in this report period. Operating expenses and salaries for the Coordinator's Office were covered by these funds in fiscal year 2012.

Cost **States:** $18,864 **Federal:** $224,008

Project Accomplishments

The Connecticut River Coordinator's Office enhanced the Commission's ability to manage and implement restoration programs through a variety of activities and accomplishments:

Coordination

- The Coordinator continued to provide administrative support to the Commission and Technical Committee as the Executive Assistant and Secretary, making meeting arrangements, assisting in setting agendas, handling mailings, monitoring financial receipts and disbursements, and recording and distributing minutes of Commission and Technical Committee meetings. The Coordinator also participated on the Fish Passage, Salmon Studies, Fish Culture, Sea Lamprey, and Shad Studies subcommittees. The Coordinator served as the Chair for Shad Studies Subcommittee.

- The Coordinator's Office continued to administer the four-state (Connecticut, Massachusetts, New Hampshire, Vermont) Federal Aid Coordination and Technical Assistance Project to provide for program coordination and technical assistance. This report cycle concluded the five year agreement period. A new five year agreement was submitted by each of the basin states and is in the process of approval at the time of this report.

- The Coordinator's Office compiled information for use by the U.S. Atlantic Salmon Assessment Committee in its annual report for 2011 year and arranged and attended the annual meeting in Turners Falls, MA at the S.O. Conte Anadromous Fish Research Center during March 2011. Data calls and planning meeting were held pre and post this meeting during the report period.

- The Coordinator participated as a member on the Vermont Yankee Nuclear Power

Station's Environmental Advisory Committee.

- The Coordinator worked with Connecticut Department of Energy and Environmental Protection (CTDEEP), New Hampshire Fish and Game (NHFG), Rhode Island Division of Fish and Wildlife (RIDFW), U.S. Geological Survey – Conte Lab (USGS), and Holyoke Gas and Electric to develop a shad trap and transfer schedule for the Holyoke Fish Lift.

Fisheries Management, Evaluations and Technical Assistance:

- The Coordinator provided blueback herring tissue samples to a coast-wide river herring genetic study led by Duke University from samples obtained from a Wethersfield Cove (CT) and the lower Chicopee River (MA) surveys in June. CTDEEP provided alewife tissue samples from Eightmile River. Sampling provided scales for continued monitoring of blueback herring and alewife age and spawning history.

- The Coordinator continued to work with co-investigator Dr. Ted Castro-Santos on the Migration and Survival of Connecticut River American Shad Study in the fall of 2011 reviewing and compiling data records and notice on the National Fish Wildlife Foundation's Grant award was received in November, securing the necessary funds for tags and related gear in 2012. Some preliminary and still draft analyses were completed using Passive Integrated Transponder (PIT) reader data at Holyoke Fish Lift and radio tag data from both stationary and mobile tracking events for lower river netted and tagged shad. These data for 2011 revealed a total of 82 shad radio/PIT tagged in the lower river, with 56 of these double tagged fish detected by radio receiver gear upstream of the first receiver location (river mile 24) which determined the viable fish sample size. Of the 56 viable double tagged fish, 35 or 63%, were detected as passing the Holyoke Fish Lift (HFL) via PIT reader detection.

  A plot of PIT tag fish detection (N = 38, includes 3 PIT only tagged fish) at Holyoke Fish Lift (HFL) in relation to shad daily passage counts illustrates how well study fish coincided with overall spring run timing - potentially – handling/tagging effects are not well understood. Figure 2 shows spring daily shad counts overlaid with PIT tag study fish detections at the HFL and also in relation to river discharge. It is apparent that netting operations should have been started earlier than the last week of April in 2011. However, due to the nature of 2011's funding challenges and time required for tag/receiver orders to be delivered, this situation could not have been avoided.

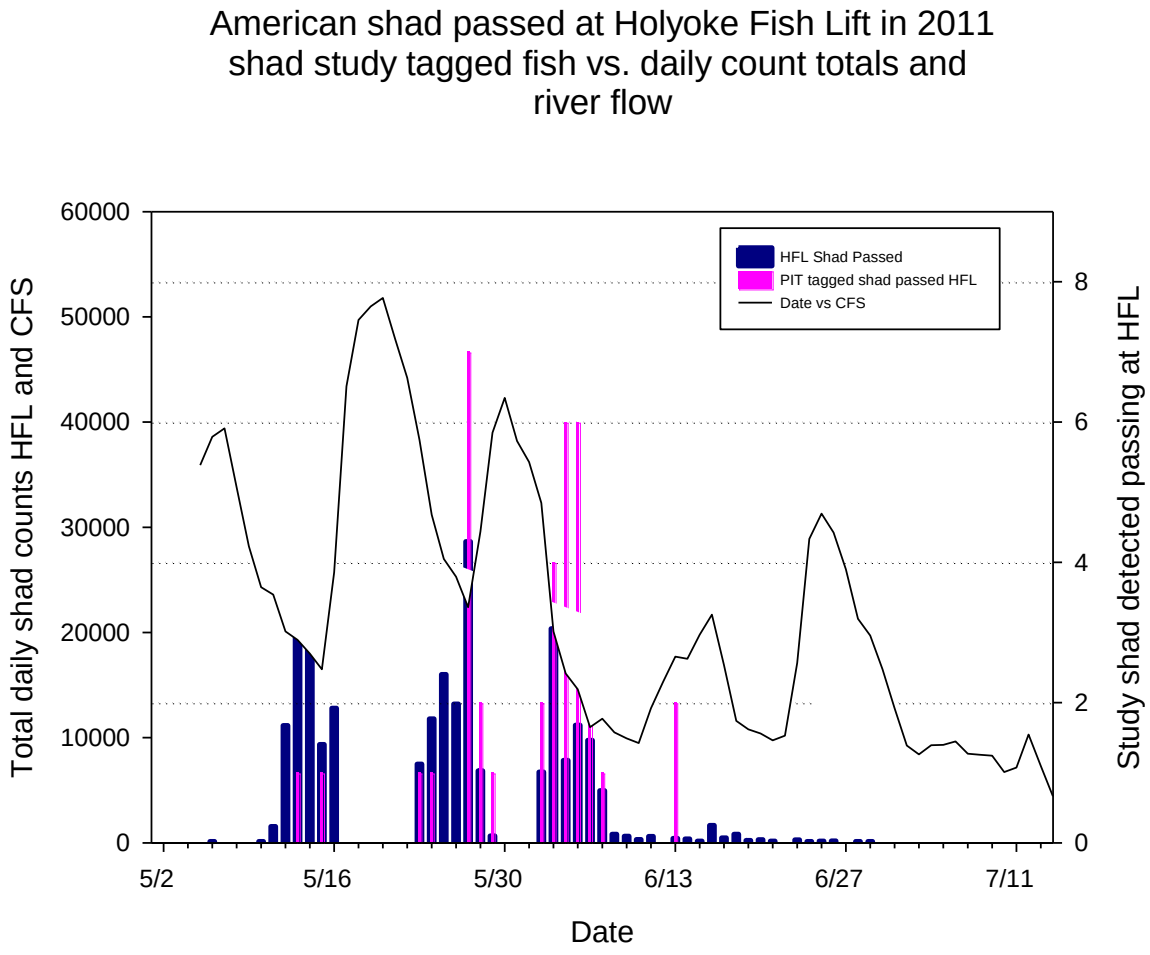

Figure 2. American shad passed at Holyoke Fish Lift in 2011 in relation to PIT tagged detected study shad captured and released at the river mouth. Only 4 tagged shad (11% of total) passed by the date at which 50% of the 2011 run had passed (5/25/11).

PIT tagged shad, detected as passing (date certain) at HFL was related to that individual's release date. These data, when plotted in relation to each other, show a statistically significant negative trend (Figure 3). The arithmetic mean for PIT tagged shad to pass is 17.3 days, (S.D. 6.9 d) with a range of 6 to 35 days.

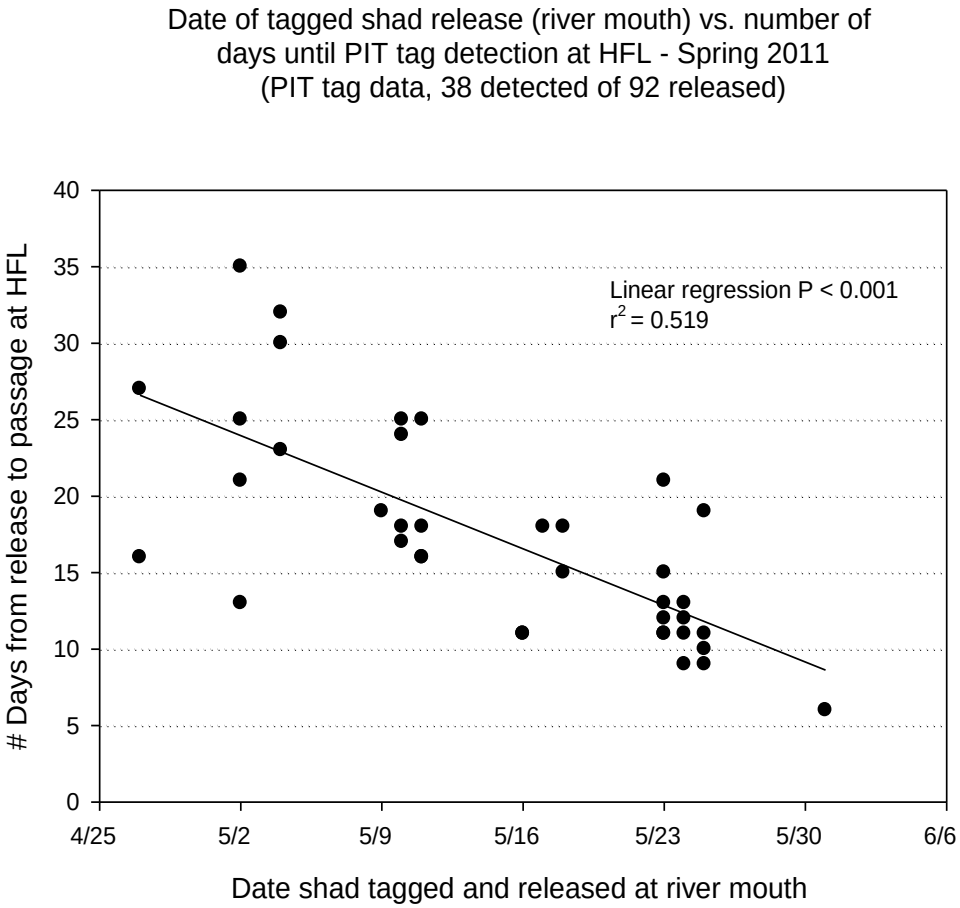

Figure 3. Data for the 38 PIT tagged shad released at the river mouth and subsequently detected as passing at the Holyoke Fish Lift. Plot shows date of capture and release (x axis) vs. the number of days until detection at Holyoke Fish Lift. Mean days to passage 17.3 days (SD +/- 6.9), minimum 6 days, maximum 35 days. A significant negative correlation was detected by linear regression analysis.

- Dr. Castro-Santos produced a Draft Report on the uppermost river segment of this shad study in December 2011, which examined movement and passage of shad from the Turners Falls Gatehouse Fishway to the Vernon Dam Fishway. His analyses revealed that of the 40 double tagged shad that passed out of the Gatehouse Fishway, 36 (90%) reached the Vernon Dam tailrace. Once passing upstream of Turners Falls Dam, tagged shad moved quickly upriver, with most arriving at Vernon in less than 2 days (median transit time 1.6 days). None of these fish passed Vernon Dam and it was noted that most fish spent more than a week in the vicinity of the dam (median 9.9 days). It was noted that not all the fish sustained a presence in this area as some individuals moved among several locations down river. With these data, made possible in part with TransCanada's financial support, it was clear a fish passage barrier existed.

- The CRASC Fish Passage subcommittee, due in part to the data obtained in the telemetry study and ongoing concerns at all fishways for ensuring operations are occurring as designed, developed a new annual fishway inspection program. USFWS, Engineer Brett Towler and other state and federal staff were instrumental in developing a standardized protocol and then implementing an inspection schedule that was designed to focus primarily on main stem fishways. Inspections conducted by Dr. Towler and Dr. Alex Haro resulted in the identification of issues within the Vernon Fishway (March-April). Working in cooperation with TransCanada, several repairs and adjustments throughout the fishway were successfully completed. American shad passage was observed at a rate not seen in over seven years and by the end of the spring passage season approached close to the lower management passage target of 40% shad passage from the preceding dam (Figure 4).

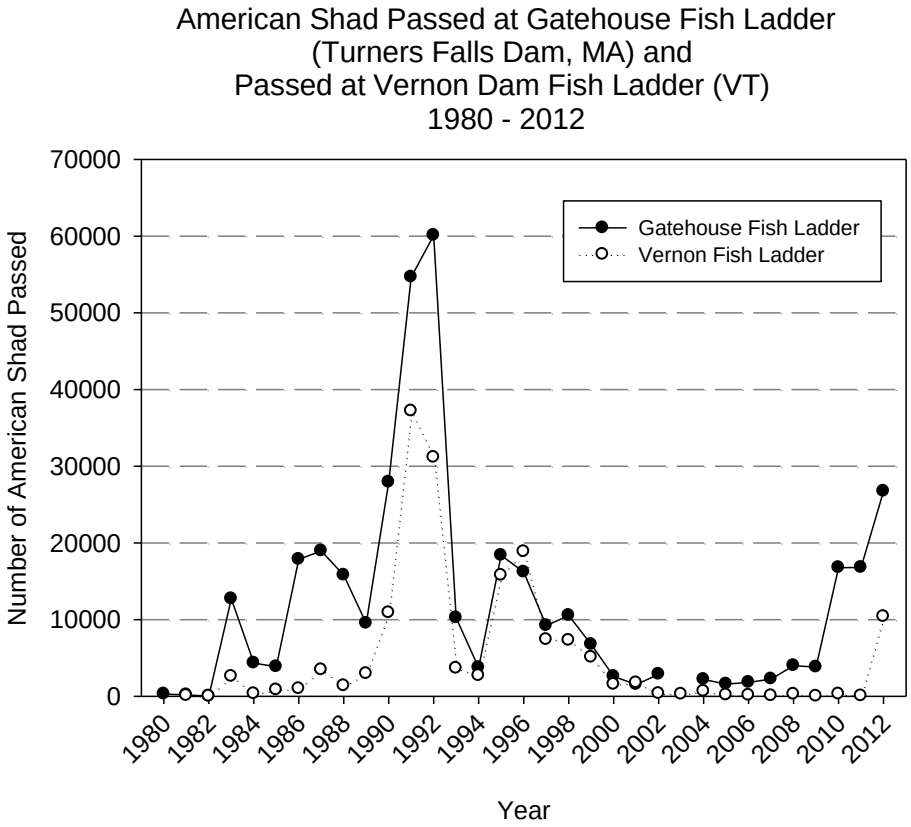

Figure 4. American shad counted as passing the Gatehouse Fish Ladder at Turners Falls Dam 1980-2012 and the number counted as passing Vernon Dam Fish Ladder 1981-2012. Dam and fishway operational, structural, and environmental parameters have varied and been modified over this time period. Identification of passage issue via Shad Movement/Migration Study results, CRASC involvement, USFWS Engineering and Conte Lab, and TransCanada support/responsiveness, led to "fixes" at ladder effective in 2012.

- In 2012, the number of stationary radio receiver locations was expanded, including improved geographic coverage in the Holyoke to Turners Falls Dam reach and the Turners Falls Dam to Vernon Dam reach. A total of 6 receiver stations were set up and maintained from Middletown, CT, to S. Hadley MA. At the Holyoke Dam there were four receivers sited as in 2011. Between Holyoke Dam and the confluence of the Deerfield River, four new receiver sites were established. Cabot Power Station tailrace and the spillway ladder at the Turners Falls Dam had receivers as in 2011. A new site on Rawson Island, in the bypass reach at Turners Falls, was established and set up to scan both channels around that island. Another new site was on the Turners Falls Dam, directed upstream. The traditional extensive telemetry array at the upper Turners Falls Canal was in place again in 2012, as part of the ongoing USGS Conte study with the power company. A new site was located downstream and opposite bank from the Northfield Mountain Pump Storage (NMPS) intake and upstream of the intake on same shore. The site at the NMPS intake (defined as the tailrace) was again installed. Other sites moving upstream include the Northfield Mount Hermon School dock and the old USGS Vernon Station, which were both also used in 2011. The Vernon Dam tailrace/fishway also had a near field and far field receiver set up as in 2011. Both USFWS and USGS shared in setting up, tending, and maintaining these sites over a 5 month period, with TransCanada also utilizing their consultant firm to assist at Vernon Dam.

- American shad were gill netted (tended drift, <15 min soak) by the USFWS in the vicinity of Old Lyme, CT from the first week in April through the last week of May. One hundred yard nets of varying monofilament mesh size (4.5 – 5.75 in stretch) and depths (10 – 14 ft), were fished during the day at varying tides/flows. Healthy fish were removed from the net and placed in a floating live car. Radio tags (Lotek MST-930, 4g air weight) were inserted into the stomach through the esophagus and a PIT tag was inserted into the abdomen, fork length, sex, and observations (rating for scale loss) were noted on field sheets. All radio tagged fish were double tagged in generally 5 - 10 second and quickly released directly back to the river. Based upon catch rates, and once a target of 15-20 shad had been double tagged (target for a week), additional captured shad were single tagged with PIT tags only. A total of 89 American shad were double tagged (radio and PIT) and additional 56 were single PIT tagged in the lower river from gill net sampling. A total of 76 American shad were double tagged (radio and PIT) and an additional 53 single PIT tagged at the Holyoke Fish Lift. These fish were dip netted directly from the trapping facility. A total of 20 of the shad tagged at the Holyoke Fish Lift were sampled for blood to examine stress levels (USGS, Conte Lab, Physiology Section). All USFWS tagging utilized the 164 MHz coded tags. The USGS, Conte Lab tagging efforts at Turners Falls Cabot Station, utilized the 151 MHz coded tags.

- Co-Principal Investigator on the Shad Study, Dr. Castro-Santos double tagged (radio and PIT) 117 American shad and 123 were single PIT tagged at Turners Falls. As in 2011, these fish were done in paired released that included fish trucked from Holyoke Fish Lift

and also trapped at the exit of the Cabot Fish Ladder. These tagged shad were all released into the Turners Falls Canal. In total, 282 shad were double tagged (radio and PIT) in 2012, compared to 270 in 2011.

- Stationary radio receivers were maintained and downloaded weekly or more frequently from time of set up March (varied on river mile – lower basin set up first) through the end of August. Issues with receiver equipment (e.g., signal noise, power, and hardware) varied from site to site and was documented. In addition mobile tracking occurred on a limited basis around Holyoke and Turners Falls dams, with two complete study area survey conducted at the end of June and July (Vernon, VT to Essex, CT).

- At of the time of this report, shad study data have been entered into an Access Database and is being reviewed for quality control, organization, and structured for analyses.

- A National Fish and Wildlife Foundation, Bring Back the Natives Program grant proposal to fund the shad study for a second year in 2012 was awarded in November 2011, and provided $60,000 in funds to purchase tags and other equipment in 2012. A USFWS, Quick Response Grant proposal was developed by the USFWS and USGS to fund a second intern for the study in 2012, which was awarded and used to hire a part-time technician for Dr. Castro-Santos.

- The Coordinator's Office continued shad restoration programs in cooperation with the NHFG, CTDEEP, RIDFW and the USGS-Conte. A summary of American shad transfers from Holyoke Fish Lift and stocking locations are provided in Table 4.

Table 4. Summary of American shad transfers from Holyoke Fish Lift spring of 2012 with stocking locations.

Agency	Stocking location	Number Released
NHFG	Ashuelot River, NH	421
RIDFW and CTDEEP	Upstream of Vernon Dam, NH	1,064
CTDEEP	Farmington River, CT	80
CTDEEP	Oxbow, Easthampton, MA*	80
USGS - Conte	Turners Falls Canal, MA	566
RIDFW	Pawcatuck River, RI	702
CTDEEP	Naugatuck River, CT	150
USFWS	North Attleboro NFH, MA^	295
	Total	**3,358**

*stock truck breakdown – emergency release; ^ tank spawned with cultured larvae stocked into RI rivers

- The USFWS sampled 60 shad from the Holyoke Dam for a wild fish health assessment, in cooperation with the USFWS, Northeast Fishery Center (NEFC), Lamar Fish Health Center. All shad tested negative for pathogens of concern.

- Staff from the Coordinator's Office completed sea lamprey nest surveys (MA) in selected lower Massachusetts and Connecticut River tributaries, generally from the first upstream barrier (dams) to the end (downstream) of suitable nest habitat (Table 5).

Table 5. Sea lamprey nest counts for 2010-2012.

Tributary	2012	2011	2010
Green River	108	84	184
Fall River	66*	133	27
Sawmill River	84	142	65
Manhan River	NA	35	20

* partial count – construction on RT 2 bridge overpass did not permit complete survey

- Coordinator assisted RCNSS with fall 2011 and fall 2012 spawning activities during the report period and also at WRNFH for its last Atlantic salmon broodstock spawning in November 2011. Returning adult salmon from 2012 trap/hatchery sheets were entered into a Program database. All basin salmon stocking records were entered into the Program database.

- The Coordinator supervised one 9 month Student Conservation Association (SCA) intern and utilized dozens of students and volunteers. A total of approximately 300 volunteer hours, along with USFWS personnel from other offices/programs (~200 hours) were essential to achieving project/program objectives primarily in field activities.

- The Coordinator's Office completed one new grant agreement to assist with the removal of a small dam (Stroud Dam) and culverts (Skunk Brook and Kinne Brook) on a tributary to the Westfield River in Chester, MA working with Trout Unlimited. Five grant agreements concluded during this report period including: Nash Stream (NH) Fish Movement and Genetics Study, USGS Conte Laboratory; Nash Stream Fish Population Study, NHFG; Warren Brook Habitat Restoration, Town of Alstead, NH; Indian Stream (NH) Brook Trout Project, Trout Unlimited; and Deep Brook (CT) Water Quality Study, Trout Unlimited. Five previous grant agreements remain open and are administered by the Coordinator's Office that include: Ed Bills Pond Dam Removal, American Rivers; Hallville Pond Dam Fishway, Eastern CT Conservation District; Manahan River Fish Ladder, Town of Easthampton, MA; Alewife Brook/Scoy

Figure 5. Ed Bills Pond Dam, Eightmile River (CT)

Pond Habitat Enhancement, Town of East Hampton, NY; and Thousand Acre Pond Dam removal project, Town of Athol, MA.

- The Coordinator's staff cleaned and slide mounted adult sea-run Atlantic salmon scale samples. The Coordinator worked with Mr. Steve Gephard (CTDEEP) in the aging of salmon scales and developing the 2012 run summary data (2011 run summary finalized during this report period as well).

- The Coordinator maintained long-term temperature loggers (n=20) from Old Lyme, CT upriver to Wilder Dam, (VT/NH) in the fall of 2012 (Figure 6), first deployed in the fall of 2009. Loggers record year-round at 20 minute intervals. Loggers were also placed in lower portions of selected tributaries, Salmon River, Farmington River, and Westfield River. Data have been downloaded and units were re-deployed.

- In March 2012, the Coordinator sent a letter to the Secretary of the Vermont Agency of Natural Resources (dated March 16, 2012), which detailed concerns with the existing VY thermal discharge permit relative to diadromous fish species (and their various lifestages) that are under restoration. A number of published studies have both shown and reported the negative impacts of such exposures, which suggest the potential to negatively impact population restoration goals and objectives as stated in approved management plans (references provided in 16 March letter). Key points include the fact that studies to determine the effects of the discharge plume (e.g., zone of passage) on outmigrating Atlantic salmon smolts, adult up-stream migrating American shad, down-migrating spent adult shad, and outmigrating juvenile American shad have never been conducted, despite agency requests, as permitted discharge temperatures have increased over time.

  Fish passage (up and down) operations at Vernon Dam, required under federal law, do not match "winter" (October 16 – May 14) and "summer" (May 15 – Oct 15) periods of thermal limits for VY discharge. Discharge has been reported to reach temperatures as high as 100°F at a flow rate of 800 cubic feet a second (Vermont Yankee reports), although no monitoring of actual instantaneous discharge temperature is reported to occur. As examples of this disconnect, the Atlantic salmon smolt passage window begins April 1 and juvenile shad passage end on November 15. In 2012, adult shad upstream passage at Vernon Dam was required to start on April 15. The discharge point of VY is 0.45 miles upstream of the Vernon Dam fishways, on the same side of the river. Thermal compliance for VY is determined 0.5 miles downstream of Vernon Dam (13.4°F whole river increase allowed at this downstream point – "winter period"; 2-5°F increase – "summer period"). Thermal impact concerns are related to biologically important thresholds, just one of which is illustrated in Figure 6 (e.g., trigger to spawn). Thorough mixing of the heated discharge is not considered complete until 0.5 miles downstream of Vernon Dam, with values in the intervening area of the dams' fishways, forebay and tailrace expected to fluctuate more widely. Additionally, compliance is based on a VY thermal model, which was developed prior to significant changes that were made at Vernon Dam and power station back in 2008. Changes to Vernon Station increased

turbine discharge capacity 54%, significantly effecting spill and operations. These hydraulic and hydrological alterations may have effects on the input parameters to the VY thermal compliance model completed using field data from 2002.

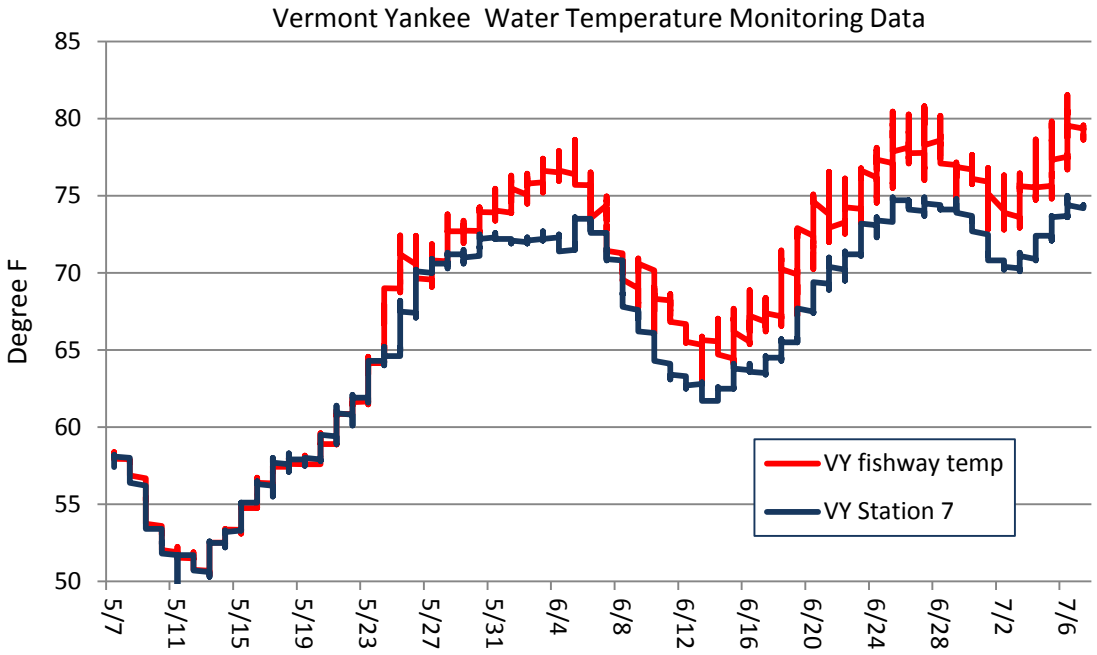

Figure 6. Vermont Yankee data for their Vernon Dam fishway water temperature logger compared with their Station 7 logger water temperature data (upstream of their discharge) in 2010. Note that Vermont Yankee was offline from April 27 through May 21-22, 2010. Adult shad optimal spawning temperatures have been defined as 57.2°F to 68°F by the U.S. Fish and Wildlife Service's Habitat Suitability Index Models and Instream Flow Suitability Curves for American Shad ([A]Stier and Crance, 1985).

- The Federal Energy Regulatory Commission's license to operate the Wilder, Bellows Falls, Vernon, and Turners Falls dams/power stations, as well as the Northfield Mountain Pump Storage reservoir and power station expire in April 2018. The process to relicense will officially begin in October 2012 with the owner's submission of a Preliminary Application Document. Meetings of agency staffs during this report period have identified three main areas of concern; 1) habitat (e.g., instream flow, flow fluctuations), 2) fish passage (e.g., up and downstream fish passage effectiveness, delays) and 3) population (e.g., entrainment, delays, survival rates, spawning success). The regulatory process will be used to identify and more clearly examine areas of concern through studies in the first years.

[A] Stier, D. J. and J. H. Crance. 1985. Habitat suitability index models and instream flow suitabilitycurves: American shad. U. S. Fish and Wildlife Service Biological Report No. 82. (10.88), Washington, D. C.

Outreach

- The Coordinator's Office developed a one day teacher orientation for the Atlantic Salmon Egg Rearing Program (ASERP) in cooperation with Trout Unlimited and the Massachusetts Division of Fish and Wildlife (MADFW) – January 2012. The ASERP was conducted in 43 elementary schools in western Massachusetts in 2012.

- The Coordinator's Office updated the station website on the Internet (http://www.fws.gov/r5crc) with current information and activities on going.

- The Coordinator's Office continues to maintain databases on migratory fish restoration activities. Daily fish counts at eight different dams were entered into a database by Office staff. These fish counts were updated daily (M-F during the spring run) on a telephone hotline (413/548-9628) and on the Internet (www.fws.gov/r5crc);

- Coordinator was interviewed for the Shad Movement Study in the field, by the Hampshire Daily Gazette and the Greenfield Recorder as well as Channel 40 News.

- Coordinator was interviewed by local papers and radio media regarding the USFWS decision to no longer culture Atlantic salmon for the Program.

Program Results

The Connecticut River Coordinator's Office collected and reported information relating to the activities and accomplishments occurring in the Connecticut River basin anadromous fisheries restoration program. The Coordinator's Office compiled and maintained the following program data/information for 2011. [Some of the data presented here is preliminary. For final, accurate, peer reviewed program data/information, refer to the annual U.S. Atlantic Salmon Assessment Committee Report.]

Adult Atlantic Salmon Returns

A total of 54 sea-run Atlantic salmon adults were documented as returned to the Connecticut River watershed during 2012. This is a decrease from the 111 known returning adults in 2011. Twenty nine adult salmon were captured at the Holyoke Fish Lift (MA) on the Connecticut River; five salmon were captured at the Rainbow Dam fishway on the Farmington River, CT; six salmon were captured at the West Springfield Project, MA on the Westfield River; ten salmon were captured at the Leesville Dam, CT on the Salmon River and 4 salmon was captured by CTDEEP downstream of Leesville Dam. Thus, total salmon for Salmon River was 14 fish.

From the 29 sea run adults trapped at Holyoke Fish Lift, ten adults were tagged (radio and PIT)

and released (river km 138) to continue their migrations. One of these radio tagged released fish was subsequently trapped at the HFL later and brought RCNSS were it was held through spawning, leaving nine tagged fish at large. Salmon released above the Holyoke Dam were surgically fitted with radio tags as part of a TransCanada agreement with the agencies. Monitoring of radio tagged adults was substantially reduced this year by the State of Vermont, but receivers at fish lifts provided data on movements upstream at main stem dams. Only two tagged salmon were noted as passing Turners Falls Dam by fish counting software (five noted as passing by radio tracking), four tagged salmon were determined as passing Vernon Dam. Two salmon were determined as passing Bellows Falls Dam and continued upstream to also pass at Wilder Dam. TransCanada was preparing a report on the tracking of these fish expected in January 2013.

A total of 45 sea runs were retained for broodstock in 2012, some mortalities occurred prior to spawning, primarily fish with visible injuries at time of delivery; all of the sea runs were transported to the Richard Cronin National Salmon Station (RCNSS), Sunderland, MA and held for spawning in the fall. Mature parr were collected to ensure desired level of crossing in the fall of 2012.

Age and origin information was derived from scales and physical examination such as an adipose fin clip (all stocked smolts clipped) of each salmon when available (e.g., some scales not possible to accurately age, thus numbers may not directly relate for cross references). Of the 54 salmon documented as returned in 2012, 53 fish were determined/observed to be of wild (fry stocked) origin, and one was of hatchery origin (smolt stocked). Known sea-age (sea winter = SW) of wild salmon was comprised of 54 (2SW) salmon, no grilse (or 1SW) observed. Freshwater age (at smolt emigration on readable scales) of wild salmon was comprised of 3 age-1, 50 age-2, and one age-3 fish.

Atlantic Salmon Egg Collection (Fall 2011)

State and Federal fish culture facilities, located within four basin states of Connecticut, New Hampshire, Vermont, and Massachusetts, spawned sea-run, kelt and domestic brood stock and incubated a total of 4.940 million eggs in fall of 2011 and into winter/spring of 2012.

Sea-Run Brood Stock: A total of 376,000 sea-run salmon eggs taken at the RCNSS in fall of 2011. All fish and eggs tested negative for IPN and other pathogens of concern.

Captive/Domestic Brood Stock: A total of 4.389 million eggs were taken from domestic females held at the Roger Reed State Fish Hatchery (1.399M), Kensington State Fish Hatchery (1.809M), and White River National Fish Hatchery (1.180M). This is a dramatic reduction in production from 10.0M eggs produced by these facilities in 2010, attributable to the loss of most of the broodstock at WRNFH due to the Irene Storm flood in late August 2011.

Kelts: A total of 176,000 eggs were taken from kelts held at the North Attleboro National Fish Hatchery (NANFH). This was the final year kelts were to be maintained

for the Connecticut Program.

Juvenile Atlantic Salmon Releases

A total of 1.819 million Atlantic salmon were stocked into the Connecticut River watershed in 2012. This compares with 6.105 million salmon stocked in 2011. The 2012 total includes: 1.224 million unfed fry; 509,107 fed fry; 3,105 age-0 parr; 7,499 age-1 fall parr; 3,963 age-2 parr; and 71,018 age-2 smolts (viable) stocked into tributary systems. Smolts were stocked in the Farmington River (28,980), Deerfield River (32,855) and Westfield River (3,444).

Two year old smolts were assessed to determine the proportion of parr vs. smolt (length threshold), fatal fin condition, and viable smolt beginning in 2006, by CTDEEP staff working with federal hatchery managers and agency partners. Data from assessments at Dwight D. Eisenhower NFH (formerly Pittsford Hatchery) and Berkshire NFH in February 2012 was used to provide finer scale data on stocked viable smolts, reported here (minus proportion with fatal fin condition) and parr (fish <150mm).

Juvenile Atlantic Salmon Population Status

The relatively long-term smolt, mark and recapture population estimate, conducted by FirstLight Power Resources, Holyoke Gas and Electric Company, and the Connecticut River Coordinator's Office was not conducted in the spring of 2012. Issues regarding access by a subcontractor at Holyoke Dam could not be resolved in time. This project will not be occurring in 2013.

Juvenile salmon populations were assessed by electrofishing in late summer and fall of 2012 at index stations throughout the watershed. Sampling was conducted by CTDEEP, MADFW, NHFG, VTFW, and USFS. Data are used to evaluate fry stocking, estimate survival rates, and estimate smolt production. Index site assessment data is incomplete at the time of this report.

Genetics

Sea-Run Broodstock Management

The USFWS analyzed genetic diversity of the sea-run Atlantic salmon broodstock using microsatellite analysis as part of an established management protocol. As in the past, all of the sea-runs were PIT-tagged to ensure individual identification at spawning. The spawning of RCNSS sea runs and kelts from NANFH (Nov 2011) followed past protocols to maximize the genetic variation of the sea-run mating pool. Dr. Meredith Bartron (USFWS) developed these mating protocols using tissue analyses from adults and genetic software analyses.

In the fall of 2011 and 2012 at RCNSS, spawning was managed utilizing hormones after the first natural spawning event. It was decided by the Fish Culture Subcommittee to not hormone implant until after the first natural spawning date. As a result, the first egg take was relatively low, after which the remaining fish were hormone implanted. As in past years, mature parr were collected in September and held for spawning with sea-run females to increase genetic diversity. Parr were also implanted with hormones to ensure milt production was synched with females.

There were no future family group jars utilized as at RCNSS 2012, as was the case in 2011. All

fertilized eggs were placed in existing egg stacked incubators with segregation provided by individual stack water source (15 trays per stack ~ 7-10,000 per tray).

Genetic Monitoring

The genetically marked fry study (micro satellite neutral markers – parentage assignments possible) was initiated with the objective of evaluating the relative productivity of habitat throughout the basin based on survival of genotyped salmon smolts stocked as fry in known locations as well as stream origins of returned (marked) adults. The results of this study was intended to help managers make better decisions about stocking strategies, habitat restoration needs, fish passage priorities, and etc. at a landscape level. Marked fry were first stocked in 2002 and the design utilizes a partitioning of the basin into ten zones of management interest, principally from North to South (some are individual larger tributaries or several geographically close smaller tributaries). The number of genetically marked fry stocked in the basin has ranged from 1.4 up to 3.6 million (as a proportion of the total fry stocked annually it varies) annually since the projects implementation, last group of marked fry stocked in the spring of 2011.

Tissue samples of smolt were taken at the Rainbow Dam, and Cabot Station (Turners Falls) in downstream bypass samplers in the spring of 2012. Tissues samples were provide to USFWS NEFC Genetics Unit, and with the use of VTFW State Wildlife Grant (SWG) funds the USFWS Fisheries Program and NOAA Fisheries funding, this program is analyzing current year samples and also addressing archived samples. FirstLight Power, Holyoke Gas and Electric and CTDEEP have agreed to allow use of the costs of their smolt related operations to meet required non-federal "in-kind" match for the VTFW SWG project. The last group of marked smolts (at age-2) are expected to be primarily sampled in 2013 at two bypass samplers (Cabot and Rainbow), with adult returns of these marked fish primarily in 2015 (as two sea-winter returns), which has been determined to be the final year of examining adults for marks.

Fish Passage

The USFWS' Hydropower Coordinator, John Warner, is the lead for most of the activities summarized below and works closely with State Agency representatives. The following is taken from Mr. Warner's report to CRASC Technical Committee, June 26, 2012.

Holyoke – Connecticut River

- Consulting parties (FWS, NOAA, MDFW, TU, CRWC) have agreed on the new design for the downstream passage system at Hadley Falls Station
- HG&E proceeding with construction drawings
- We will need to review construction schedule and implications for operating upstream fish passage facilities during construction

Turners Falls – Connecticut River

- 2012 Gatehouse evaluations by Conte Lab - Haro/Castros-Santos – ongoing

Vernon – Connecticut River

- Ladder problems noted last year were corrected – reports suggest generally good operating conditions
- Ongoing shad migration study could shed light on overall passage success

Connecticut River Relicensings (Turners Falls Northfield Mountain, Vernon, Bellows Falls and Wilder projects – Licenses expire in 2018)

- Preliminary Application Document (PAD) for each project will be prepared and distributed in October 2013.
- Public meetings to follow PAD - opportunity to raise issues/ identify study needs.
- Potential for meetings with owners prior to PAD but not required.
- Preliminary data collection on mussels, flows, river temperatures etc ongoing.

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Fifteen Mile Falls – Connecticut River

- Moore dam sampler operated without flow inducers in 2012.
- Captured smolts were transported below Vernon Dam rather than below McIndoes. As of June 18, 1,375 were captured (approx. same as 2011)

Gilman Dam – Connecticut River

- Guidance screen and new bypass completed and operated

Fiske Mill - Ashuelot R.

- Fish lift operational in mid-May after glitches worked out but high river flows and no tailrace barrier may have affected passage numbers
- 2 sea lampreys, and a number of trout, suckers and smallmouth bass lifted. One large salmonid lifted
- Tailrace barrier to be installed for 2013

New Hydro Proposals at Corps Dams – West, Black and Westfield Rivers

- Licenses issued for Ball Mtn and Townshend dams
- FERC will not require specific downstream passage and entrainment measures since Corps has final say on anything built at their dams.
- Start of construction uncertain

Migratory Fish Returns

American Shad - A total of 500,905 adult American shad were counted in 2011 at all passage facilities in the basin. This compares with 249,480 shad in 2011. A total of 490,431 shad were passed upstream of the fish lift in Holyoke, Massachusetts in 2012 (Figure 7). A total of 10,300 shad were passed upstream of the West Springfield Project in 2011, which was an all-time high passage record (5,029 passed in 2011, also a record). A total of 174 shad were passed upstream of the Rainbow Dam Fishway on the Farmington River in Connecticut, down from the 274 fish passed in 2011. Of the shad passed above the Holyoke Dam, 26,727 shad were counted and passed at the Gatehouse fishway at Turners Falls Dam in 2012 compared to the 16,798 passed in 2011. Overall, the 2012 passage number as a percentage of shad passed at Holyoke is

approximately 5.5%. The CRASC, Shad Management Plan has a target of 40-60% shad passage at each successive barrier on the main stem. Continued operational and structural changes at the (Turners Falls) Gatehouse fishway entrances, have been experimentally shown (USGS study) to explain the increases in passage observed since 2010 of shad out of the canal. As discussed earlier, repairs to the Vernon Dam fishway resulted in 10,386 shad counted as passing, up from 46 shad in 2011. This translates to 39% passage (at Vernon) of the shad passed upstream of Turners Falls Dam (Figure 4).

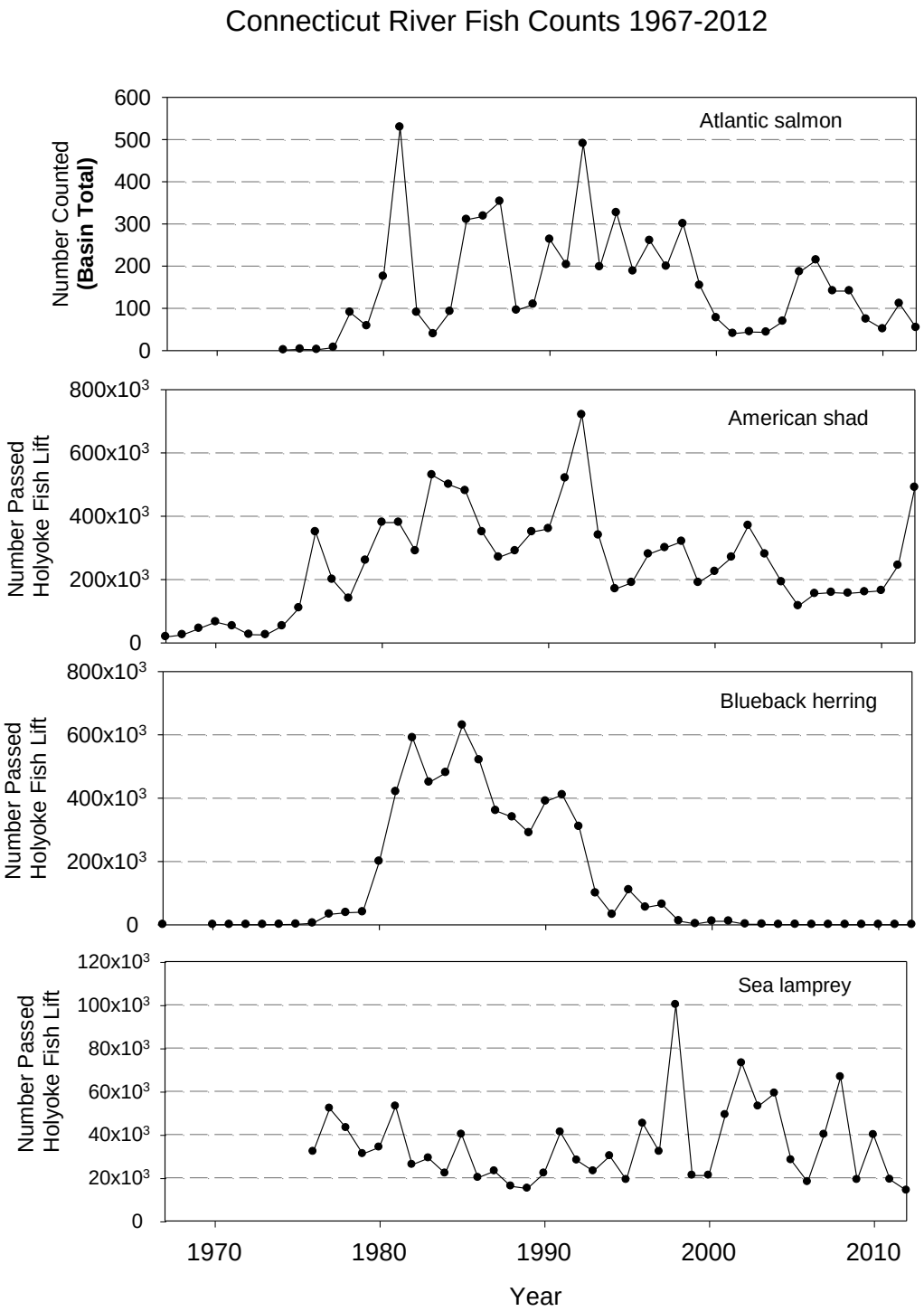

Figure 7. Summary of Atlantic salmon returns to Connecticut River basin (all facilities), and Holyoke Fish Lift passage counts for American shad, blueback herring and sea lamprey (1967-2012). Fish counts are affected by structural and operational changes (dams and fishways), and environmental conditions (temperature and flow).

Spring 2012 river flows influenced shad passage rates at Holyoke Dam with three clear pulses of shad passing around high flow events (Figure 8). River discharge was well below average spring values from the end of March through third week of April with variable but more typical values for much of the mid to late spring, more detail to follow.

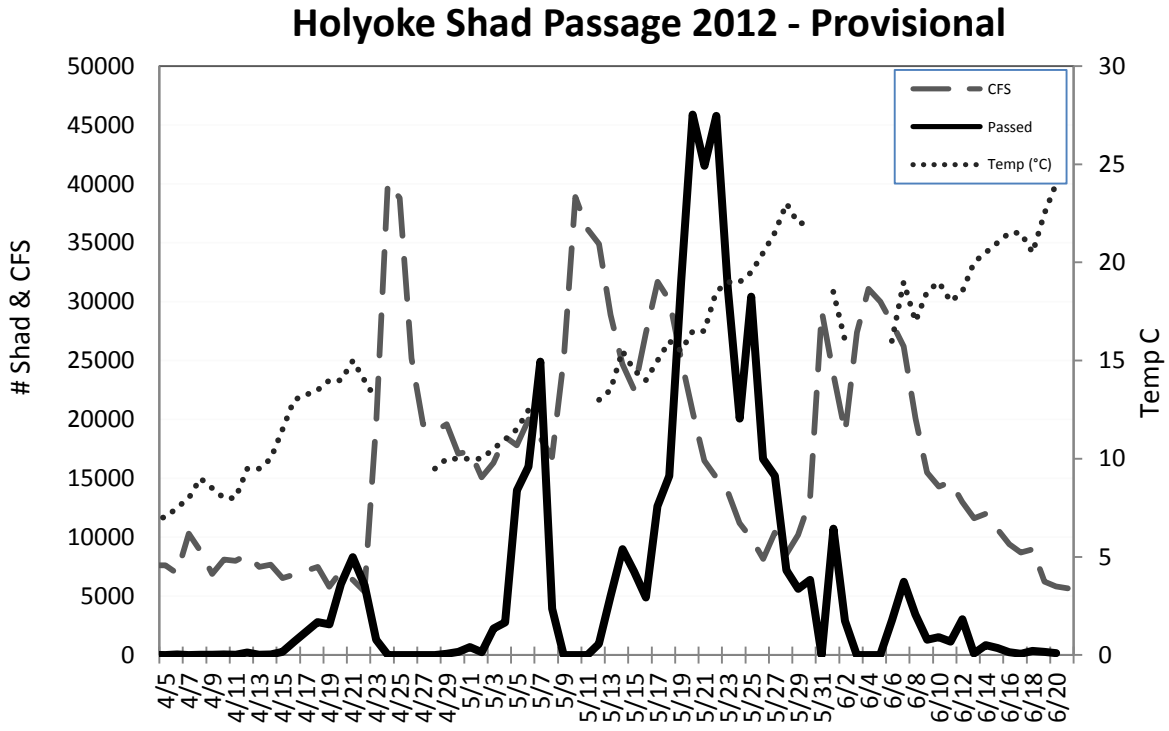

Figure 8. Holyoke Fish Lift American shad passage counts for the spring of 2012, with "daily" CFS value from USGS web site and the reported "daily" water temperature by HFL staff also shown.

Blueback Herring - A total of 39 blueback herring were counted at the Holyoke Dam Fish Lift in 2012 with two herring reported passing on the Westfield River at the West Springfield fish ladder. River herring counts are not believed to reliably serve as a population metric for the lower river, and larger lower tributaries (downstream of fishways), in suitable habitat. This situation is a critical assessment need which was addressed by the Coordinator's Office in 2010 by population assessment work as well as a new restoration strategy implemented in 2010. Due to the Shad Movement Study time requirements and resource limitations, in 2011 and 2012 these programs were drastically scaled back (spring assessment surveys) or not conducted (herring netting/transfers). NOAA Fisheries continues its review of river herring (blueback herring and alewife) for listing under the Endangered Species Act at the time of this report.

Sea Lamprey - A total of 15,361 sea lamprey were observed returning to the Connecticut River

basin in 2012 based on fishway observations. This compares with 27,233 lampreys in 2011, which is low but within the range of expected variability. A total of 712 sea lamprey were passed upstream of Rainbow Dam (6,507 in 2011), 1,589 lampreys were passed upstream of the West Springfield Project, and 14,089 lampreys were passed upstream of the Holyoke Dam (Figure 7). A total 4,503 sea lamprey passed upstream of Turners Falls Dam (Gatehouse fishway count), 748 passed upstream of Vernon Dam, and 99 passed upstream of Bellows Falls Dam.

Striped Bass - A total of 334 striped bass were counted at the Holyoke Dam Fish Lift in 2012 consistent with recent years' observations. Several requests for striped bass count data have come from biologists outside the basin. As these data were provided, a quick plot of counts over time at HFL suggests increases in migratory stock abundance indices in the mid 1980s through the declared "recovery" of that stock in 1994 by the Atlantic States Marine Fisheries Commission (Figure 9). Striped bass passed at HFL are limited to fish generally less than approximately 20 inches, so only relatively younger age-classes (likely < age-4) are represented. Blueback herring counts also have been inversely correlated to the 1980-1998 period and striped bass increases by CTDEEP.

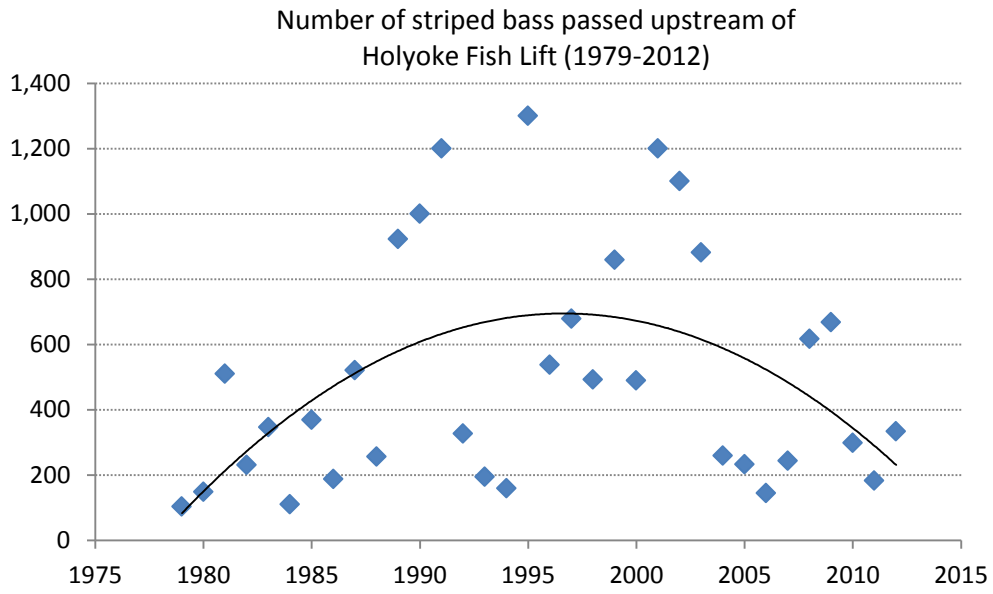

Figure 9. Striped bass counted as passing the Holyoke Fish Lift 1979 – 2012.

Gizzard Shad - A total of 341 gizzard shad were counted at the Holyoke Dam Fish Lift in 2012.

American eel – The American eel passage count from eel specific passes operated at Holyoke Dam, 39,423 in 2012 compared to 8,755 (2011) and 4,138 (2010) and 5,639 (2009). The Rainbow Dam eel pass (Farmington River) passed 197 eels in 2012, compared with 5,512 in

2011 and 889 in 2010 (CTDEEP had no explanation for the low 2012 count). The USFWS was petitioned to consider listing American eel under the Endangered Species Act in 2011. The review process continues at the time of this report.

Additional data to describe the two key environmental conditions (water temperature and river discharge) during the spring fish passage season are illustrated by the water temperature profile of the Rocky Hill (CT) Ferry, USFWS temp logger, located off the third pier pilings (Figure 10). As discussed earlier, very low spring flows in 2012, coupled with well above normal air temperatures, resulted in rapid water temperature increases, until a large flow event in the third week of April (Figure 11). The temperature profile time series for the Rocky Hill temperature site, fall 2009 through fall 2012, illustrates the degree of variability among the values observed in the three different spring periods (Figure 12).

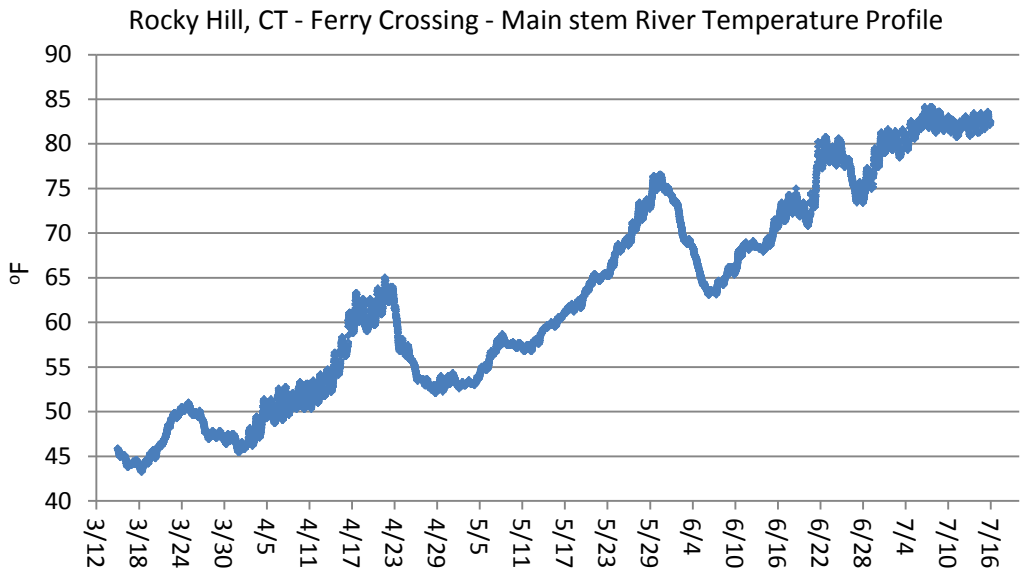

Figure 10. Water temperature (°F) profile from temperature logger deployed in Rocky Hill, CT main stem river (3/15/12 through 7/15/12) – USFWS CRC study.

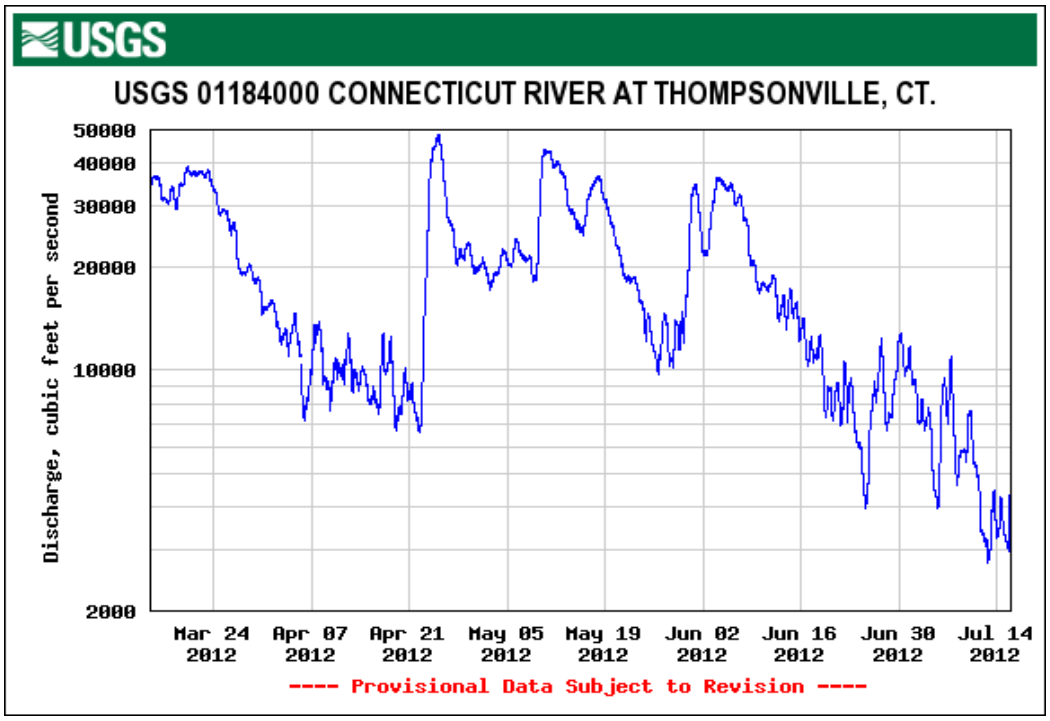

Figure 11. River discharge history for 2012 fish passage season (3/15/12 – 7/15/12), Thompsonville, CT, USGS Gauge Station.

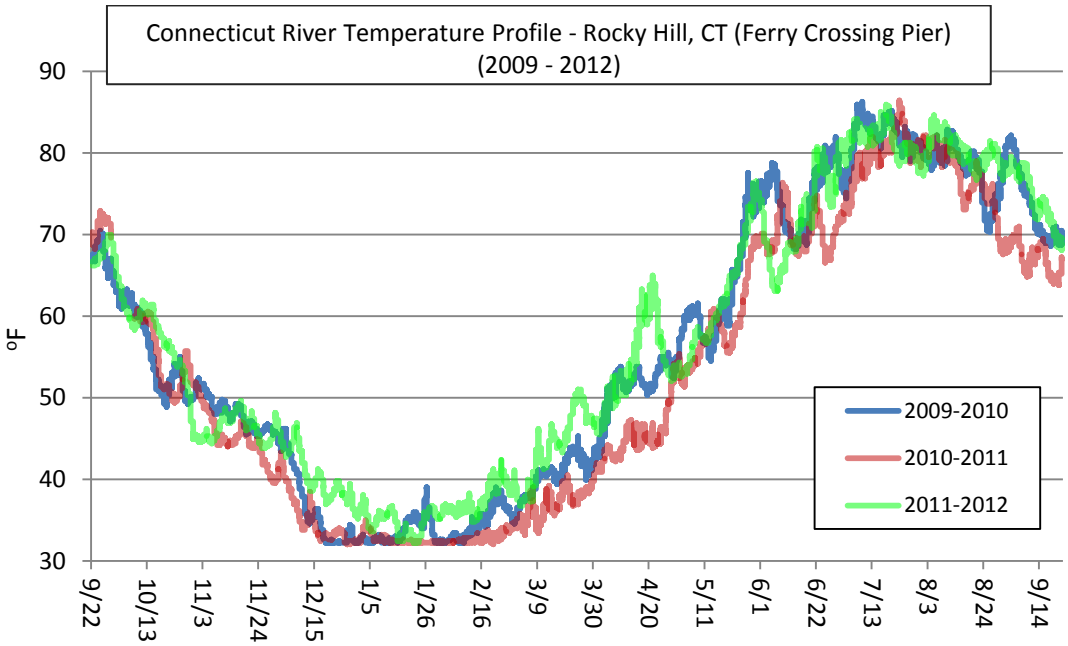

Figure 12. Water temperature profiles for the period fall 2009 through fall of 2012, at the Rocky Hill, CT Ferry Crossing. In the fall of 2010 (October) there was a 9d down-time period for the logger due to delays in battery replacement (shown as break in red line).

Appendix A. Description of the Connecticut River Basin

The Connecticut River is the longest river in New England. It begins in the Fourth Connecticut Lake (2,625 feet above sea level), and collects water from several major tributaries as it flows South between the states of New Hampshire and Vermont, and through Massachusetts and Connecticut. After collecting water from the 11,250 square mile drainage basin, the river flows into Long Island Sound at Old Saybrook, Connecticut, over 400 miles from its origin.

The river basin environment varies from highly developed and urbanized stretches in the lower river valley to more rural and forested reaches in the tributary and headwater areas. Atlantic salmon habitat exists throughout the basin. There are 38 major tributaries of significance to the Connecticut River Atlantic Salmon Restoration Program.

The natural streambed gradient profiles are interrupted by artificially ponded stretches created by the numerous dams located on the river and its tributaries. Over 2,500 dams in the basin impact and fragment habitat and natural steam processes, according to the most recent assessment of barriers in the basin (The Nature Conservancy). Hydropower dams and a main stem pump storage hydropower facility can regulate/alter flows, particularly in the main stem and lower reaches of larger tributaries. Aquatic organism entrainment and or impingement through turbines and for power station cooling systems are also a serious concern. In addition, discharge of heated effluent from power stations, are also cause for concern for organisms. Summer water temperatures average between 70^{o} and 80^{o}F with temperature peaks sometimes reaching 90^{o}F in July and August.

The Connecticut River and its tributaries support a diverse group of fishes and invertebrates. Both intentional and accidental introductions have altered native fish communities within the basin. Currently, at least 11 diadromous fishes utilize (e.g., spawning or feeding forays) or visit the Connecticut River, including American shad, Atlantic salmon, blueback herring, alewife, shortnose sturgeon, Atlantic sturgeon, sea lamprey, American eel, hickory shad, gizzard shad, and striped bass. Surveys in the early 2000s were never able to confirm the presence of rainbow smelt which are believed to be extirpated, along with the Atlantic sturgeon, and rainbow smelt. Occurrences of Atlantic sturgeon have been determined to come from other coastal river populations such as the Hudson River. In 2012, the Atlantic sturgeon was listed at a federally Endangered Species by NOAA Fisheries, with the Hudson River population identified as the closest Distinct Population Segment for this species in proximity to the Connecticut River.

Appendix B. Atlantic Salmon Life Cycle

Atlantic salmon spawn in October and November, females construct redds, burying their eggs following fertilization by a male(s). Fertilization may occur by a single or multiple adult sea-run males and/or single or multiple mature male parr. Most females lay a total of 7,000 to 8,000 eggs in two or more redds. A steady supply of clean, well oxygenated water is critical to sustain these eggs. The eggs remain in the gravel throughout the winter before hatching in the spring. Newly hatched salmon, called sac fry, obtain food from their attached yolk sac. The salmon emerge from the redd, primarily from April to June, when the yolk sac has been completely absorbed and begin to disperse into habitat. Feeding activities begin at this time so timing of emergence with food item availability is of importance. Salmon fry, approximately one and one quarter inches long at emergence, quickly set up feeding territories which they defend from other fish.

Fry that have spent their first summer in the stream where they hatched are three to four inches long by fall and are called parr. After one full year in freshwater, the parr will have grown to a length of four to six inches. Parr remain in freshwater for a period of one to three years. The freshwater residence period is largely dependent on growth rate. The fastest growing parr, usually from warmer, more productive tributaries, spend only one year in freshwater. Slower growing parr, often from colder, less fertile tributaries, spend three, or rarely, four years in freshwater. Most parr in the Connecticut River basin spend two years in freshwater. During their first fall, parr may disperse widely from their first summer location to seek new habitat.

Parr destined to leave the freshwater environment the following spring begin a process called smoltification during the preceding winter. Pronounced physical changes occur during the spring after salmon reach a size suitable for migration to the sea, six to eight inches or more. These changes allow juvenile salmon to adapt to life in marine waters. Throughout the smoltification process a series of behavioral, physiological, and morphological changes occur that transform young salmon from territorial, bottom-dwelling, freshwater fish to schooling, saltwater fish. Juvenile salmon leaving for the ocean are called smolts. Smolts lose the dark vertical stripes, parr marks, on their sides and become bright silver in color. Smolts migrate to Long Island Sound from April through June. Some smolts may commence pre-smolt movement in the fall to start their long migration. This is believed to have been an important adaptation of the original upriver stocks of Connecticut River salmon.

Connecticut River smolts move eastward around Cape Cod and begin a long migration northward along the coast after reaching Long Island Sound. The salmon reach waters off of the west coast of Greenland in late summer where they share feeding grounds with other Atlantic salmon from North America and Europe. Most Connecticut River salmon return to spawn after residing in the ocean through two winters (2SW). A few salmon, called grilse, return after spending only one winter at sea (1SW), and others wait until after their third sea winter to return (3SW). The average 2SW salmon grows from six inches long and weighing about two ounces as a smolt entering Long Island Sound to 30 inches and 10 pounds as a returning mature salmon. Grilse (1SW) average about four pounds and 3SW salmon often weigh more than 15 pounds.

Adult salmon return to the Connecticut River primarily in May and June. These salmon attempt to reach the streams where they resided prior to emigrating as smolts. They spend the summer holding in deep pools before spawning in the fall. From the time they enter their natal river until spawning, often six months later, the salmon do not feed; feeding begins after they return to saltwater in the fall or spring. Atlantic salmon, unlike Pacific salmon, do not die after spawning, though many die as a consequence of the rigors of the upriver migration, the spawning effort itself, and not feeding for up to one year while in freshwater. Adults that survive the rigors of migration and spawning change from silver to a very dark color and are called kelts. Kelts return to the ocean in late fall or early spring, at which time they regain their silver color. A small percentage of salmon survive several spawning runs alternating between freshwater and marine environments. Repeat spawners and grilse are valuable to the salmon population for maintaining genetic variability and providing a buffer against poor smolt outmigration years. Additionally, repeat spawners are particularly valuable to anglers because of their large size.

Appendix C. History of the Anadromous Fish Program

Atlantic salmon were once abundant in the Connecticut River and spawned in all major tributaries not blocked by natural barriers. Salmon ascended the main stem Connecticut River to Beechers Falls, VT, nearly 400 miles upriver from its outlet at Long Island Sound. No fishery management or scientific information exists that provides a technical description of the pre-colonial salmon population because extirpation predated the development of fishery science. However, historical accounts of the region are filled with references to large salmon runs and significant use of the species by the native aborigines and early European settlers. As colonization by Europeans and the development of water power sites expanded throughout the basin, the salmon population declined. The major cause of the decline was the construction of dams that block salmon migration to upstream spawning habitat (Figure 1). The first dam across the main stem Connecticut River was constructed in 1798 near the present site of Turners Falls, MA. It blocked the access of salmon to the remaining spawning habitat in the northern portion of the river and the species disappeared from the basin, after years of unregulated harvest in the lower river and the loss of spawning runs in lower basin tributaries.

An interagency state/federal program to restore salmon to the Connecticut River based on the stocking of fry hatched from eggs taken from Penobscot River salmon was initiated in the 1860s. Although the effort resulted in the return of hundreds of adult salmon for several years in the 1870s and 1880s, the program eventually failed due to both uncontrolled harvest of fish in Connecticut waters and the failure to construct effective fish passage at dams in Massachusetts.

Interest continued in restoring salmon in the basin; however, no action was taken for decades due to the lack of funds and effective fish passage technology. The condition of the river environment continued to deteriorate in response to widespread pollution and dam construction. By the late 1960s, many tributary dams were subsequently washed away and never re-built or were removed and pollution abatement programs were initiated. Long term cooperative restoration programs became feasible with the passage of the federal Anadromous Fish Conservation Act of 1965 (P.L. 89-304) which made funds available for interstate fish restoration programs. The combined effects of all these events set the stage for Atlantic salmon restoration.

The current Atlantic salmon restoration program formally commenced in 1967, when the four basin states, USFWS, and NMFS signed a statement of intent to restore anadromous fishes to the Connecticut River. Early stockings were comprised of two-year old smolts of Canadian origin reared in federal trout hatcheries that had recently been converted to salmon production. The first adult salmon return from these smolt releases was documented in 1974.

Between 1974 and 1977, ten more salmon returned from the ocean. Penobscot River salmon eggs became available to the program and were used to stock the river starting in 1976. As a result of this release, 90 adult salmon returned to the river in 1978. Early in the program, the emphasis was placed on stocking smolts. The USFS joined the effort in 1979 because of the impact of the agency's land-based holdings on salmon habitat in the northern watershed. Shortly thereafter, the USFWS built a large, modern salmon hatchery in Bethel, VT, and Connecticut Department of Environmental Protection (CTDEEP) and MAFW converted trout hatcheries for salmon production. In 1983 smolt production shifted from a two-year to a one-year rearing regime in an effort to increase the quantity and quality of smolts. Early experimental stockings

of salmon fry into nursery habitat showed the potential for natural, instream rearing of natural, high-quality smolts (referred to as "stream-reared" smolts) which are comparable to wild smolts. Evidence from the Farmington River indicated that stream-reared smolts produced from fry stocking yielded substantially greater adult return rates than hatchery-reared smolts (10 times greater). Production of stream-reared smolts was combined with smolts produced in hatcheries to increase smolt emigration from the river. A major effort was begun in 1987 to stock as many fry as were available into appropriate habitat in the basin. Adults produced from fry stocking will attempt to return to spawn to the tributary in which they were stocked. Although numbers of fry stocked to date have been inadequate to fully seed the habitat, stream-reared smolts produced from those releases have contributed substantially to adult returns. Use of fry also maximizes the opportunity for natural selection to occur in the juvenile freshwater phase, an important component of the Program's effort to allow development of heritable traits and characteristics.

Since 1994, the Program has not imported any genetic material (gametes or fish) and has been utilizing "Connecticut River" fish only. This important fact needs to be taken in the context that a salmon generation is typically five years. This translates to only three generations occurring from 1994 to 2011. Also importantly, genetic monitoring has demonstrated the development of unique genetic characteristics (alleles) that distinguish the Connecticut River population from other populations at that scale. The use of conservation genetics has enabled the Program to maintain a genetically healthy population to maximize genetic diversity and reduce risks of inbreeding and outbreeding depression.

Unfortunately, adult returns per 10,000 stocked fry has declined dramatically from what had been documented from 1979 through 1994, when this rate averaged 0.71 (high of 1.6). For the period 1995 through 2008, the mean adult/10,000 fry stocked is 0.11 (refer to U.S. Atlantic Salmon Assessment Committee Report 24 – 2011 Activities (http://www.nefsc.noaa.gov/USASAC/Reports/). This latter period is when the program shifted to fry stocking as the primary restoration strategy, directly coinciding with this unexpected dramatic decline in fry return rates. This translates to a sustained reduction on the order of 1/6 of what had been observed for this rate (before 1994) even with no or minimal downstream fish passage measure in place for fry origin smolts, high sea fisheries operating and the restoration broodstock of a mixed genetic origin, all of which had been addressed to the extent possible. What are the mechanisms driving this sustained depression in marine survival attributed to the environment? Will marine conditions improve to those resulting in the fry return rates of the 1970s and 1980s? The questions remain at this time and monitoring a research programs have not identified any clearly notable causal factors.

Action to provide upstream fish passage on the river had begun prior to the salmon project when, in 1955, a fishlift was constructed at Holyoke Dam to pass American shad and river herring. This facility was expanded in 1975 and 1976 when a trap was built for salmon and other modifications occurred, although not studied, upstream passage efficiency appeared to improve greatly. Other fishways built between 1974 and 1987 at major dams on the main stem river and certain tributaries allowed returning salmon access into a large portion of the basin targeted for restoration. Although most salmon are currently retained at the lowermost dams when they reach them, fishways were still constructed at the upstream dams in order to pass American shad and other species. Major issues with several different fishways have been apparent relative to ineffectiveness at passing shad and herring. These issues have been dealt with in a case by case basis, often with limited success, and is an area impacted by legal constraints and funding (e.g. Rainbow Dam fishway is DEEP owned).

Upstream passage at Turners Falls Dam fishways have been studied and modified for decades. Passage issues are best explained by the fact that no ladders of the size required on the main stem had been designed for shad at that time in this Program. USFWS relied on best information (no specific studies available) at the time that suggested West Coast fish ladders on the Columbia were effective at passing American shad. This led to the adoption of these designs, downsized considerably from the Columbia River basin, for use on the main stem dams. The USFWS worked with the power companies in the design and construction, using the best information available to develop operating parameters for flow, velocities, and turbulence measures. Unfortunately, in the case of Turners Falls, modifications at Cabot Station ladder were determined necessary after only two years, and those changes resulted in improved passage, although still well below target rates.

Fish passage at dams above Vernon Dam (Bellows Falls and Wilder dams) have been built specifically for salmon. An agreement with upstream dam owners stipulated that 10% of all salmon trapped at Holyoke will be released to use these upstream fishways. Four fishways (Holyoke, West Springfield, Rainbow, and Leesville) are the primary trapping locations for sea-run adult brood stock. Downstream passage facilities, designed to safely guide smolts past hydroelectric sites, were not included in the construction of fishways at the seven originally targeted dams nor were they mandated at other dams in the watershed. This deficiency occurred because of the lack of technology for designing effective site-specific downstream fish passage systems. As the number of fry stocked in the basin increased during the 1980s (clear shift in early 1990s stocking numbers), concern grew for the deleterious effect of hydroelectric turbines on outmigrating smolts as well as juvenile and spent adult American shad. Stream-reared smolts were early on forced to either pass through turbines or spill at gates, at numerous hydroelectric generating stations as they emigrated downstream to the ocean. Efforts to provide downstream fish passage on both main stem and tributary projects were initiated in the 1980s. In 1990, memoranda of agreement (MOA) were signed with two major utility companies that operated hydroelectric facilities at six main stem projects that established time frames for downstream passage construction. Efforts to provide adequate fish passage conditions at these projects and throughout the basin are ongoing. With the installation and evaluation of downstream fish passes, smolts in the main stem have been stocked upstream of Holyoke Dam. Smolts have also been stocked in the Westfield River upstream of the West Springfield Dam, in the lower Deerfield River below the first dam, and in the Farmington River upstream and downstream of the Rainbow Dam.

Due to relatively low adult salmon return numbers (Figure 7) since the mid 1990s, the approach to ensure the best scenario for genetic adaptations to develop and be passed on (through natural selection) necessitated the use of adult returns as one spawning group. The value of these fish in terms of their genetics, required capturing them and ensuring their successful spawning, to increase the chance of passing any unique trait developments on to the next generation. To maximize the opportunity for natural selection to act on both freshwater and marine life stages, fry stocking became the primary restoration strategy, as noted earlier. The strategy requires a number of eggs not attainable from sea-run returns alone so the progeny of sea-run mating had to be raised to maturity in a hatchery, referred to as domestic broodstock, which had provided the Program with the overwhelming majority of eggs, to approach target fry numbers (~70-85%) on an annual basis. Studies to allow fish to spawn naturally were conducted in the Westfield River in the 1990s, with some success and issues, in the end return numbers could not support such an effort without "hatchery brood releases" being utilized too. Hatchery fish performance in this capacity was determined unacceptable as a large scale strategy and sea-run adults cannot be

made to stay in areas they had not been fry planted in, all creating a challenging situation further complicated by the fragmented habitat/ access issues with many barriers. Had early Program adult return rates based on number of fry stocked been sustained into the 1990s and later, different restoration strategies would have been possible to consider, including tributary specific approaches to restoration.

The loss of the White River National Fish Hatchery (WRNFH) in 2011, while serving as a lead in domestic broodstock and fry production, severely impacted the Program in important areas. WRNFH had been producing approximately 65% of the fry for the Program in the past 10 years. Vermont and New Hampshire relied on almost exclusively on this production to stock their state waters, and the hatchery also supported the States of Massachusetts and Connecticut stocking and hatchery programs. The loss of this facility, in conjunction with ongoing reviews of the best science and information related to restoration efforts, and emerging USFWS Northeast Region fisheries issues (fiscal and priorities), led the USFWS to announce its decision to conclude fish culture activities for the Connecticut River Atlantic Salmon Program in this report period.

Appendix D. Administrative Report

Total Federal Aid Expenditures – FY2012

Utilities (Electric, Telephone & Propane)	$ 7,631.93
Vehicle Fuel & Maintenance	$ 6,477.64
Field Supplies	$ 1,541.22
Building Supplies	$ 488.68
Office Supplies, Operations & Maintenance	$ 2,730.35
Sub-Total:	$18,868.00
USFWS Overhead:	$ 1,130.18
Grand Total:	$20,000.00

NHFG (4837-5009)

Utilities (Electric, Telephone & Propane)	$ 3,278.42
Vehicle Fuel & Maintenance	$ 154.23
Building Supplies	$ 126.42
Office Supplies, Operations & Maintenance	$ 1,158.93
USFWS Overhead:	$ 282.00
Total:	$ 5,000.00

MADFW (4837-5010)

Utilities (Electric, Telephone & Propane)	$ 3,175.83
Field Supplies	$ 1,541.22
USFWS Overhead:	$ 282.95
Total:	$ 5,000.00

VTFW (4837-5011)

Vehicle Fuel & Maintenance	$ 4,603.65

Office Operations & Maintenance	$ 114.00
USFWS Overhead:	$ 282.35
Total:	$ 5,000.00

CTDEEP (4837-5012)

Utilities (Electric, Telephone & Propane)	$ 1,177.68
Vehicle Fuel & Maintenance	$ 1,719.76
Building Supplies	$ 362.26
Office Operations & Maintenance	$ 1,457.42
USFWS Overhead:	$ 282.88
Total:	$ 5,000.00