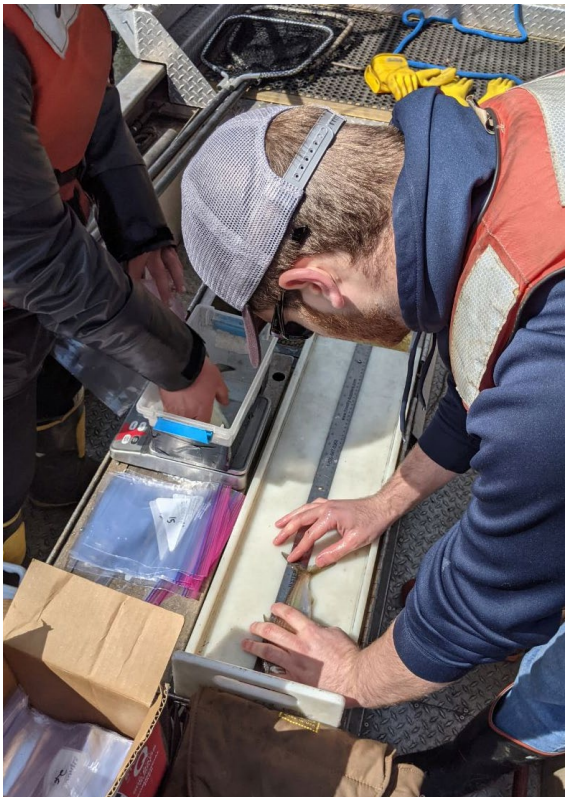
**CONNECTICUT RIVER BASIN**

**ANADROMOUS FISH RESTORATION:**

**Coordination and Technical Assistance**

**F-100-R-39**



# Annual Progress Report
# October 1, 2021 - September 30, 2022

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

# Executive Summary

**Federal Aid Project # F-100-R-39**

**States:** Connecticut, Massachusetts, New Hampshire, and Vermont

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

**Period Covered:** October 1, 2021 - September 30, 2022

**This annual report provides an opportunity to organize and document, to varying degrees, work activities conducted by the Connecticut River Fish and Wildlife Conservation Office (CTRFWCO), formerly the Connecticut River Coordinator's Office, which includes work outside of the Connecticut River basin and activities not funded by this grant.**

*Cover photo – Adult River Herring Population Assessment Program, field processing of sampled fish.*

**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.
- Represent the Service on Commissions, Technical Committees, and work cooperatively with State agencies and other partners.
- Identify fishery program priorities, design, and implement projects to address issues and opportunities, and develop plans.
- Administer grant programs to address fish habitat, passage, management, and research projects.

**Accomplishments:**

<u>Program Coordination</u>

- Organized and coordinated two Connecticut River Atlantic Salmon Commission (CRASC) meetings and two Technical Committee meetings (Appendix A, agendas).
- Organized and operated the remote "CRASC Technical Committee Management and Research Forum" in February (Appendix B, program).

- Coordinated the fifth season (2021) of the juvenile alosine survey with state agencies cooperators and other partners for the upper basin.
- Assisted in organizing a meeting of the Holyoke Cooperative Consultation Team to address Holyoke Project fish passage items with members.
- Provided annual upstream and downstream fishway operations letters (for CRASC) to hydropower owner/operators and the Federal Energy Regulatory Commission (FERC).
- Coordinated with main stem power companies and state agency partners to ensure fish passage facilities were operated as planned in 2022.
- As lead writer, finalized the CRASC update the Atlantic States Marine Fisheries Commission (ASMFC) Connecticut River American Shad Habitat Plan, approved in February by CRASC. The Plan was subsequently approved by the ASMFC Shad and River Herring Management Board in May (http://www.asmfc.org/files/ShadHabitatPlans/CRASC_CT_RiverAmShadHabitatPlan_May2022.pdf).
- Arranged meetings and worked on drafting new Connecticut River Migratory Fish Restoration Committee Charter/MOU as member of a CRASC subcommittee.
- Coordinated the development of a project list of assessment, research, outreach, planning needs for CRASC with the Technical Committee and partners and developed a priority ranking for funding.
- Managed CRASC federal budget allocation of $500,000 (FY22) that was placed in the CTRFWCO Station Budget as a subaccount in June.
- Following CRASC approved uses of those funds (end of June); worked with USFWS contracting to develop specifications to purchase a new electrofishing boat, contract awarded in September for $113,500; applied $7,000 to CTRFWCO seasonal hire agreement with American Conservation Experience (July); purchased eDNA backpack sampler and filter packs $9,900 (August); initiated hiring process for GS11 Fishery Biologist one year temp (July); other approved uses of funds were in planning stages up to end of September (USGS Conte Lab inter-Departmental agreements (two) and Connecticut River Conservancy cooperative grant agreement, with extensive, required grant system trainings.
- Coordinated development of additional CRASC project list for potential federal funding in FY23 budget. Planned meeting with CRASC in October on that topic.

Technical Assistance

- The juvenile alosine assessment in 2021 (conducted in partnership with Massachusetts Division of Fisheries and Wildlife (MADFW) and support by Vermont Department of Fish and Wildlife (VTDFW) staff, concluded on 10/20/21. During this report period (October) a total of 160 juvenile shad were sampled between Vernon Dam and Turners Falls Dam and from Bellows Falls to Vernon Dam. The relative abundance (rate) was intermediate to the five-year time series for both zones, for that month. Assessment data collected by MADFW and USFWS for this study for the period 2017 to 2021 is planned for comprehensive analyses in 2023.
- This juvenile assessment program was not conducted in the summer and fall of 2022.
- Worked over the year with other agency members; New Hampshire Fish and Game (NHFG), VTDFW, Vermont Department of Environmental Conservation, and USFWS Ecological Service) to develop a fish passage and protection settlement agreement with Great River

Hydro for Vernon, Bellows Falls and Wilder projects. The Agreement was signed in August.

- Continued work with state and federal agency partners on development of a settlement agreement on fish passage and protection measures, operational flows, fish passage performance measures, adaptive management measures and ichthyoplankton entrainment mitigation for the FirstLight Turners Falls and Northfield Mountain Pumped Storage Project over the course of the report year. As of the end of this report year (Sept 30, 2022), an Agreement in Principle on fish passage, protections, and related measures was being finalized.
- Organized and facilitated planning and technical oversight meetings (USFWS, MADFW) for a 2022 spring creel survey below Holyoke Dam and the Chicopee River area, to be conducted by the Connecticut River Conservancy (CRC). Worked directly with CRC, obtained data and completed preliminary analyses.
- As the USFWS member to the ASMFC Shad and River Herring Technical Committee (TC) worked on a variety of TC activities over the course of the report year. Provided the CTRFWCO River Herring Assessment data to the Chair of Stock Assessment Subcommittee (Katie Drew) for a July Data Workshop.
- Presented our USFWS 2013-2021 river herring population assessment data to ASMFC for the River Herring Benchmark Stock Assessment team at July Data Workshop.
- Served as the USFWS representative to the NOAA River Herring Habitat Conservation Plan's Steering Committee, that met over the year. As of the time of this report a draft report document was being finalized.
- Completed the Annual Sport Fish Restoration Grant Report for FY21, in January 2022 and posted on CTRFWCO web site.
- Worked as a team member on the CRASC Technical Committee's drafting of the first American Eel Management Plan.
- Conducted the annual spring adult river herring population assessment in the lower Connecticut River basin for the ninth year. Sampling occurred on 28 dates from April 5 through June 14, 2022. This is a record high number of sample dates for the program. A total of 1,433 Blueback Herring were captured and processed on the boat with 470 Alewife also captured and processed.
- A total of 903 Blueback Herring and 356 Alewife were subsampled from the field and processed in the laboratory the following day to confirm species, extract otoliths, obtain scale and female ovary samples and gill tissue (freshwater mussel glochidia research).
- Data from spring 2022 Adult River Herring Population Assessment Program were entered into the Access database and spreadsheets to compare many metrics that are objectives of this program. Otolith aging was initiated in the summer of 2022, results covered later. Blueback Herring data were prioritized to meet late fall deadline to include 2022 data in the ASMFC Stock Assessment.
- Scale samples from the Blueback Herring (n = 903) and Alewife (n = 356) were cleaned and slide mounted. All scale samples were examined by projector for spawning history by two readers independently, with consensus reads for disagreements, analyses covered later.
- Provided program information and requested data (e.g., fish counts) to cooperators, researchers, power companies, and the public.
- Administered grant/program agreements for two American Conservation Experience(ACE) paid interns that worked full time from April 1 through August 27 of 2022. Supervised a Westfield State University intern (unpaid) for class credit in the months of May and June.

- Obtained target 60 fish American Shad sample from Holyoke Fish Lift, dissected and prepared tissue samples for USFWS Fish Health examination (done annually).

Cooperative Research

- Served as USFWS project officer and cooperator for the U. S. Geologic Survey University of Massachusetts Cooperative Fish and Wildlife Research Unit (UMass USGS Coop Unit) and Conte Fish Research Laboratory (CAFRC) study, "Environmental Factors Controlling Juvenile River Herring Productivity and Emigration (2019-2022)", partially supported by the USFWS Science Support Program (SSP).
- In October of this report year, was a co-author on the paper "**What have we lost? Modeling dam impacts on American Shad populations through their native range**" was published on-line in the Journal Frontiers in Marine Science: https://www.frontiersin.org/articles/10.3389/fmars.2021.734213/full
- Served on a team hiring a USFWS Pathways Biologist that is also a M.S. Student at UMass Amherst. Developed research plans for the Biologist/M.S. Jacqueline Stephens, with UMass USGS Coop Unit Leader Allison Roy as her academic and research supervisor. Her research will include Blueback Herring spawning mark criteria development and determining statistically based minimum sample sizes using known ages and freshwater mussel utilization of migratory fishes for glochidia.
- Supported the development (Project Officer) of a USFWS Science Support Program (SSP) Grant application in 2022 that was awarded to the USGS Conte Lab to study fishway entrance designs for passage effectiveness of river herring.
- Uploaded all required metadata files (receivers and tagging) to the Mid-Atlantic Acoustic Telemetry Observation System (MATOS) for the Blueback Herring Migration and Movement Study (https://matos.asascience.com/project/detail/184).
- Obtained MATOS detections update reported in February and in June for "other" system array detections of our study tagged fish.
- In early March, deployed 26 acoustic receivers on moorings from Old Lyme, CT to Hadley, MA on mainstem and select tributaries and coves for return detection of tagged bluebacks.
- Retrieved all but one acoustic receiver in July. Downloads of data completed with only two tagged fish from last year detected. Receiver data uploaded to MATOS with many other tags from other studies detected.
- In August of this report year was a co-author on the paper "**Counting eggs before they hatch: Reproductive seasonality of Blueback Herring,**" presented at the American Fisheries Society's Annual Meeting in Spokane Washington, remotely by Dr. Eric Schultz (UConn).
- September 2022 organized a state (MA, CT, RI) and federal agency (my office and NOAA) meeting on spring 2022 river herring adult run declines. One day event at Rhode Island Department of Environmental Management (RIDEM) office included agency presentations and discussions. Completed meeting notes and facilitated next steps, including plan to draft a common letter for all partner agencies to sign on with recommended actions, for Directors to use (Councils, Boards etc.).

- Worked with David Perkins (FWS Project Leader Cronin Aquatic Center) on developing a new USFWS Research Dive Team, through USFWS Regional Dive Lead. Completed scuba refresher course, obtained gear and continuing other steps to have our team operating for the 2023 season.

- September 2022 organized a meeting among CRASC TC Sea Lamprey and Eel Subcommittee members with FWS Lamar Genetics Lab, to initiate plans for eDNA sampling with new equipment.

Outreach

- October – gave a presentation for the FWS National Conservation Training Center (online open nationally), on the "River Herring Population Assessment Program" of this office.
- November - gave a presentation to the NOAA River Herring Collaborative on the "Blueback Herring Migration and Movement Study for the Connecticut River".
- November - gave presentation to Westfield State University Environmental Studies class on Migratory Fish Restoration, Management, Status and Trend.
- May - worked with CRC to organize and run a field World Migratory Fish Day event at Holyoke Rows, MA (https://worldfishmigrationday.com/event/fish-and-or-river-monitoring-demonstration-celebrating-fish-restoration-on-the-connecticut-river/)
- May – June, worked with an independent film maker, creating a documentary on the Connecticut River, included field and lab work interviews and filming on river herring program.
- Served as lead agency member for the September 2022 Sea Lamprey Rescue event organized by the CRC, for the Turners Falls Power Canal outage (dewatering). Coordinated CTDEEP staff for larval lamprey collection and transfer for CTDEEP restoration programs. (https://www.youtube.com/watch?v=A6ffGu69iRc)
- From April through June provided weekly fishway counts report of the basin to an email distribution list of approximately 225 people. Posted weekly report counts to the CTRFWCO web site. Fishway count report updates were provide a biweekly or less frequent interval through remainder of the year (Appendix C).

# Acknowledgements

Many people have contributed to the work accomplished by this office in the report period that I want to recognize and thank. Most significantly, Darren Desmarais served as the sole permanent staff (Fish Biologist) for the CTRFWCO and contributed greatly to the office's accomplishments in many areas over the report period, particularly on the river herring population assessment program, acoustic tagging study equipment, gear set up and deployment, data management, data entry, data summaries and summary analyses, otolith aging, equipment and lab oversight, equipment maintenance and a variety of fieldwork including leading on several river herring sample events in the spring. Phil Herzig (USFWS) was exceptionally helpful in the preparing equipment and boats/gear for the acoustic receiver deployment in early March.

The two American Conservation Association Interns (paid) that worked April through August, performed exceptionally well in all activities they were involved with supporting and conducting over the period. Kyle Hubbard and Julian Burgoff made significant contributions to the river herring population assessment program and many facets of that projects work (sampling, data collection, lab processing of fish, scale prep and scale reading, data entry and analyses), that would not have been possible without their hard work, skills, and abilities. Other substantial work activities included their support on freshwater mussel research with Pathways Biologist Jackie Stephens, retrieval of acoustic receivers, receiver data file checks for tags, and exploratory data analyses of the 2022 spring creel survey data from the Connecticut River Conservancy. Conner Lemke from Westfield State University was an unpaid intern, that donated approximately 140 hours of well-done work to our activities in the spring.

The new USFWS Pathway Biologist and UMass M.S. student, Jackie Stephens, started in May and assisted in both field and lab activities in the spring through summer. Her thesis research, freshwater mussel reproductive ecology using anadromous fish (particularly Alewife and Blueback Herring) and river herring spawning run data collected by our assessment (time and space shifts in metrics), with a focus on spawning history of Blueback Herring. The spawn history determination, methods, equipment, etc., are a key element as our Program seeks to better address what is a large-scale concern in best practices for such determinations.

The Connecticut River Conservancy, from the Director Andy Fisk to field staff Andrea Donlon, Aliki Fornier, and Kathy Uffer, have provided ongoing staff support for field activities and important technical support (FERC and other areas) over the course of the year. Andrea Donlon took another job late in the spring and her dedication and engagement will be missed by this office and many partners. Andy Fisk also accepted another position as CTDEEP Natural Resources Bureau Chief, that did not become official until post this report period.

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

State fishery agencies -

- Connecticut: Kevin Job, Tim Wildman, Jacque Roberts, Justin Davis
- Massachusetts: Rebecca Quinones, Caleb Slater, Steven Mattocks, Brian Keleher and Ben Gahagan
- New Hampshire: Matt Carpenter and Greg Comstock (DES)
- Vermont: Lael Will (and her seasonal technicians), Hannah Harris, Jeff Crocker (DEC), Eric Davis (DEC)

Federal agencies –
- USFWS: Melissa Grader, Phil Herzig, Jessica Pica, Dave Sagan, Andy French, David Perkins, Tim Warren, and Jackie Stephens
- NOAA Fisheries: Bill McDavitt, Bjorn Lake, and Julie Crocker
- USGS Conte Lab: Ted Castro-Santos, Alex Haro, Brett Towler, Micah Kieffer, Kevin Mulligan, Sam Parker
- USGS Massachusetts Cooperative Fish and Wildlife Research Unit – Allison Roy

Universities-
- University of Massachusetts, Adrian Jordaan and Meghna Marjadi
- University of Connecticut, Eric Schultz
- Westfield State University, Dave Christensen

# The Anadromous Fish Program and

# The Connecticut River Atlantic Salmon Commission

The administration of the interjurisdictional cooperative effort to restore diadromous fish species to the Connecticut River basin is accomplished through the Connecticut River Atlantic Salmon Commission (the Commission). During the period from 1967-1983 (prior to the Commission), restoration of anadromous fish, primarily Atlantic Salmon and American Shad, on the Connecticut River was guided by the Policy Committee and the Technical Committee for Fisheries Management of the Connecticut River Basin. The importance of this formally structured, coordinating, and regulatory body to the restoration program was federally 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 2003 and will expire on October 28, 2023. This law, 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 anadromous fish 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 Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) also referred to as NOAA Fisheries.

The Commissioners develop and 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). The Technical Committee has eight subcommittees, with specific areas of responsibility (American Shad, River Herring, Atlantic Salmon, American Eel, Sturgeon, Sea Lamprey, Fish Passage, and Habitat). Other experts and cooperators from the member agencies including the U.S. Geological Survey, Conte Anadromous Fish Research Center (CAFRC), Trout Unlimited, The Nature Conservancy, Connecticut River Conservancy, private industry, and others participate with the subcommittees and Technical Committee as needed. The Connecticut River Coordinator (Coordinator), also the Connecticut River Fish and Wildlife Conservation Office Project Leader, is an employee of the USFWS, acts as the Executive Assistant to the Commission and the Secretary for the Technical Committee and is the USFWS Technical Committee representative.

The CRASC meets at least twice each year, and the Technical Committee (and its subcommittees) meets as frequently as needed. This report period, the Commission met on December 1, 2021, and on June 28, 2022 (see Appendix A for meeting agendas). The Commission formed a Subcommittee to work on either a Charter, Memorandum of Understanding, or other binding instrument to maintain the structure and function of the CRASC with its purposes and objectives better defined for the current and future migratory fish restoration. The CRASC, as a federally approved entity, will expire on October 28, 2023. This Subcommittee met several times over the course of the report year utilizing other current multi-

state and agency river restoration agreements such as the 2014 signed Susquehanna River Anadromous Fish Restoration Cooperative. A working draft document was refined but not completed at the end of this report period. Plans to complete the document were in place and have proceeded in subsequent time.

The Coordinator is responsible for assisting on coordination of state and federal activities, providing; technical expertise, project development and implementation of fish population assessments, restoration, management, and research programs, program evaluation, assist the USFWS Ecological Services Division on Federal Power Act with select Federal Energy Regulatory Commission (FERC) projects, and conduct advocacy and outreach of the cooperative diadromous fish restoration program in the Connecticut River watershed (Figure 1). The Coordinator also organizes meetings, identifies priorities, develops initiatives, and plans, implements them, and maintains and develops partnerships to accomplish objectives. The Coordinator serves as the USFWS representative to the Atlantic States Marine Fisheries Commission's Shad and River Herring Technical Committee (Chair and Vice Chair 2016-2020) and on other subcommittees as needed.

Fish species under restoration and enhancement in the Connecticut River basin include American Shad, Blueback Herring, Sea Lamprey, American Eel, and Alewife, primarily addressed by efforts to provide safe, timely, and effective upstream and downstream passage to historic habitats as well as measures to improve habitat quality (e.g., address rapid, large-scale fluctuations in sub-daily discharge from hydropower operations). Shortnose Sturgeon, a federally endangered species, is under recovery and continues to be monitored, studied, and protected in a variety of ways, some of which will be covered in later report text. Atlantic Sturgeon are also present in the lower river and are federally protected.

In 2022, there were four documented adult Atlantic Salmon returns to the basin, three passed at the Rainbow Dam Fishway (Farmington River) and one was observed below Leesville Dam on the Salmon River and later caught and released by an angler in the fall upstream of the dam. All adult returns were considered multi-sea winter fish. The Connecticut Department of Energy and Environment Protection (CTDEEP) continued fry stocking with its Atlantic Salmon Legacy Program working with the Connecticut River Salmon Association and its numerous salmon-in-schools program, providing a valuable outreach and education program to students in Connecticut. The program also maintains the presence of Atlantic Salmon in the basin, within the State of Connecticut. In 2022, a total 227,523 salmon fry were stocked in the West Branch of the Farmington River in May. In addition, 76,812 fry were stocked in the Salmon River in April. These stocking numbers represent a return to the CTDEEP target stocking numbers up from the 2021 total of only 33,585 fry stocked due to chiller issues impacting eggs and fry development.

The CRASC continues to serve as an important mechanism to maintain communication and coordination on migratory fish restoration and management activities in the Connecticut River basin. Given the status of diadromous species (both in-basin and coast wide), the main stem hydropower facilities in FERC relicensing process, and recent Holyoke Dam downstream passage (Settlement Agreement) measures being completed and under evaluation, there is a need and value of a basin-wide coordinated management approach.

The Technical Committee had meetings on November 17, 2021, and June 15, 2022 (see Appendix A for meeting agendas). The Shad Subcommittee completed the update to the original 2014 Atlantic States Marine Fisheries Commission (ASMFC) Connecticut River American Shad Habitat Plan. This Plan was approved by the CRASC and submitted to the Atlantic States Marine Fisheries Commission at their May Board meetings where it was accepted. The Sea Lamprey Subcommittee had meetings to plan for nest survey work in the spring. The American Eel Subcommittee had several meetings over the period making significant progress on an American Eel Management Plan. Many of the Fish Passage Subcommittee members addressed ongoing FERC relicensing items on the main stem, and tributary FERC projects, some non-jurisdictional projects of high conservation value, and ongoing passage activities and plans at the Holyoke Project (trap and transfers, lift operations, sturgeon, eel passage).

The federal budget in fiscal year 2022 also included funding for the CRASC as part of the Omnibus Appropriations Bill:

> **Connecticut River Atlantic Salmon Commission.-The agreement provides $500,000 for the Connecticut River Atlantic Salmon Compact, as authorized in Public Law 98-138, for research, monitoring, conservation, and habitat restoration work related to this high-priority watershed.**

The CRASC was aware of the potential approval of this item based on non-federal partner discussions with the primary sponsor Senator Patrick Leahy (Vermont). The CRASC Commission tasked its Technical Committee to develop a list of possible projects that were occurring and could utilize additional funding support or were new, for the noted areas (i.e., research monitoring, etc.) and to further provide a ranking of priority. The Technical Committee also engaged partners that have provided ongoing support to the purposes and goals of CRASC's restoration work. The Commission then used the following framework and criteria:

> On a regular basis the Technical Committee will maintain a list of un- or underfunded projects eligible for CRASC funding. This project list will serve to support annual appropriations requests to Congress submitted by public or state agency Commission members. CRASC Commission makes final decisions on funding based on Technical Committee recommendations. Funding is then committed by USFWS to entities or agencies being provided funding. Commitments to fund projects will generally be made on a one-year basis, with the possibility of annual renewals for recurring or multiyear work CRASC funding can support salaries, supplies and materials, and capital acquisitions.
>
> Prioritization Process-
> Does the Project:
> - Support the objective of a CRASC management or research plan?
> - Support the mission and priorities of the CRASC to restore and protect migratory fish?
> - Provide administrative or technical support to address unmet or backlogged compilation of and analyses of data?
> - Support outcomes that will impact more than one watershed state.
> - Include the involvement of volunteers or members of the public?

- Increase the exposure and understanding of the work and priorities of the CRASC?
- Does CRASC funding complete, or entirely support, the project or request's budget?
- At this time, it is not recommended to support restoration projects such as dam removals, aquatic or riparian habitat improvements.

Funded Projects-

- CRASC shall maintain a record of equipment purchased with funds noting useful life.
- Equipment within its useful life shall remain subject to the terms of CRASC funding or oversight by the Commission
- Entities receiving CRASC funds shall maintain all necessary records and produce reports as required by CRASC or USFWS, CT River Coordinator's Office (or CTRFWCO).

The CRASC approved list of projects are described in Table 3 and represent funding support for a diverse array of fishery needs covering population monitoring and assessment (equipment and staff), fish passage research, resource utilization assessment, public outreach and education.

| Activity | Org / Agency | Status as of September 30, 2022 | Budget |
|---|---|---|---|
| **Annual personnel expenses (salary, benefits)** | | | |
| Community and applied science staff salary (partial support) | CRC | FWS Grant Agreement in development | $75,000 |
| Seasonal angler survey technicians (4), MA area and CT area | CRC | FWS Grant Agreement in development | $31,000 |
| Fish passage monitoring at VT dams (2) - may be able to expand | CRC | FWS Grant Agreement in development | $15,000 |
| Seasonal field technicians (2) | USFWS | Used $7,000 for interns agreement for 2023 | $7,000 |
| GS 11 Biologist (term) - analyses of backed up data, products (reports) | USFWS | in hiring system process | $94,000 |
| | | | ========== |
| **Total Personnel expenses** | | | **$222,000** |
| | | | |
| **Nonpersonnel expenses** | | | |
| Migratory fish public engagement/marketing of CRASC priorities | CRC | FWS Grant Agreement in development | $14,600 |
| Upstream Sea Lamprey Passage Design & Testing (year 1) | USGS Conte Lab | DOI Agreement in development | $75,000 |
| eDNA Sampler Backpack (Eel, lamprey, other spp.) and sample packs | USFWS | Purchased by USFWS | $9,900 |
| eDNA additional sample packs | USFWS | To be purchased in 2023 field season | $4,000 |
| eDNA Sample analysis (40 samples) | USFWS | Analyses by FWS Lamar, paid direct by FWS | $9,000 |
| Electrofishing boat & equipment (USFWS) | USFWS | Contract completed, cost $113,500 (2k to outfit) | $115,500 |
| American eel fish new technology U/S passage study | USGS Conte Lab | DOI Agreement in development | $50,000 |
| | | | ========== |
| **Total Nonpersonnel Expenses** | | | **$278,000** |
| | | **Total** | **$500,000** |

Table 3. List of projects, activities, equipment targeted for funding by CRASC utilizing FY22 Federal Budget of appropriation of $500,000. Federal funds were not available (in CTRFWCO budget) until early June 2022, with formal CRASC approvals of funds at the end of June.
"CRC" Connecticut River Conservancy

CRASC scheduled meetings (Commission and Technical) are open to the public, contact Ken Sprankle at ken_sprankle@fws.gov or at 413-548-9138 ext. 8121, to receive notices for scheduled meetings. Interested citizens are given the opportunity to provide input and area news publishers are notified of scheduled Commission meetings via email. Minutes of both Commission and Technical Committee meetings once approved are available and posted on the

Connecticut River FWCO website. Any one requiring hearing assistance or any other considerations should contact Ken Sprankle at least 3 weeks in advance of scheduled meetings, so appropriate arrangements can be made.

Table 1. Connecticut River Atlantic Salmon Commission Membership (as of September 2022).

| **Connecticut River Atlantic Salmon Commission** | |
|---|---|
| **Federal** | **U.S. Fish and Wildlife Service**<br>*Kyla Hastie (Acting)*<br>Regional Director, Region 5<br>*Rick Jacobson, alternate* |
| | **National Marine Fisheries Service**<br>*Michael Pentony*<br>Northeast Administrator<br>*Christopher Boelke, alternate* |
| **Connecticut** | **Connecticut Dept. of Energy and Environmental Protection**<br>*Peter Aarrestad (Acting)*<br>Chief, Bureau of Natural Resources<br>*Tim Wildman, alternate* |
| | **Public Sector Representative**<br>*Tom Chrosniak* |
| **Massachusetts** | **Massachusetts Division of Fisheries and Wildlife**<br>*Mark Tisa*<br>Director<br>*Todd Richards, alternate* |
| | **Public Sector Representative**<br>*Andrew Fisk (Chair)* |
| **New Hampshire** | **New Hampshire Fish and Game Department**<br>*Scott Mason*<br>Executive Director<br>*Scott Decker, alternate* |
| | **Public Sector Representative**<br>*Donald McGinley* |
| **Vermont** | **Vermont Department of Fish and Wildlife**<br>*Christopher Herrick*<br>Commissioner<br>*Eric Palmer (Vice Chair), alternate* |
| | **Public Sector Representative**<br>vacant |

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

| **Connecticut River Atlantic Salmon Commission Technical Committee** | |
|---|---|
| **Federal** | **U.S. Fish and Wildlife Service**<br>*Kenneth Sprankle* |
| | **National Marine Fisheries Service**<br>*William McDavitt* |
| | **U.S. Forest Service**<br>*Jeremy Mears* |
| **Connecticut** | **Connecticut Dept. of Energy and Environmental Protection**<br>*Tim Wildman* |
| **Massachusetts** | **Massachusetts Division of Fisheries and Wildlife**<br>*Rebecca Quinones* |
| | **Massachusetts Division of Marine Fisheries**<br>*Ben Gahagan* |
| **New Hampshire** | **New Hampshire Fish and Game Department**<br>*Matthew Carpenter* |
| **Vermont** | **Vermont Department of Fish and Wildlife**<br>*Lael Will*<br>(Chair) |

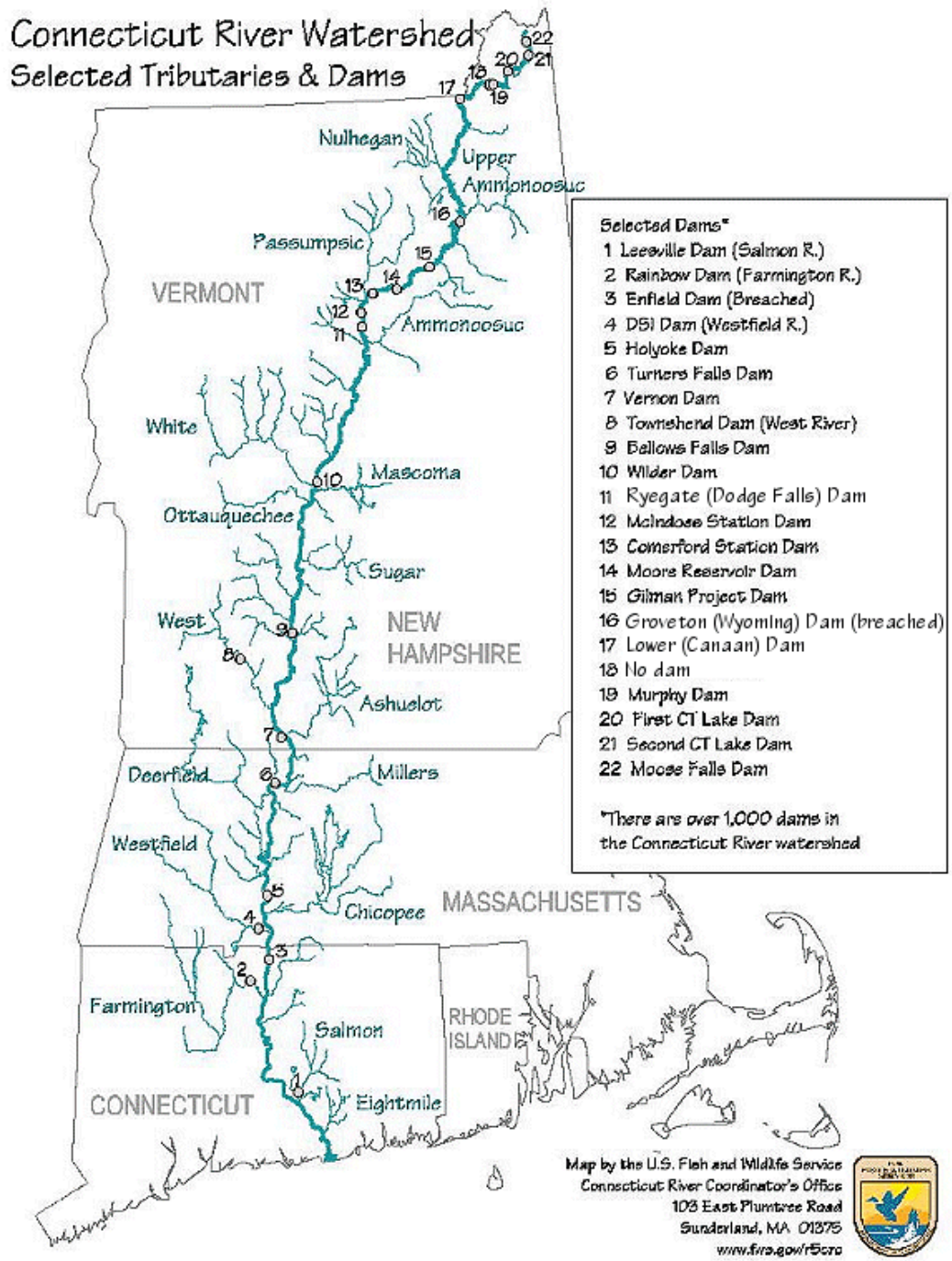



Figure 1. Connecticut River basin with major tributaries and main stem dams.

## Coordination and Technical Assistance Funding

The Connecticut River Fish and Wildlife Conservation Office (CTRFWCO), under the USFWS' Wildlife and Sport Fish Restoration Program's F-100-R-39 and a five-year Memorandum of Understanding, for this report period, was targeted to receive $20,000 from the four state fishery agencies using their annual Sport Fish Restoration Program apportionment (F-100-R) or agency-generated funds. The grant funds were assessed an USFWS administrative overhead fee leaving $16,270 available. The Office also primarily utilized Station Base Funds (Management Assistant Funds) that totaled $344,903 for FY22. In addition, the FY22 Federal Budget allocation of $500,000, that was placed in the CTRFWCO budget was used per the approved spending plan by CRASC, for items/actions that could be completed from July through September ($130,400 expended or fully obligated) in this report period (Table 3 and 4).

Table 4. Federal fiscal year 2022 (report period) funds utilized by the CTRFWCO.

| Station Base FWS Budget | Four State Agreement | CRASC Fed Budget | Total |
|---|---|---|---|
| $344,903.00 | $16,270.00 | $130,400.00 | $491,573.00 |

## Project Accomplishments

The Connecticut River Fish and Wildlife Conservation Office enhanced the Commission and States' ability to plan, coordinate, manage, evaluate, and implement restoration programs through a variety of activities, some of which are described in greater detail in the following sections. Please note that data presented in this report have been reviewed to the extent possible but is subject to change and should be considered provisional. **Use of any presented data should be discussed with the Coordinator to avoid potential issues with use, analyses, and/or interpretation**.

**Fisheries management, restoration, assessment, technical assistance and additional select information**

In 2022 the adult population assessment program for river herring was initiated by this office in early April, utilizing boat electrofishing as the primary sampling gear, for the ninth year of data. The first year of this annual program was in 2013, with 2020 work cancelled due to Covid. Study objectives of the project include: 1) obtain a minimum whole fish sample of 80 Blueback and Alewife for age structures, per target sample location; 2) obtain baseline demographic data on all sampled river herring (species, length, weight, sex, spawning condition); 3) derive relative abundance/catch measures using repeated standardized (time) sample runs; 4) conduct surveys across a broad geographic range of spawning aggregations and over the duration of the runs (April-June), representing spatial and temporal variations for both species; 5) determine fish ages from otoliths and spawning history from scale examinations; and 6) utilize standard stock

assessment procedures and statistics to describe status and trends and examine other relevant data for influence/relation on population metrics.

Female Blueback Herring gonad/reproductive status research continued in collaboration with Drs. Eric Shultz (UConn), Ganias Konstantinos, and Faivos Mouchlianitis (Aristotle University of Thessaloniki, Greece). In 2022, coordination calls were held on analyses and results of egg development stage analyses and related data that is in preparation for publication. Dr. Shultz providing platform presentation on our research with updates using 2022 data at forums including the Annual American Fisheries Society meeting.

This long-term monitoring program was developed to address identified priority data needs, specific to the Connecticut River and also more broadly coast-wide, as described in the Atlantic States Marine Fisheries Commission's River Herring Benchmark Stock Assessment Report released in May 2012 and the most recent August 2017 release of the River Herring Stock Assessment Update. The ASMFC report concludes "*…river herring continue to be depleted on a coast wide basis and near historic lows*." The ASMFC started its River Herring Benchmark Stock Assessment in July with a Data Workshop with members from Florida to Maine. Our study data were presented and approved for inclusion in this significant coastwide assessment that remains in process with a target completion date in late 2023. At the workshop, it was agreed by participants it would be of value to allow additional time to provide data and analyses from 2022 (including age structure if possible). The CTRFWCO was able to meet the requested deadline with the additional 2022 data included in the various status, trends, modeling work shifted to November of 2022.

Table 5. An annual summary of the CTRFWCO's river herring population assessment program's effort, catch, and laboratory processing total by species (2013-2022).

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|
| Number of sampling dates | 18 | 21 | 20 | 25 | 26 | 23 | 27 | 25 | 28 |
| Total sample runs | 81 | 124 | 114 | 145 | 145 | 147 | 147 | 118 | 173 |
| Total electrofishing seconds | 41,177 | 55,736 | 56,025 | 71,845 | 68,353 | 69,835 | 80,473 | 56,838 | 84,208 |
| Total bluebacks captured | 714 | 2,593 | 1,448 | 1,586 | 2,650 | 2,396 | 3,456 | 1,813 | 1,433 |
| Total alewives captured | 107 | 220 | 258 | 586 | 200 | 366 | 243 | 128 | 470 |
| Blueback Herring otolith/scale – lab | 501 | 655 | 622 | 730 | 1,192 | 991 | 1,473 | 929 | 903 |
| Alewife otolith/scale - lab | 103 | 188 | 165 | 461 | 190 | 284 | 217 | 114 | 356 |

There was an increase in the number of sample days in 2022, making it highest number of dates in the time series and translated across other metrics with a record setting number of sample runs and electrofishing seconds (Table 5). However, even given this level of effort our fish capture totals were relatively low and is best represented by our catch-per-effort metric that accounts for variable sampling effort among years.

In 2022, sampling was initiated on April 5 in the Mattabesset River with 83 Alewife captured and no Blueback Herring observed. When sampling runs encounter high catch rates (>60 fish collected), only with Blueback Herring, with less than the standard 500 seconds shock time expended, the run duration is shortened. This situation occurred on only two runs in 2022 (record low), compared to 9 runs in 2021, 22 runs in 2019, 18 runs in 2018 and 16 runs in 2017 and is reflected in the aggregate catch rate summaries and comparisons (Figure 2). The annual catch rate was based on the aggregate of individual sample runs, using all sites, after Blueback Herring were determined present in the system (removes varying frequencies of early zero runs when Alewife are being sampled among years). The Blueback Herring 2022 season annual aggregate relative-abundance was the lowest value in the time series 2.6 fish-per-minute (standard error 0.20). In 2022, Blueback Herring were detected on April 7 with two fish in Wethersfield Cove. This sample date was not included in Figure 2, with the April 13 sample date considered representative of the run's arrival. Regardless, April 13 is an early arrival date (same as observed in 2021), with prior years of the program typically having blueback arriving the third week of April. Sampling concluded on June 14, 2022, like previous years, with sampling at Wethersfield Cove.

Holyoke Fish Lift counted 283 Blueback Herring passed in 2021 a very low number in the data time series. There continues to be no detectable relationship between the survey CPUE and HFL counts. Data on fishway counts will follow later in this report.

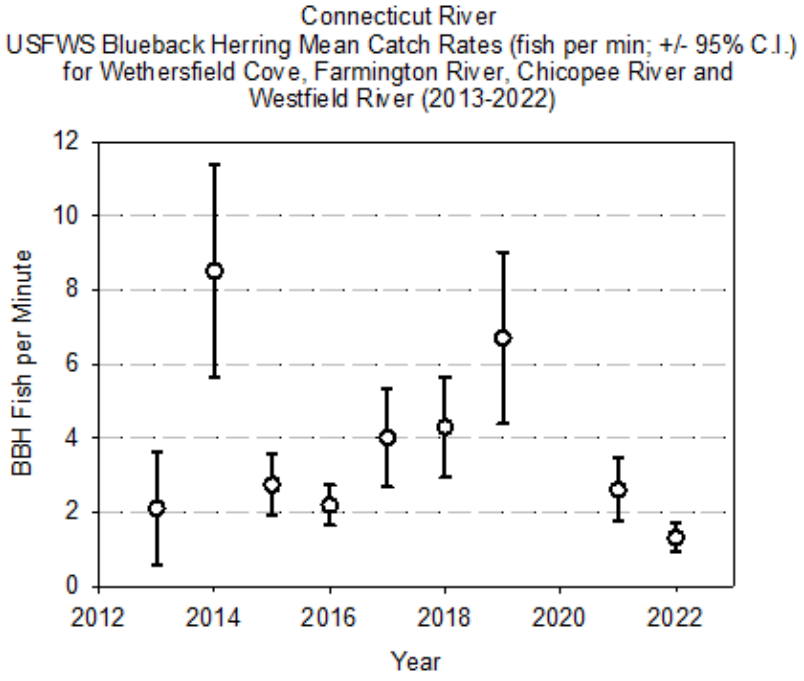



Figure 2. Annual catch-per-unit effort (fish per minute) for Blueback Herring among four standard index areas. Sample efforts prior to first documented arrivals (catches) are excluded from analyses (e.g., 141 runs vs. 173 total runs in 2021).

Blueback Herring catch rates over the sample season were variable but overall low, with the first occurrence of the species in sampling observed on April 7, 2022, in Wethersfield Cove and fish still present on the final sample date of June 14, 2021, at Wethersfield Cove. Relative abundance of Blueback Herring varied over space and time at the site level (Figure 3). In 2022, as shown in Figure 1, the record low abundance rate was attributed among all site when compared to rates commonly observed in previous years data at the site level. The Westfield River observed consistently low rates to zero catches over the season (Figure 3). The Chicopee River exhibited wide ranging catch variability from extremely low rates to moderate (for this year) that is believed to be tied to wide ranges in that tributary's discharge in May and June of 2022 (at low discharge habitat becomes very limited and boat operation is restricted). Only one sample run is possible under "good" water discharge conditions given the upstream limits of bedrock shoals that are always impassable approximately 1 km upstream of the Connecticut River. Both the Farmington River and Wethersfield Cove provide abundance rates over time more representative of a normal distribution over the season, with the Farmington River performing at a substantially reduce rate to previous years and in relation to Wethersfield Cove. Wethersfield Cove often demonstrates the highest catch rates among sites and seems less influenced by discharge rates that may affect tributaries habitat conditions, more directly. A comparison plot of these same data for the year 2017 shows the extent of decreases at the site level, noting that 2017 was an "intermediate" year for overall relative abundance in the study time series (Figure 4).

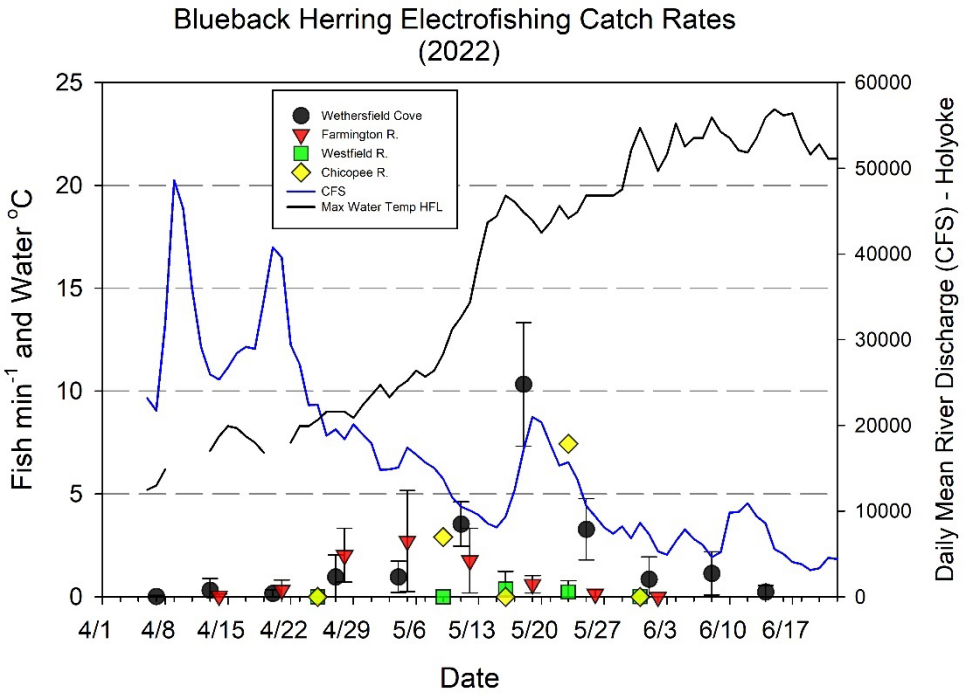



Figure 3. Adult Blueback Herring relative abundance expressed as mean fish captured per minute ± standard deviation, by sample area and date for 2022 season. Reported daily maximum water temperature (Holyoke Fish Lift) and daily mean river discharge, U.S. Geological Survey, Holyoke, MA gage station.

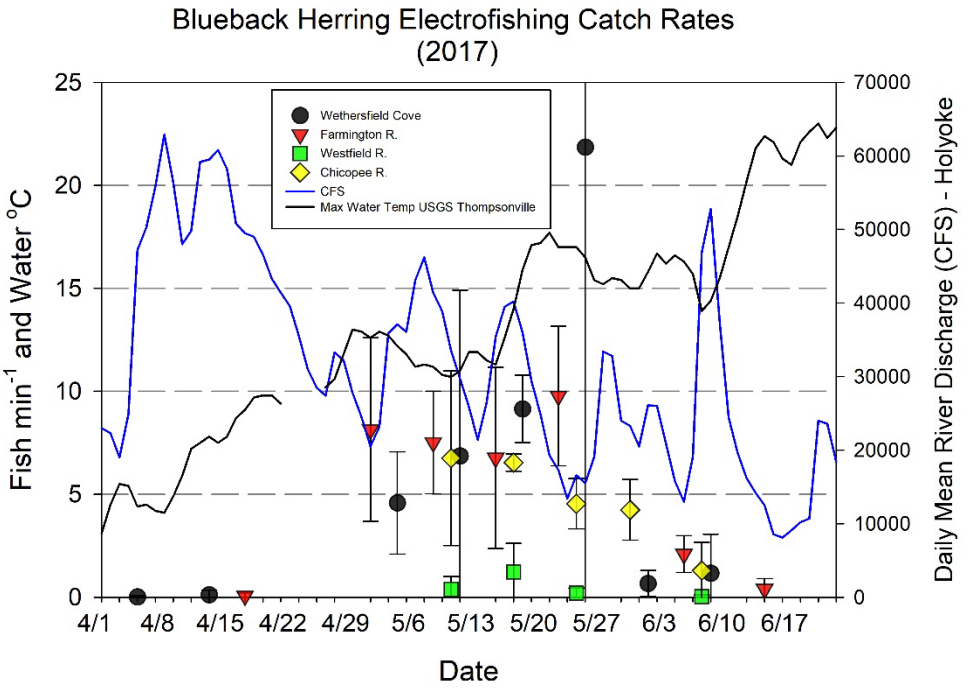



Figure 4. Comparison figure of adult Blueback Herring relative abundance expressed as mean fish captured per minute ± standard deviation, by sample area and date for the 2017 season. First Y axis kept to same scale for comparison with 2022.

A summary of river herring mean total lengths (mm) with standard deviations are shown by sex, for each species, by year in Table 6. The mean size of male and female Blueback Herring was intermediate for the assessment time series. Male and female Alewife mean total length were also intermediate to the time series (Table 6). Age structure of the adult run, by sex, provides necessary information to help interpret shifts in general statistical measure such as fish length data. Variability in annual juvenile production abundance for Blueback Herring, as measured by the CTDEEP Juvenile Alosine Seine Survey (juvenile index value), has shown a highly significant correlation to adult Blueback Herring catch-at-age (Sprankle 2019). Consistent with that relationship, the 2018 Blueback Herring (CTDEEP) juvenile index was relatively strong for the recent time series and the expected 2022 adult Blueback Herring relative abundance was expected to be "relatively" good compared to the assessment program time series. This was not the case as discussed earlier. However, age structure analysis of Blueback Herring in 2022 was consistent with the age-4 cohort (both males and females) having the greatest percentage cohort representation from lab processed fish.

Table 6. A summary of annual mean total length (mm) with standard deviations (SD), for all processed Blueback and Alewife, by sex, for the survey years of 2013 – 2022.

| | **Blueback** | | **Alewife** | |
|---|---|---|---|---|
| Year | Male Mean TL mm (± SD) | Female Mean TL mm (± SD) | Male Mean TL mm (± SD) | Female Mean TL mm (± SD) |
| 2013 | 253.8 (12.1) | 264.9 (12.6) | 261.6 (15.8) | 287.7 (16.2) |
| 2014 | 253.8 (11.4) | 264.9 (13.2) | 266.2 (10.8) | 276.1 (15.5) |
| 2015 | 263.0 (10.4) | 277.8 (11.7) | 273.1 (11.7) | 287.9 (12.4) |
| 2016 | 265.2 (13.3) | 281.3 (13.0) | 270.7 (18.0) | 286.4 (19.0) |
| 2017 | 257.5 (12.7) | 271.7 (14.9) | 265.0 (18.3) | 278.4 (21.4) |
| 2018 | 256.7 (12.9) | 268.4 (14.7) | 269.5 (14.9) | 280.0 (18.1) |
| 2019 | 260.4 (9.9) | 273.3 (13.4) | 274.4 (11.0) | 291.3 (15.0) |
| 2021 | 266.5 (15.5) | 279.9 (18.3) | 264.5 (9.5) | 276.2 (13.8) |
| 2022 | 261.7 (15.7) | 272.6 (17.5) | 272.4 (9.1) | 286.0 (11.1) |

Reading of Blueback Herring otoliths was initiated and completed within the report period ahead of the ASMFC River Herring Stock Assessment Subcommittee's date of submission. A total of 903 laboratory processed Blueback Herring otolith samples were used to characterize the age structure of the 2022 run, with 888 fish (95.5%) successfully assigned an age (Table 7). The mean age for both sexes combined was 4.5 with S.D. ± 1.4. The youngest age fish was age-2 (male) and the oldest was age-8 (both male and female). Alewife otolith sample readings were not completed in the report period and will be examined later.

Table 7. The age structure for Blueback Herring sampled from the Connecticut River in 2022, by sex with cohort representation expressed in percentage contribution to the total.

| | Male | | | Female | |
|---|---|---|---|---|---|
| **Age** | N | % | | N | % |
| **2** | 2 | 0.3 | | 0 | 0.0 |
| **3** | 154 | 25.1 | | 60 | 21.9 |
| **4** | 249 | 40.6 | | 117 | 42.7 |
| **5** | 44 | 7.2 | | 22 | 8.0 |
| **6** | 69 | 11.2 | | 27 | 9.9 |
| **7** | 88 | 14.3 | | 45 | 16.4 |
| **8** | 8 | 1.3 | | 3 | 1.1 |
| | 614 | | | 274 | |

In addition, staff cleaned and slide mounted scale samples from the 2022 laboratory processed fish: Blueback Herring (N = 903) and Alewife (N = 356). Eight scales from each fish sample were cleaned and mounted on glass slides and then examined by microfiche reader for the presence of previous spawning marks (defined by scale erosion mark presence) or as a first spawning virgin fish. Two readers, working independently, identified first time (virgin) or repeat spawn (defined frequency). Samples that were not in agreement were examined by the team for a consensus determination. In 2022, the percent virgin spawners for Blueback Herring (sexes combined) were 66% (Figure 5).

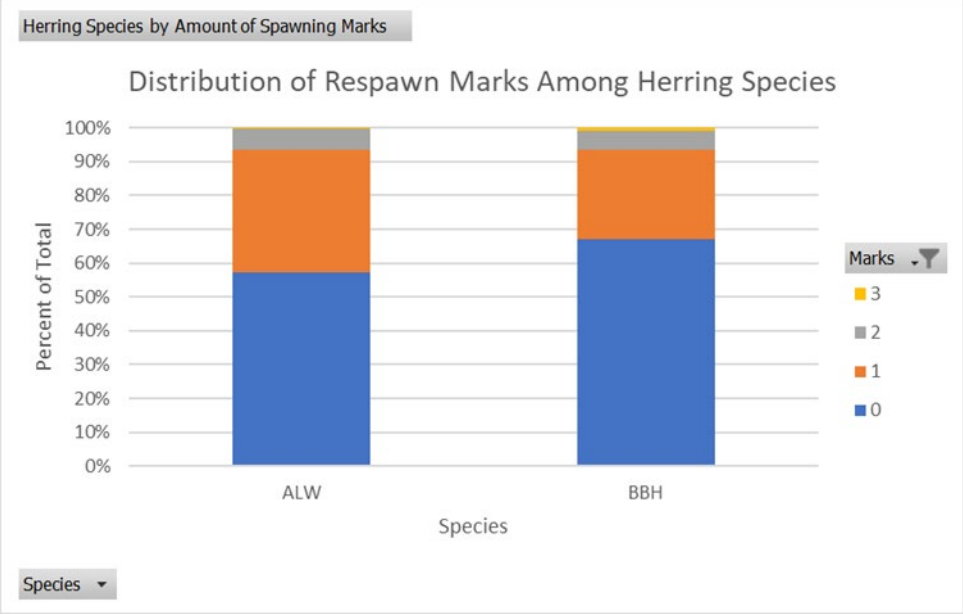



Figure 5. Spawning history (0 = virgin, 1 = single previous spawn, etc.) of Blueback Herring and Alewife for sexes combined, in 2022.

Female Blueback Herring ovaries from laboratory processed fish were extracted and weighed over the field season (N = 631) and were plotted over time, all sites combined (Figure 6). These dates were also examined in relation to the catch rates of females and broken out by sample area

for the more in-depth work occurring on reproductive ecology with partner researchers (in progress).

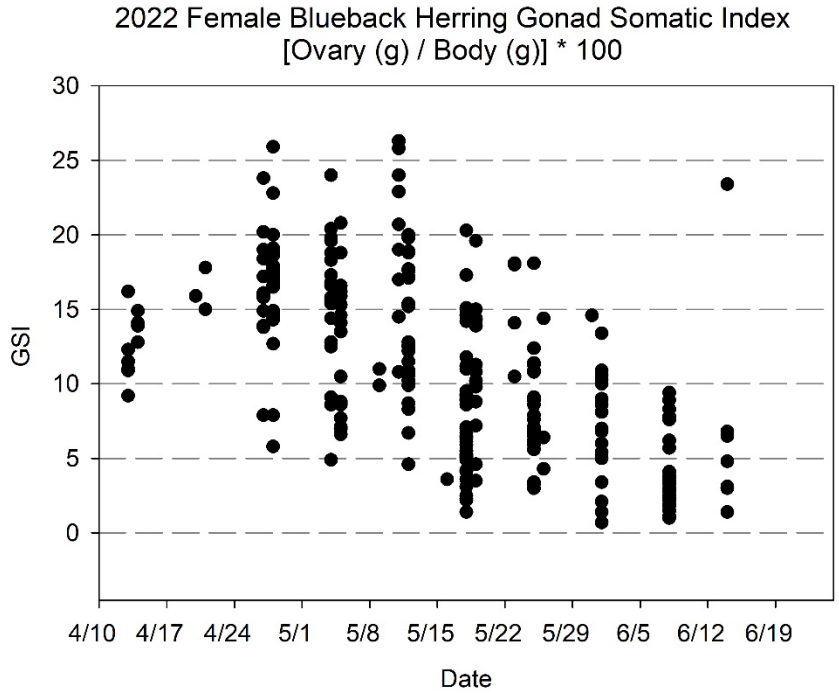



Figure 6. A plot of spring 2022 Blueback Herring female gonad somatic index (ovary wgt/total weight*100) as a percentage value over time, all site combined.

**Connecticut River Adult Blueback River Herring Migration and Movement Study**

In 2022 the Blueback Herring Migration and Movement Study done in partnership with the U.S.G.S. Conte Laboratory (Dr. Ted Castro-Santos co-Principal Investigator) continued with the second-year study phase to monitor for tagged Blueback Herring returns. The 155 surgically tagged (VEMCO V7 tags) bluebacks released in 2021 had their tags programmed for 45 days on, then sleep for 300 days, then back on for ~45 days. In March of 2022, a total of 26 acoustic receiver/moorings were redeployed at the same, or in proximity to, the receiver locations used in 2021. Crow Point Cove in Wethersfield, CT was one new location. The receivers were retrieved in July of 2022. Only one receiver in the Middle Haddam (CT) reach was unable to be recovered. Receiver downloads were completed with only two Blueback Herring that were tagged in 2021 detected in 2022 on study receivers. However, many receivers had varying amounts of other studies tagged fish detection that were all uploaded to the Mid-Atlantic Acoustic Telemetry Observation System (MATOS also known previously as ACT).

In this report period study fish detections on acoustic receivers from the 2021 season were organized and included additional tag detections from CTDEEP acoustic receivers (deployed as part of a separate sturgeon movement study). The CTDEEP receiver data added a substantial amount of tag detection information to the study, particularly in the lower main stem river. Movement plots were created for each tagged blueback in 2021, showing date of detection at a receiver on the x axis and receiver location in terms of river kilometer (rkm) on the y axis (Figures 7, 8, 9). The rkm designation for these draft plots does not differentiate main stem receivers' locations from those in coves and tributaries (currently). However, the provided plots

show examples of greatest upstream movement tied to several days in succession at the Farmington River and Wethersfield Cove (CT) in these examples.

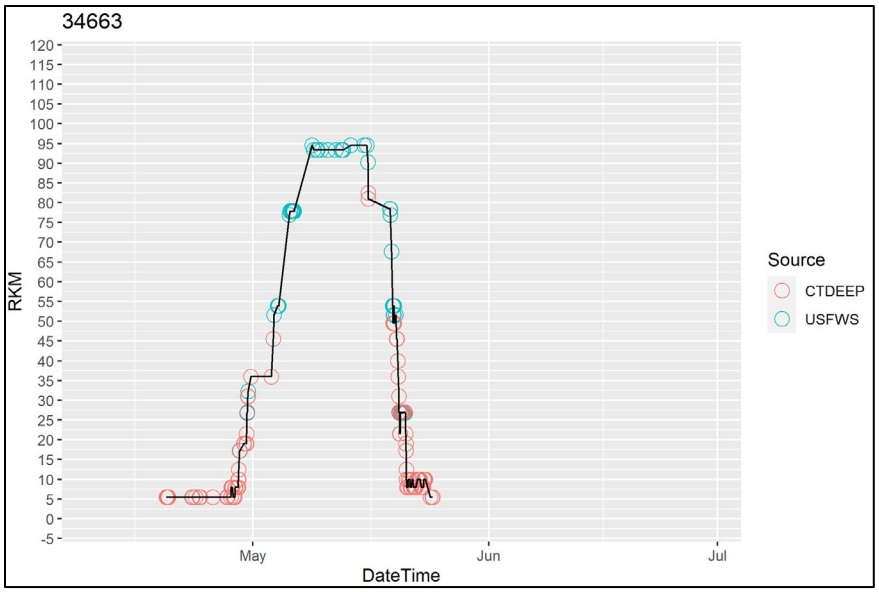



Figure 7. Example movement plot of a female Blueback Herring tagged and released on 4/19/21, that migrated into the Farmington River at its most upstream extent and successfully out-migrated to the most downstream receiver in late May (a period of ~ 5 weeks).

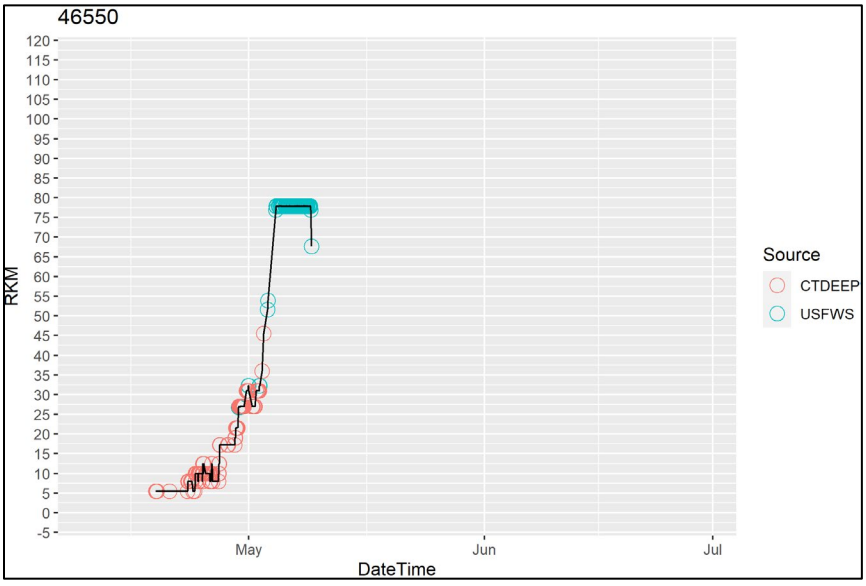



Figure 8. Example movement plot of a male Blueback Herring tagged and released on 4/18/21, that migrated into Wethersfield Cove at its most upstream extent and did not survive for downstream migration.

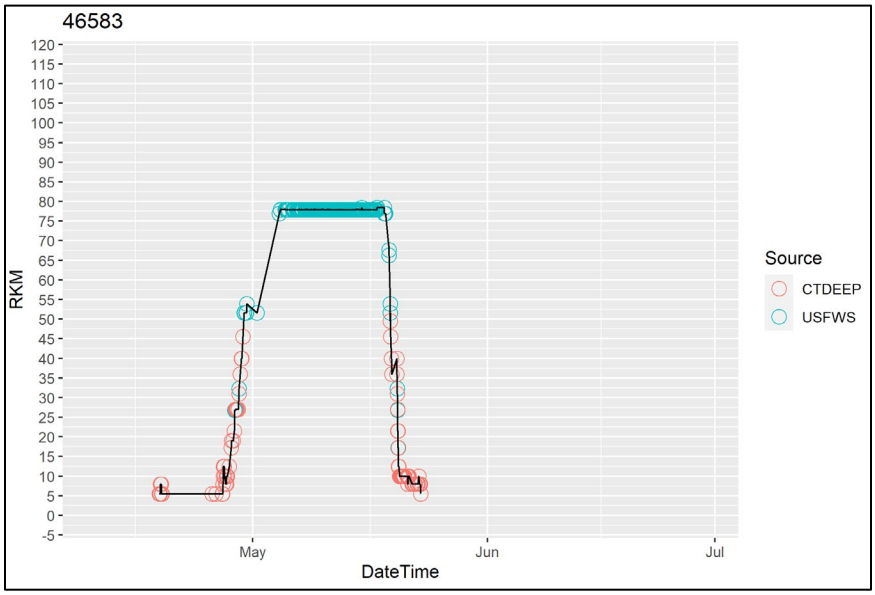



Figure 9. Example movement plot of a male Blueback Herring tagged and released on 4/18/21, that migrated into Wethersfield Cove at its most upstream extent and completed its downstream outmigration (period of one month). This plot shows a near two-week period of continuous occupation of Wethersfield Cove.

As our study is part of the MATOS, developed by/for researchers to share acoustic tag and receiver data among studies on the East Coast, we were able to obtain other researchers detection of our tagged fish from other study receivers in the marine environment. In June of 2022 data downloads from the MATOS allowed us to identify a total of 43 Blueback Herring tagged in 2021 that were also detected in marine receiver arrays from Block Island (RI) to the Gulf of Maine (Portland, ME), up to the time the tags were programmed to shut off (Figure 10). As all tags were programmed to shut off after 45 days from release, the latest a tag could be available for detection was mid July 2021 and that is reflected with the marine detections. These marine data are also planned for analyses and reporting in 2023. An example of these provisional data includes detections at a large marine array "Southern New England" that detected 22 of our tagged fish that took an average of 6.9 days (S.D. ± 4.4 d) to reach (minimum 3 days, maximum 22 days) from the last detection at the Connecticut River mouth.


Figure 10. Google Earth image showing the locations of marine acoustic arrays that detected tagged Blueback Herring up to mid July 2021.

This Office continued to maintain databases on migratory fish restoration activities. Daily fish counts at different dams were entered into databases. Fish counts were updated in-season at frequent intervals during the spring, with email notifications to individuals and postings to the Connecticut River Fish and Wildlife Conservation Office website.

# Program Results

The Connecticut River Fish and Wildlife Conservation Office collected and reported information relating to the activities and accomplishments occurring in the Connecticut River basin diadromous fisheries restoration program. Note some of the data presented here are preliminary, not all counts were final at the time of this report (Appendix C).

Holyoke Gas and Electric Fish Passage Team members.

***Migratory Fish Returns***

American Shad

A total of 191,651 adult American Shad were counted in 2022 at all first barrier passage facilities in the basin. A total of 190,352 American Shad were passed upstream of the Holyoke Dam, Massachusetts (river km 138), in 2022 through its two fish lifts, this is a 20% decrease from 2021 (Figure 11). The mean annual passage counts at Holyoke for the period 1976-2021 is 314,695 (±SD 128,126). The 25$^{th}$ and 75$^{th}$ percentile values for passage counts are 208,508 and 375,683 respectively. The Holyoke Fish Lift opened on 4/6/22 following delays due to ice conditions present on the 4/1 annual target open date, followed by high water turbidity. The lifts were also close from 4/9 – 4/12 due to a combination of high flows and turbidity. Normal lift operations restarted on 4/13 continuing until 4/19, when river conditions triggered lift shut down. On 4/22 fish lifting resumed and continued without interruption (per operations management plan) through 6/30, the conclusion of the spring anadromous passage operations period.

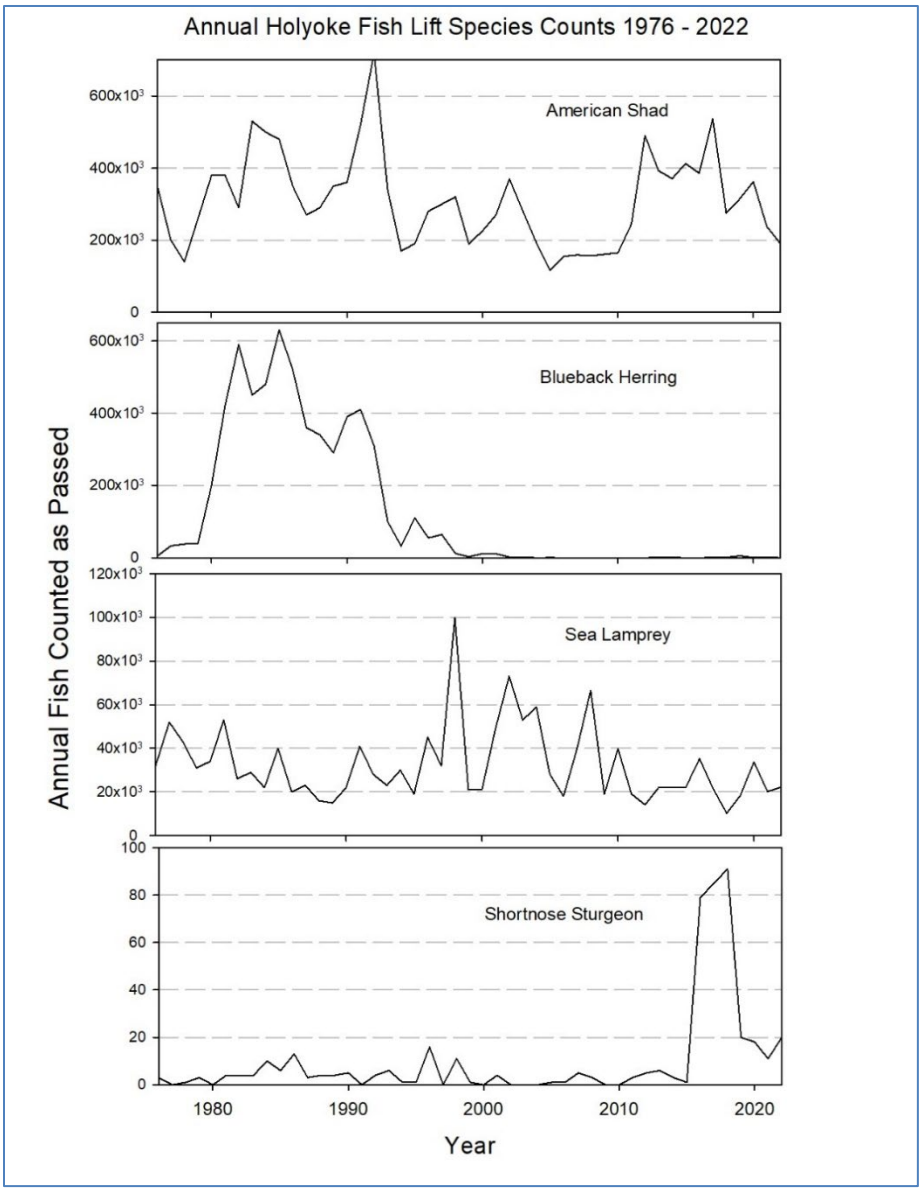



Figure 11. Select count summary of Holyoke Fish Lifts passage counts for American Shad, Blueback Herring, Sea Lamprey and Shortnose Sturgeon (1976-2022). Fish passage (counts) are affected by structural and operational changes at both dams and fishways and by environmental conditions (temperature and flow/spill) within year and among years.

The highest single passage dates for shad occurred on 5/14 and 5/21 with ~19,100 shad counted passing on those dates (Figure 12). Dates of over 10,000 American Shad passed included 5/11 – 5/15 (inclusive) and 5/21. Main stem river discharge for the lower basin was below average, to well below average, for much of the season from late April through the end of June, with one minor increase to discharge, briefly in mid-May. That event (~20,000 CFS) was well below the 40,000 CFS discharge level that triggers a HFL shut down. River discharge and water temperature data, as provided from the USGS Thompsonville CT Site, describes two key environmental variables affecting anadromous fish spring runs in 2022 (Figure 13 and 14).

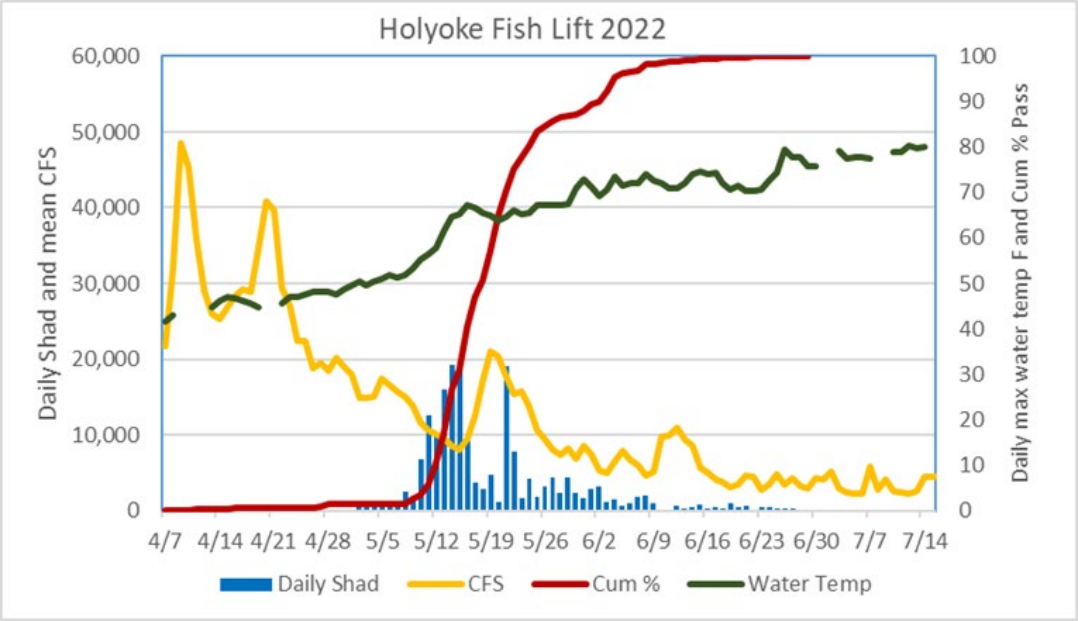



Figure 12. Daily American Shad passage counts from Holyoke Fish Lifts with water temperature and river discharge (USGS) data included for the period April 7 to July 15, 2022.

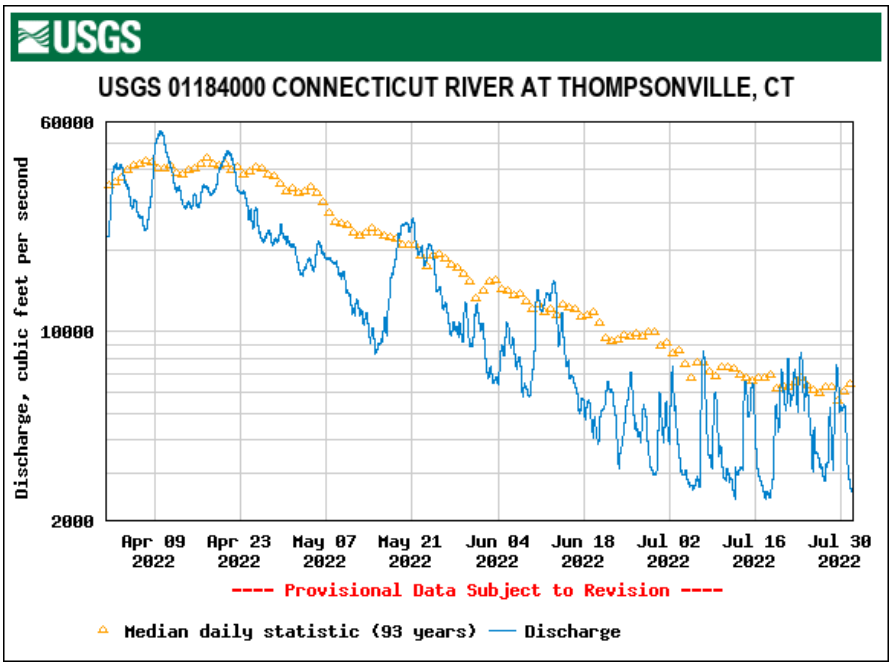



Figure 13. Mean daily river discharge measured at USFWS Thompsonville Gage, with long-term mean values also shown.

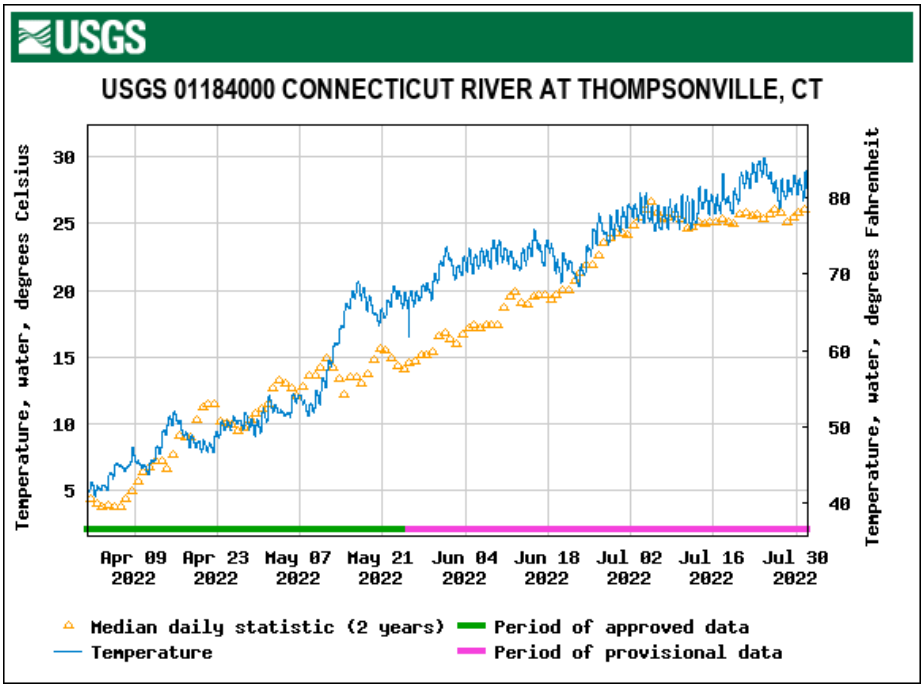



Figure 14. Mean daily water temperature as measured at the USGS Thompsonville Gage. Daily mean water temperatures are shown but caution should be used in their interpretation give it is only two years of data.

Holyoke Gas and Electric (HGE) in coordination with the state and federal agencies, agreed to trap-and-haul facility use in 2022. The use of trap-and-haul at the HGE Holyoke Project supported research activities and the USGS Conte Laboratory, restoration activities by the USFWS North Attleboro National Fish Hatchery, Rhode Island Department of Environmental Management (RIDEM), CTDEEP, and fish health evaluation by the USFWS CTR FWCO (Table 8).

Table 8. Summary of fish captured at the Holyoke Trap and Transfer Facility in 2022, by date, agency, species, number, and disposition/purpose. Support by the HGE Fishway Monitoring staff allowed this work to occur.

| Date | Agency | Species | Count | Live/Sacrificed | Details |
|---|---|---|---|---|---|
| 25-May | CTDEEP | Lamprey | 132 | Live | Used for restoration purposes in and out of basin (sum 232) |
| 26-May | CTDEEP | Lamprey | 100 | Live | |
| 12-May | CTDEEP | Shad | 90 | Live | Used for restoration purposes in and out of basin (sum 360) |
| 13-May | CTDEEP | Shad | 90 | Live | |
| 16-May | CTDEEP | Shad | 90 | Live | |
| 17-May | CTDEEP | Shad | 90 | Live | |
| 17-May | RI DEM | Shad | 80 | Live | Moved to Ashuelot R for out-of basin transfers by USFWS program to support RI |
| 19-May | RI DEM | Shad | 80 | Live | |
| 3-May | USFWS | Shad | 100 | Live | Used for hatchery brood to support restoration in coastal MA, RI and NH rivers (sum 364) |
| 4-May | USFWS | Shad | 64 | Live | |
| 10-May | USFWS | Shad | 100 | Live | |
| 11-May | USFWS | Shad | 100 | Live | |
| 10-May | USFWS | Shad | 60 | Sacrificed | annual fish health testing (CTRFWCO) |
| 6-May | USGS | Shad | 100 | Live | Used for experimental trial runs of fishway entrance designs and different treatments (sum of 1,120). Fish released after short holding/trial run period. |
| 10-May | USGS | Shad | 100 | Live | |
| 11-May | USGS | Shad | 100 | Live | |
| 16-May | USGS | Shad | 90 | Live | |
| 17-May | USGS | Shad | 80 | Live | |
| 18-May | USGS | Shad | 80 | Live | |
| 19-May | USGS | Shad | 80 | Live | |
| 23-May | USGS | Shad | 100 | Live | |
| 24-May | USGS | Shad | 100 | Live | |
| 25-May | USGS | Shad | 100 | Live | |
| 31-May | USGS | Shad | 80 | Live | |
| 1-Jun | USGS | Shad | 110 | Live | |
| 3-May | USGS | White Sucker | 15 | Live | Used for swimming perfromance studies |

The three fish ladders at the Turners Falls Project were opened on 4/29/29 (Cabot Station and Spillway Ladder and Gatehouse Ladder) following the requested CRASC Fish Passage Operations Plan for 2022. The first American Shad observed passing was on 5/5 at Cabot Ladder. Fishway counts were provided at regular intervals by FirstLight Power with a total of 23,576 shad passing the Gatehouse Ladder at Turners Falls Dam in 2022, a slight decrease from the 21,052 passed in 2021. The Turners Falls Dam and power canal is a three-fishway complex. Fish must first pass either the Cabot Station Ladder (into the power canal) or the Spillway Ladder, located at the base of the dam and upstream end of the "bypassed reach." Fish passing the Cabot Ladder exit into the lower power canal that requires finding one of two entrances to the Gatehouse Ladder at the upstream end of this 2.1-mile-long canal. Spillway Ladder (at the dam) passed fish may go directly to the entrance of the Gatehouse Ladder, but as in the case of all ladders, have opportunities to drop back, including into the canal. A total of 32,753 shad were counted passing into the power canal from the Cabot Station Ladder. A total of 6,250 shad were counted passing the Spillway Ladder. Spillway Ladder counted shad are believed to have limited fall back/loss (~ <10%) vs. those in the power canal. Fish in the canal must locate and use the Gatehouse Ladder entrances that are affected by several dynamic factors (e.g., turbulence, entrance gates attraction flow/locations). The Turners Falls Fish Ladders were closed on 6/30/22.

Overall, the 2022 passage number at Gatehouse Ladder (requiring passage at noted two other ladders) as a percentage of American Shad passed at the Holyoke Dam Fish Lifts was 12.4% compared to 8.9% observed in 2021 (Table 9). The 2017 CRASC Shad Management Plan has a minimum passage objective of 397,000 American Shad for the Turners Falls Project, or ~58% of

the minimum target passage objective at Holyoke, based on upstream habitat. The CRASC Shad Plan describes there is 1.4 times the amount of shad habitat upstream of the Turners Falls Dam versus the amount of habitat between Holyoke and Turners Falls dams. In addition, density dependent growth impacts have been documented for juvenile shad sampled in the Holyoke to Turners Falls reach, versus the upstream habitat reaches (Mattocks et. al 2019). These facts and additional management goals and objectives of the CRASC Plan provide a clear rationale for the basis to achieve the defined passage performance criteria of the Plan and its Addendum on Fish Passage (CRASC 2017; as amended 2022).

Table 9. Annual American Shad fishway passage counts for Holyoke, Turners Falls and Vernon Projects on the main stem river and Rainbow Dam/Project (Farmington River) and the West Springfield Project (Westfield River) for the period 1980 – 2022.

| Year | Holyoke Dam Passed | Turners Falls Dam Passed | TF % of Holyoke Total | Vernon Dam Passed | Vernon % of TF Total | Farmington River, Rainbow Dam Passed | Westfield River, W. Springfield Dam Passed |
|---|---|---|---|---|---|---|---|
| **1980** | 376,066 | **298** | 0.1 | | | 480 | |
| **1981** | 377,124 | 200 | 0.1 | **97** | 48.5 | 167 | |
| **1982** | 294,842 | 11 | 0.0 | 9 | 81.8 | 737 | |
| **1983** | 528,185 | 12,705 | 2.4 | 2,597 | 20.4 | 1,565 | |
| **1984** | 496,884 | 4,333 | 0.9 | 335 | 7.7 | 2,289 | |
| **1985** | 487,158 | 3,855 | 0.8 | 833 | 21.6 | 1,042 | |
| **1986** | 352,122 | 17,858 | 5.1 | 982 | 5.5 | 1,206 | |
| **1987** | 276,835 | 18,959 | 6.8 | 3,459 | 18.2 | 792 | |
| **1988** | 294,158 | 15,787 | 5.4 | 1,370 | 8.7 | 378 | |
| **1989** | 354,180 | 9,511 | 2.7 | 2,953 | 31.0 | 215 | |
| **1990** | 363,725 | 27,908 | 7.7 | 10,894 | 39.0 | 432 | |
| **1991** | 523,153 | 54,656 | 10.4 | 37,197 | 68.1 | 591 | |
| **1992** | 721,764 | 60,089 | 8.3 | 31,155 | 51.8 | 793 | |
| **1993** | 340,431 | 10,221 | 3.0 | 3,652 | 35.7 | 460 | |
| **1994** | 181,038 | 3,729 | 2.1 | 2,681 | 71.9 | 250 | |
| **1995** | 190,295 | 18,369 | 9.7 | 15,771 | 85.9 | 246 | |
| **1996** | 276,289 | 16,192 | 5.9 | 18,844 | 116.4 | 668 | **1,413** |
| **1997** | 299,448 | 9,216 | 3.1 | 7,384 | 80.1 | 421 | 1,012 |
| **1998** | 315,810 | 10,527 | 3.3 | 7,289 | 69.2 | 262 | 2,292 |
| **1999** | 193,780 | 6,751 | 3.5 | 5,097 | 75.5 | 70 | 2,668 |
| **2000** | 225,042 | 2,590 | 1.2 | 1,548 | 59.8 | 283 | 3,558 |
| **2001** | 273,206 | 1,540 | 0.6 | 1,744 | 113.2 | 153 | 4,720 |
| **2002** | 374,534 | 2,870 | 0.8 | 356 | 12.4 | 110 | 2,762 |
| **2003** | 286,814 | | | 268 | | 76 | 1,957 |
| **2004** | 191,555 | 2,192 | 1.1 | 653 | 29.8 | 123 | 913 |
| **2005** | 116,511 | 1,581 | 1.4 | 167 | 10.6 | 8 | 1,237 |
| **2006** | 154,745 | 1,810 | 1.2 | 133 | 7.3 | 73 | 1,534 |
| **2007** | 158,807 | 2,248 | 1.4 | 65 | 2.9 | 156 | 4,497 |
| **2008** | 153,109 | 4,000 | 2.6 | 271 | 6.8 | 89 | 3,212 |
| **2009** | 160,649 | 3,813 | 2.4 | 16 | 0.4 | 35 | 1,395 |
| **2010** | 164,439 | 16,422 | **10.0** | 290 | 1.8 | 548 | 3,449 |
| **2011** | 244,177 | 16,798 | **6.9** | 46 | 0.3 | 267 | 5,029 |
| **2012*** | 490,431 | 26,727 | **5.4** | 10,386 | **38.9** | 174 | 10,300 |
| **2013** | 392,967 | 35,293 | **9.0** | 18,220 | **51.6** | 84 | 4,900 |
| **2014** | 370,506 | 39,914 | **10.8** | 27,706 | **69.4** | 536 | 4,787 |
| **2015** | 412,656 | 58,079 | **14.1** | 39,771 | **68.5** | 316 | 3,383 |
| **2016** | 385,930 | 54,069 | **14.0** | 35,513 | **65.7** | 141 | 5,940 |
| **2017** | 537,249 | 48,727 | **9.1** | 28,682 | **58.9** | 615 | 6,000 |
| **2018** | 275,232 | 43,146 | **15.7** | 31,724 | **73.5** | 341 | 5,752 |
| **2019** | 314,353 | 22,575 | **7.2** | 12,862 | **57.0** | 276 | 4,064 |
| **2020** | 362,423 | 41,252 | **11.4** | 13,897 | **33.7** | 510 | 5,549 |
| **2021** | 237,306 | 21,052 | **8.9** | 9,701 | **46.1** | 47 | |
| **2022** | 190,352 | 23,576 | **12.4** | 13,763 | **58.4** | 11 | 1,288 |
| **Mean** | 318,983 | 18,368 | | 9,533 | | 419 | 3,693 |
| SD | 129,829 | 18,005 | | 12,070 | | 445 | 2,154 |
| Low | 116,511 | 11 | | 9 | | 8 | 913 |
| High | 721,764 | 60,089 | | 39,771 | | 2,289 | 10,300 |

Vernon Dam (Vernon, Vermont) fish ladder was opened on 4/29/22 and closed on 7/15/22, following CRASC's fishway schedule plan. A total of 13,763 American Shad were counted passing upstream of Vernon. Vernon Dam Ladder passed 58.4% of the American Shad counted passing from the Turners Falls Gatehouse Ladder in 2022. Great River Hydro had completed necessary improvements to the ladder entrance gate (2021), to track tailwater levels, so that the attraction flow and associated hydraulics are within USFWS Fish Passage Engineers criteria. This work addressed an issue identified as effecting the 2020 passage season when extreme low river discharges occurred. In 2022, extreme low flows occurred in early May and then from late May through the conclusion of the upstream passage season on 7/15/22 (Figure 15).

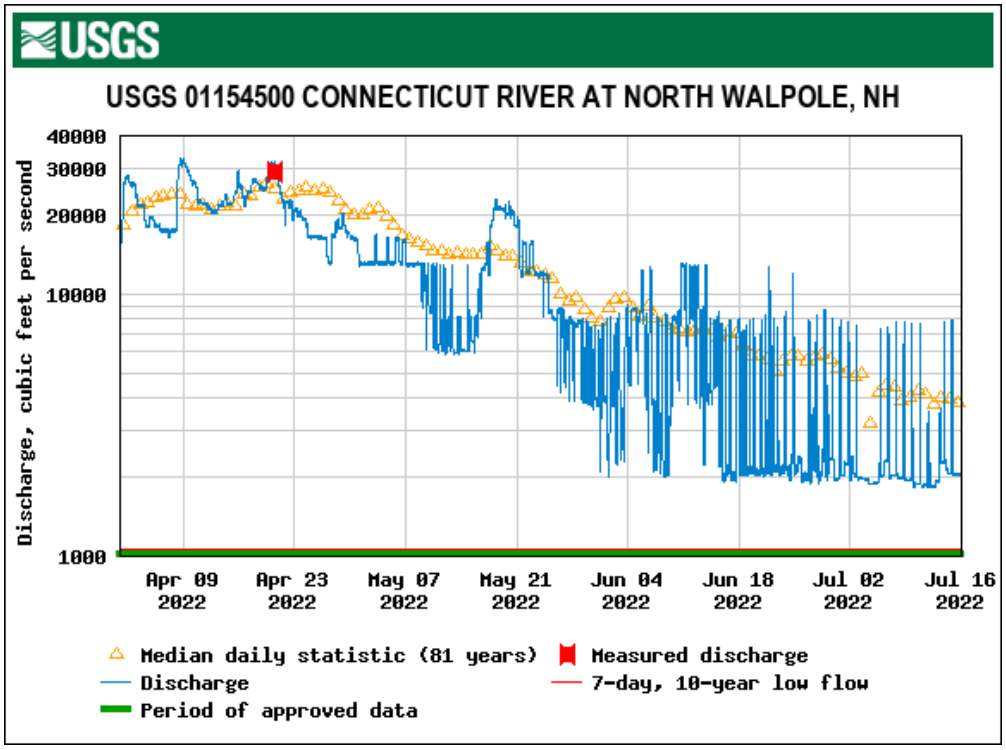



Figure 15. Daily average river discharge from first gage upstream of Vernon Dam, located 1 km downstream of Bellows Falls Dam for 4/1/22 through 7/15/22.

Bellows Falls Fish Ladder was opened on 5/19/22 and passed 1,561 Sea Lamprey (reason for ladder opening as the target species) and 896 American Shad upstream. This project's ladder was, by agreement, previously triggered on Atlantic Salmon upstream passage needs, so its period of operation was often limited/restricted in the past. The dam is located at the historic upstream extent of American Shad in the river. Beginning in 2013, TransCanada now Great River Hydro, agreed to open this ladder based on a trigger of 100 Sea Lamprey passed at Vernon Dam following a request from CRASC, to provide Sea Lamprey access to upstream habitats.

The West Springfield Fish Ladder on the Westfield River was operated in the spring of 2022 with a total of 1,288 American Shad passed, the third lowest count since the ladder's opening in 1996. A total of only 11 (remarkably low count) American Shad were passed upstream of the Rainbow Dam Fishway on the Farmington River in Connecticut, a fishway with known upstream passage issues for this and other species.

Downstream passage and protection measures were operated at the previously listed facilities per CRASC Fish Passage Operations Schedule (Appendix D). Upstream Fish Passage Operations Schedules were also provided (Appendix D).

Shortnose Sturgeon – A total of 20 Shortnose Sturgeon (SNS) were trapped and passed upstream at Holyoke Fish Lift from lift in 2022, with the first fish captured on 5/16/22 and last on 9/16/22. Shortnose Sturgeon passage events occurred in May (N = 3), June (N = 14), July (N = 1), August (N = 1) and September (N = 1). The seasonal timing of SNS passage was earlier for the year, as past years most frequent passage data is commonly in summer months. All fish utilized the Spillway Lift with three fish being captured and passed at the lift in prior years (all 2018 season). Another fish had been tagged by USGS Conte Lab. All four of those fish were previously PIT tagged with the remaining balance (N=16) having not been tagged before (all received a PIT tag). The CTDEEP once again documented successful Shortnose Sturgeon spawning downstream of the Holyoke Dam in 2022. The CTDEEP quickly pulled all sample gear soon after collected 36 eggs and several larvae

This is the seventh year of operations of the modified spillway lift entrance design to pass sturgeon, with annual counts tracking closely among the first 3 years and decreasing notably in 2019 and 2020 (Figure 11). The fish lift passage operations for SNS was operated without any deviations and without any notable events from the passage plan from 7/4/22 through 7/21/22 when a planned outage for a new log boom occurred. Normal lift operation began again on 8/1/22 and continued through 9/16/22 when the annual power canal outage occurred for regular inspection and maintenance. This outage prevents upstream passage operations as the canal provides water for fish lift entrance operations. Normal fish lift operation began again on 9/28/22. On 10/4/22 an issue with water leakage around the downstream bypass pipe (from power canal) the power canal was again dewatered for investigation and fixes to the noted leakage. Lift operations did not occur for the remainder of the season.

Blueback Herring - A total of 283 Blueback Herring were counted at the Holyoke Fish Lift in 2022 a substantial decrease from the 1,242 counted in 2021 (Figure 11).

The CRASC River Herring Management Plan (2004) identifies an annual passage goal of 300,000-500,000 Blueback Herring at the Holyoke Fish Lift. That goal had been attained and exceeded up to the early 1990s, as population declines were being observed along much of the East Coast.

Sea Lamprey - A total of 23,028 Sea Lamprey were observed from first barrier fishway returning to the Connecticut River basin in 2022. This is a slight increase from the 2021 count for first barriers (20,620), driven primarily by the Holyoke Fish Lift, but observed among all counts. The annual mean number of Sea Lamprey passed at Holyoke is 32,385 fish (1976-2021).

A total of 9,077 Sea Lamprey subsequently passed upstream of Turners Falls Dam (through Gatehouse Ladder), or 41% of the number passed at Holyoke (the proportion in 2021 was 56%). A total of 5,105 Sea Lamprey passed upstream of Vernon Dam (or 56% of the Gatehouse Ladder total) with 1,561 lampreys passed upstream of Bellows Falls Dam. In the lower river basin, 104 Sea Lamprey passed at Rainbow Dam versus 470 in 2021. The CTDEEP conducted its regular Sea Lamprey nest census in the Salmon River basin in 2022, extrapolating an estimated 90 Sea Lamprey (a time series low value).

Striped Bass - A total of 314 Striped Bass were counted passing at the Holyoke Fish Lift in 2022 versus the 352 passed in 2021.

American Eel – The American Eel passage count at Holyoke Dam, which used three specially designed ramp/traps in different project locations (tailrace fish lift entrance, upper stilling basin, and S. Hadley shore of bypass reach), totaled 7,841 in 2022. This is a decrease from the 12,945 eels counted in 2021 (Figure 16). The tailrace fish lift entrance eel ramp and upper stilling basin eel ramp were installed and operational on April 17, 2022. The South Hadley eel ramp was operational on May 5 when safe access was permitted. All three facilities were operated through November 15, 2022, with some exceptions, including the power canal outage (9/16-9/28) that the two Holyoke side ramps were not operational. The South Hadley eel ramp was out of operation for the last two weeks of August to construct a wall to better protect the ramp entrance. Eel ramp/traps are not checked on weekends after July 15. The Holyoke Gas and Electric Report on American Eel passage will be available in the winter of 2023 and will compare catch rates among the trap locations and provide details on other statistics. American eels captured in these ramp/traps are relatively small, primarily ranging between 10-20 cm in total length.

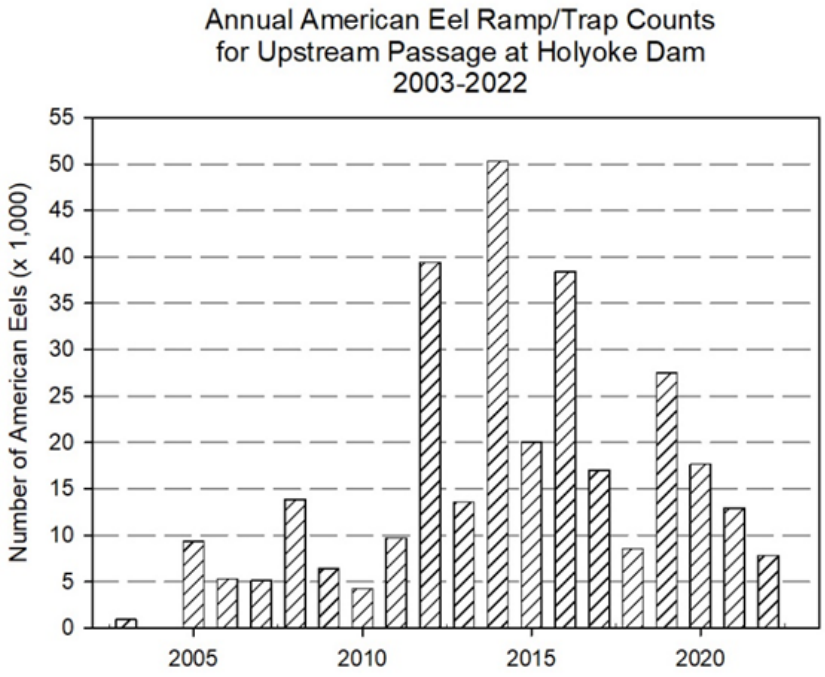



Figure 16. Annual American Eel ramp/trap counts reported by Holyoke Gas and Electric, at Holyoke Dam, for the period 2003-2022.

Atlantic Salmon – In 2022 there were three reported returns of sea-run adult Atlantic Salmon at the Rainbow Dam fishway on the Farmington River. Those fish were passed upstream. There was a single adult salmon observed below the Leesville Dam on the Salmon River that was believed to be the fish subsequently caught and released by an angler in the fall of 2022 (photo provided). Historically adult returns are dominated by four-year-old fish (age-2 smolt and two sea winter assignments).

Gizzard Shad - A total of 35 Gizzard Shad were counted at the Holyoke Fish Lift in 2021, an increase from the 66 observed in 2020.

**Literature Cited**

CRASC. 2017. Connecticut River American Shad Management Plan. Amended 2022, Fish Passage Performance Addendum. USFWS, 103 East Plumtree Road, Sunderland, MA.

Mattocks, S., B. Keleher, and K. Sprankle. 2019. Juvenile American Shad assessment in the Connecticut River from Holyoke Dam to Bellows falls Dam, 2017-2018. USFWS, 103 East Plumtree Road, Sunderland, MA. https://www.fws.gov/r5crc/

Appendix A. Connecticut River Atlantic Salmon Commission meeting agendas for report period.

CONNECTICUT
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Sunderland, Massachusetts 01375
Fax: 413/548-9622



**DATE:** November 23, 2021

**TO:** CRASC Commissioners, public contact list

**FROM:** Kenneth Sprankle, Connecticut River Coordinator

**SUBJECT:** Connecticut River Atlantic Salmon Commission Meeting

The Connecticut River Atlantic Salmon Commission meeting is scheduled for **December 1, 2021 at 1:00 p.m.**. and will be conducted using the Microsoft "Teams" Application*. If interested in participating, you must contact me via email (ken_sprankle@fws.gov) in order to be added to the "invite list" for that application/system. I have also secured a Teams Conference call in line. I do not need responses for the invite list from any CRASC members or people identified in below agenda.

**Agenda**

1. (1:00-1:10) – **Decision**: Determination of a quorum, approval of today's agenda, and review of minutes from February 9, 2021 meeting – *Chair Andrew Fisk*

2. (1:10-1:35) – **Discussion**: CRASC reauthorization subcommittee – (*Subcommittee members*)

   A. Report of the Subcommittee
      1. Overview of subcommittee's work to date
      2. Review of four potential options
      3. Approach for progress/Next steps

3. (1:35-1:40) – **Informational**: Status of CRASC appropriations in FY22 (*Chair Fisk*)

4. (1:40-1:45) – **Informational:** Atlantic States Marine Fisheries Commission Shad and River Herring TC updates – *Ken Sprankle*

5. (1:45-1:55) – **Decision:** Connecticut River American Shad Habitat Plan Update – submission to ASMFC

6. (1:55-2:25) – **Informational**: Report of the CRASC Technical Committee from November 17th Meeting – *Chair Lael Will*

7. (2:25-2:45) – **Presentation**: Connecticut River Blueback Herring Migration and Movement Study USFWS/USGS Conte (2021 & 2022) – *Ken Sprankle*

8. (2:45- ) Other Business
   A. Public comment
   B. CRASC Technical Committee Research and Management Forum set for February 22, 2022. A virtual meeting is planned.
   C. Establishment of 2022 CRASC Meeting dates- June 28, 2022 and December 6, 2022.

Appendix A. Continued.

CONNECTICUT
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**DATE:** June 28, 2022

**TO:** CRASC Commissioners

**FROM:** Kenneth Sprankle, Connecticut River Coordinator

**SUBJECT:** Connecticut River Atlantic Salmon Commission Meeting Agenda

The Connecticut River Atlantic Salmon Commission meeting is scheduled for **June 28, 2022 at 10:00 a.m.**, and will be conducted using the Microsoft "Teams" Application*. If interested in participating, you must contact me via email (ken_sprankle@fws.gov) in order to be added to the "invite list" for that application/system. I have also secured a Teams Conference call in line. I do not need responses for the invite list from any CRASC members or people identified in below agenda.

**Agenda**

1. (10:00-10:10) – **Decision**: Determination of a quorum, approval of today's agenda, and review of minutes from December 1, 2021 meeting – *Vice Chair Eric Palmer*

2. (10:10-10:45) – **Decision and Informational**: CRASC Status of $500,000 Federal Funds in FY22 Budget – *Vice Chair Palmer*
   A. Review of Commissioner's Business Meeting on that topic (May 25th), confirm approved expenditure plan, discuss next steps.
   B. Status of CRASC appropriation plan in FY23 and other related new federal funding plans that relate to CRASC.

3. (10:45-11:05) – **Discussion:** How do pending efforts at large landscape conservation (e.g., American the Beautiful) or other federal initiatives pair up with proposed MOA for "Migratory Fish Restoration Cooperative ." – *Vice Chair Palmer*

4. (11:05-11:20) – **Informational:** Coordinator's Report– *Ken Sprankle*
   A. Fishway count summaries and related information
   B. Fish transfers from Holyoke
   C. Regional fishway count summary review

5. (11:20-11:45) – **Informational**: Report of the CRASC Technical Committee from June 15th Meeting – *TC Chair Lael Will*

6. (11:45-11:55) – **Decision:** Correction to CRASC Connecticut River American Shad Management Plan and Fish Passage Performance Addendum (2020) – *Ken Sprankle*
   A. The CRASC downstream passage performance metric was intended and had been interpreted by Plan authors/TC member, to be an overall (total) through project survival rate of 95%. The text must be corrected and resubmitted to FERC.

Appendix A. Connecticut River Atlantic Salmon Commission – Technical Committee meeting agendas for report period.

CONNECTICUT
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**CRASC Commissioners:**
*CTDEEP:*
Rick Jacobson
Tim Wildman (Alt.)
*CT Public Sector*
Thomas Chrosniak
*MADFW:*
Mark Tisa
Todd Richards (Alt.)
*MA Public Sector:*
**Chair**, Andrew Fisk
*NHFG:*
Scott Mason
Scott Decker (Alt.)
*NH Public Sector:*
Donald McGinley
*NMFS:*
Michael Pentony
Christopher Boelke (Alt.)
*VTFW:*
Commissioner in transition
**Vice Chair**, Eric Palmer (Alt.)
*VT Public Sector:*
Peter H. Basta
*USFWS:*
**Secretary**, Wendi Weber
Lowell Whitney (Alt.)
*Executive Assistant:*
Kenneth Sprankle

**Technical Committee:**

*CTDEEP:*
Tim Wildman
*MADFW:*
Rebecca Quinones
*VTFW:*
**Chair**, Lael Will
*MADMF:*
Ben Gahagan
*NHFG:*
Matthew Carpenter
*NMFS:*
Bill McDavitt
*USFS:*
Daniel McKinley
*USFWS and Secretary:*
Kenneth Sprankle

**DATE:** November 9, 2021

**TO:** CRASC Commissioners, Technical Committee members and advisors, and other interested parties

**FROM:** Kenneth Sprankle, Connecticut River Coordinator

**SUBJECT:** Technical Committee Draft Meeting Agenda

A Connecticut River Atlantic Salmon Commission **Technical Committee** meeting is scheduled for **November 17, 2021, from 9:30 -12:00 p.m.** that will be conducted using the Microsoft "Teams" Application*. If interested in participating, you must contact me via email (ken_sprankle@fws.gov) in order to be added to the "invite list" for that application/system. I do not need responses for invite list from any CRASC members or people identified in below agenda.

**Agenda**

1. 9:30-9:40 Call to order and approval of Meeting Minutes from June 24, 2021 (*Lael Will*)
2. 9:40-9:45 Coordinator's Report (*Ken Sprankle*)
   A. Fishway count summaries/related data
3. 9:50-10:15 Fish Passage Subcommittee (*Bill McDavitt*)
   A. Five main stem FERC Project relicensing status updates
   B. Fiske Mill Dam (Ashuelot River) update
   C. Holyoke Fish Passage facilities update
   D. Vernon Fish Ladder investigation, update on findings/plan
4. 10:15-10:35 Shad Studies Subcommittee (*Ken*)
   A. CRASC American Shad Habitat Plan Update (for ASMFC)
   B. CTDEEP 2021 commercial fishery and Juvenile Index surveys (*Jacque Bonway*)
   C. MADFW/USFWS Juvenile Alosine Index surveys
   D. Conte Lab Shad Flume Studies updates and plans (*Jessica Pica*)
5. 10:35-11:05 River Herring Subcommitee (*Ken*)
   A. USFWS 2021 Adult River Herring Population Assessment Program
   B. USFWS/Conte Lab Blueback Herring migration/movement study
   C. Ecological Barriers to Fish Passage -study highlights (*Ted Castro-Santos*)
   D. USGS (Conte/UMass) research activity updates (*Stephen McCormick*)
6. 11:05-11:20 Sturgeon Subcommittee (*Micah Kieffer*)
   A. Conte Lab activities (surveys, tracking)
   B. CTDEEP research update (*Jacque Bonway/Tom Savoy*)
7. 11:20-11:30 Sea Lamprey Subcommittee (*Jeremy Mears*)
   A. Nest surveys, agencies/CRC
   B. eDNA surveys with USFS
8. 11:30-11:40 American Eel Subcommittee (*Tim Wildman*)
9. 11:40-11:45 Habitat Subcommittee (Group)
   A. Upper and Lower Collinsville Dam, Farmington River (*Bill and Tim Wildman*)
10. 11:45-12:00 Other business
    A. Winter Technical Committee Research and Management Forum (*Ken*)
    B. Proposed spring 2021 MA CTR Creel Survey for anadromous fisheries with CRC and partners (*Andy Fisk*)

Appendix A. Connecticut River Atlantic Salmon Commission – Technical Committee meeting agendas for report period, continued.

CONNECTICUT
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**DATE:** June 15, 2022

**TO:** CRASC Commissioners, Technical Committee members and advisors, and other interested parties

**FROM:** Kenneth Sprankle, Connecticut River Coordinator

**SUBJECT:** Technical Committee Draft Meeting Agenda

A Connecticut River Atlantic Salmon Commission **Technical Committee** meeting is scheduled for **June 15, 2022, from 8:30 -11:30 p.m.** that will be conducted using the Microsoft "Teams" Application*. If interested in participating, you must contact me via email (ken_sprankle@fws.gov) to be added to the "invite list" for that application/system. I do not need responses for invite list from any CRASC members or people identified in below agenda. I will send the web link once provided to me, in que at this time, as must request with paired conference call line.

**Draft Agenda**

1. 8:30-8:40 Call to order and approval of Meeting Minutes from November 17, 2021 (*Lael Will*)
2. 8:40-9:00 CRASC Commission Budget Plan for $500,000 (*Lael Will*)
3. 9:00-9:20 Coordinator's Report (*Ken Sprankle*)
   A. CT River basin fishway count summaries/related data
   B. Fish transfers and other restoration activities
   C. Regional fishway count reports
4. 9:20-9:40 Fish Passage Subcommittee (*Bill McDavitt*)
   A. Five main stem FERC Project relicensing status updates
   B. Fiske Mill Dam (Ashuelot River) update
   C. Rainbow Dam (State and Federal conversations)
   D. Burnside Hydro/Hockanum River (early stages of lice
5. 9:40-10:00 Shad Studies Subcommittee (*Ken*)
   A. ASMFC updates
   B. Conte Lab Shad Flume Studies updates and plans (*Kevin Mulligan*)
   C. Spring creel survey, CT River Conservancy (Holyoke and Chicopee areas)
6. 10:00-10:20 River Herring Subcommittee (*Ken*)
   A. USFWS 2022 Spring River Herring Population Assessment Program
   B. USFWS/Conte Lab Blueback Herring migration/movement study
   C. ASMFC Benchmark River Herring Stock Assessment plans
7. 10:20-10:40 Sturgeon Subcommittee (*Micah Kieffer*)
   A. Conte Lab activities
   B. CTDEEP research
8. 10:40-11:00 Sea Lamprey Subcommittee (*Jeremy Mears*)
   A. Activities update
9. 11:00-11:10 American Eel Subcommittee (*Tim Wildman*)
10. 11:10-11:20 Habitat Subcommittee (Group)
11. 11:20-11:30 Other business

Appendix B. Conference agenda for the CRASC Technical Committee held on February 22, 2022.

Connecticut River Atlantic Salmon Commission
Technical Committee

**Connecticut River Research and Management Forum**

*February 22, 2022*

**Virtual Meeting using TEAMS**

## Agenda

10:00-10:10 Opening remarks Lael Will (CRASC, Technical Committee Chair)

10:10-10:30 **Counting eggs before they hatch: reproductive seasonality of Blueback Herring**. Eric Schultz[1], Konstantine Ganias, Foivos Mouchlianitis, Ken Sprankle

10:30-10:50 **Juvenile river herring density and growth in Connecticut River coves**. Matt Devine[2]

10:50-11:10 **Temporal shifts in juvenile river herring diets and zooplankton assemblages in Connecticut River coves**. Meghan-Grace Slocombe[3] et al.

11:10-11:30 **Temperature and food availability influence juvenile blueback herring growth rates and energy reserves.** Lian Guo[4] , Stephen McCormick, Eric Schultz, Adrian Jordaan

11:30-11:50 **Examining patterns of dispersal for the Yellow Lampmussel (*Lampsilis cariosa*) in the Connecticut River mainstem.** Stefanie Farrington[5], David Perkins, Allison Roy, Timothy Warren

11:50 –12:40 BREAK

12:40-1:00 **Ready and swimming: ontogenetic changes preceding emigration in juvenile Alewife (Alosa pseudoharengus).** Rebecca Colby[6], Stephen McCormick, Jacqueline Stephens, Brandon Smith, Erika Shook, Peter Goggins, Annchi Li, Kayla Morin, Eric Schultz

1:00-1:20 **Climate change may cause shifts in growth and instantaneous natural mortality of American shad throughout their native range**. Erin Lunda[7], Dan Stich, Kathy Mills, Mike Bailey, Joe Zydlewski

1:20-1:40 **Here and there and everywhere: range wide life history models for American Shad.** Daniel Stich[8], Joe Zydlewski, Sam Roy, Mike Bailey, Timothy Sheehan, Ken Sprankle

1:40-2:00 **A Summary of Recent Downstream Passage Results for American eel in the North Atlantic-Appalachian Region; Where do we go from here?** Bryan Sojkowski[9]

2:00-2:10 BREAK

2:10-2:30 **American Shad behavioral responses to a novel (Palisades) fishway attraction water system.** Brett Towler and Kevin Mulligan[10]

2:30-2:50 **Ecological barriers to fish passage—how predators and structures interact to impede herring migrations.** Derrick Alcott, Elsa Goerig, Michael Long, and **T. Castro-Santos**[11]

2:50-3:10 **Developing Alewife and Sea Lamprey restoration strategies in Connecticut.** Kevin Job[12]

3:10-3:15 Closing remarks, Lael Will

*Presenter Affiliations and email contact*


1. Ecology and Evolutionary Biology, University of Connecticut, eric.schultz@uconn.edu
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8. State University of New York Oneota, daniel.stich@oneonta.edu
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12. Connecticut Department of Energy and Environmental Protection, kevin.job@ct.gov

Appendix C. An example of the Fishway Count Report produced by CTRFWCO for distribution and posted on the office web site. Often a second page includes field pictures or other data.

## Connecticut River Basin Fishway Passage Counts

This report is compiled by the U.S. Fish and Wildlife Service, CT River Fish and Wildlife Conservation Office using fishway count data provided by several agencies as well as power companies and is dependent in most cases on the review of video counts, that have an associated time lag for updates. Please visit http://www.fws.gov/r5crc for more information.

| Fishway, River - *State* | *Data as of:* | American Shad | Alewife | Blueback Herring | Atlantic Salmon | American Eel | Sea Lamprey | Striped Bass | Gizzard Shad | Shortnose Sturgeon | Other/ comment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rogers Lake-*CT* | final | | 246 | | | | | | | | 2,506 in 2021 |
| Mary Steube, Mill-*CT* | final | | 3,944 | | | | | | | | 20K in 2021 |
| Mill Pond, Falls -*CT* (NEW Fishway) | final | | 280 | | | | | | | | |
| Moulson Pond, Eightmile-*CT* | final | 1 | 4 | 87 | | | 9 | | | | |
| Leesville, Salmon-*CT* | final | | | | 1 | | 90 | | | | SL based on nest census |
| StanChem, Mattabesset-*CT* | final | | 2,732 | 0 | | | 3 | | | | |
| Rainbow, Farmington-*CT* | final | 11 | 1 | 0 | 3 | 4 | 104 | | | | setup to trap/pass eel |
| W. Springfield, Westfield-*MA* | final | 1,288 | | | | | 603 | | | | ladder closed 7/15 |
| Holyoke, Connecticut-*MA* | 10/26 | 190,352 | | 283 | | 7,841 | 22,233 | 314 | 63 | 20 | lift suspended on 10/5, eel passes operating |
| Easthampton, Manhan-*MA* | not available | | | | | | | | | | |
| **Turners Falls-Gatehouse, Connecticut-*MA* | final | 23,576 | | | | | 9,077 | | | | |
| Vernon, Connecticut-*VT* | final | 13,763 | | | | | 5,105 | | | | |
| Bellows Falls, Connecticut-*VT* | final | 896 | | | | | 1,561 | | | | |
| *Total to basin, only **first** barrier counts* | | 191,651 | 6,681 | 370 | 4 | 7,845 | 23,042 | 314 | 63 | 20 | |
| *Last year totals* | | 237,355 | 26,863 | 3,019 | 4 | 12,952 | 20,620 | 352 | 54 | 11 | |

*** Spillway Fish Ladder - at the dam 6,250 shad, 8,492 sea lamprey; Cabot Station Ladder, base of canal, 32,753 shad, and 10,410 sea lamprey. Note that at Turners Falls Project (Dam/Canal) fish must use one of these two fishways first before having the opportunity to pass the final required ladder*

A - total collected from 3 eel ramp/traps at Holyoke in 2021

This report reflects several final fishway count updates. Shortnose Sturgeon passed at Holyoke is similar to recent years 2021 (11), 2020 (18), and 2019 (20). Similar to our other species, the American Eel count among the three eel passes at Holyoke is also considerably down this year with numbers this low not seen since 2010. Those passes remain in operation at the time of this report with daily counts still running in the tens of fish. For a recently held meeting on 2022 river herring runs with RI, MA, CT biologists I updated some analyses of catch rates for Blueback Herring (next page). Low abundance was not expected as in 2018, CTDEEP had a "high" juvenile index that we have statistically correlated with our abundance rate, based on age-4 fish. Our CT River data was consistent with the fishway counts within our river system and along the southern New England

Appendix D. CRASC 2022 Fish Passage Operations Schedule for both Upstream and Downstream measures.

## Connecticut River Atlantic Salmon Commission
## 2022
## Connecticut River Schedule of Upstream Fish Passage Operations

| LOCATION (PROJECT) | UPSTREAM FISH PASSAGE | SPECIES | LIFE STAGE | DATES OF OPERATION[1] | HOURS OF OPERATION |
|---|---|---|---|---|---|
| **WILDER** | Ladder | salmon | adult | May 15 - July 15 | 24 hrs/day |
| | Ladder | salmon | adult | September 15 - Nov 15 | 24 hrs/day |
| **BELLOWS FALLS** | Ladder[2] | salmon | adult | May 15 - July 15 | 24 hrs/day |
| | Ladder | salmon | adult | September 15 - Nov 15 | 24 hrs/day |
| **VERNON** | Ladder[2] | salmon | adult | April 15 - July 15 | 24 hrs/day |
| | Ladder | salmon | adult | September 15 - Nov 15 | 24 hrs/day |
| | Ladder | shad & herring | adults | April 7[(1)]- July 15 | 24 hrs/day |
| **TURNERS FALLS** | Cabot Ladder, Gatehouse Ladder, and Spillway Ladder | salmon | adult | April 7 - July 15 | 24 hrs/day |
| | 3 facility ladders | salmon | adult | September 15 - Nov 15 | 24 hrs/day |
| | 3 facility ladders | shad & herring | adults | April 4[(1)] - July 15 | 24 hrs/day |
| **HOLYOKE** | Zone-of-Passage Flows[3] | salmon, shad, herring and sturgeon | adult | April 1 – November 15 | 24 hrs/day |
| | Tailrace and Spillway lifts | salmon | adult | April 1 – July 15 | up to 12 hrs/day[4] |
| | Both lifts | salmon | adult | September 15 – Nov 15 | up to 12 hrs/day[4] |
| | Both lifts | shad & herring | adult | April 1 – July 15 | up to 12 hrs/day[4] |
| | Both lifts | sturgeon | adult | April 1 – November 15 | up to 12 hrs/day[4] |
| | Tailrace, and Spillway Eelways | eel | juvenile | April 15 - November 15[5] | 24 hrs/day |

1 - **Actual dates of operation are based on passage of fish at the previous downstream fishway (excluding Holyoke)**. Turners Falls fishways shall be operational as soon as 50 shad have been counted passing Holyoke Fishlifts. Vernon Fish Ladder shall be operational within three days of the Turners Falls fishways being opened.

2 - Agencies have requested the operation of Bellows Falls fish ladder either once 100 sea lamprey are passed at the Vernon Dam Ladder or an adult salmon is passed, whichever occurs first.

3 - Zone -of-passage flow of 1,300 cfs or more to the bypass reach below the dam

4 - Actual hours of operation on a day-to-day basis are to be determined by the MADFW in consultation with the project owner.

5 - Actual eelpass installation dates are dependent on river flow conditions and in consultation between project owner and MADFW and USFWS

6 – Dependent on noted adult salmon passed at HFL

Continued next page.

## Connecticut River Atlantic Salmon Commission
## 2022
## Connecticut River Schedule of Downstream Fish Passage Operations

| LOCATION (PROJECT) | DOWNSTREAM FISH PASSAGE EXIT | SPECIES | LIFE STAGE | DATES OF OPERATION | HOURS OF OPERATION |
|---|---|---|---|---|---|
| **GILMAN/DALTON** | Interim Bypass Sluice | salmon | smolt | **Not required** | |
| **MOORE** | Bypass Sluice and Trap | salmon | smolt | **Not required** | |
| **MCINDOES** | Log Sluice | salmon | smolt | **Not required** | |
| **RYEGATE (DODGE FALLS)** | Fish Bypass Facility | salmon | smolt | **Not required** | |
| **WILDER** | Log Sluice | salmon | smolt | **Not required** | |
| | | salmon | adult | October 15 - December 31[1] | 24 hrs/day |
| **BELLOWS FALLS** | Angled Fish Guide Wall and Log Sluice | salmon | smolt | **Not required** | |
| | | salmon | adult | October 15 - December 31[1] | 24 hrs/day |
| **VERNON** | Fish Bypass at Unit 10 | salmon | smolt | **Not required** | |
| | | salmon | adult | October 15 - December 31[1] | 24 hrs/day |
| | | shad | adult | April 7[2] - July 31 | 24 hrs/day |
| | | shad | juvenile | August 1 - November 15 | 24 hrs/day |
| | | | | | |
| | Louver and Fish Pipe at Unit 4 | eels | adult | September 1 – November 15 | 24 hrs/day |
| | | salmon | smolt | **Not required** | |
| | | salmon | adult | October 10 - December 31[1] | 24 hrs/day |
| | | shad | adult | April 7[2] - July 31 | 24 hrs/day |
| | | shad | juvenile | August 1 - November 15 | 24 hrs/day |
| **NORTHFIELD** | Barrier Net | salmon | smolt | **Not required** | |
| **TURNERS FALLS** | Log Sluice and Trash Sluice | salmon | smolt | **Not required** | |
| | | salmon | adult | October 15 - December 31[1] | 24 hrs/day |
| | | shad | adult | April 7[2] - July 31 | 24 hrs/day |
| | | shad | juvenile | August 1 - November 15 | 24 hrs/day |
| | | eels | adult | September 1 – November 15 | 24 hrs/day |

1 - Downstream passage operation, for adults will only be required if 50 or more adults are documented as passing upstream of a dam/facility.

2 – Downstream passage measures should be operational for American Shad at the same time as upstream passage is initiated.

3 – Fish passage operations/schedule may be adjusted by NOAA Fisheries, USFWS, and/or MADFW.

Continued next page.

# Connecticut River Atlantic Salmon Commission
# 2022
# Connecticut River Schedule of Downstream Fish Passage Operations

| Location (Project) | Downstream Fish Passage Exit | Species | Life Stage | Dates of Operation | Hours of Operation |
|---|---|---|---|---|---|
| **Holyoke** | Canal Louver and new (2016) low level Bypass | salmon | smolt | **Not required** | |
| | | salmon | adult | October 15 - December 31[1] | 24 hrs/day |
| | | shad | adult | April 1 – July 31 | 24 hrs/day |
| | | shad | juvenile | August 1 - November 15 | 24 hrs/day |
| | | eels | adult | September 1 – December 1 | 24 hrs/day |
| | | sturgeon | adult | April 1 – November 15[3] | 24 hrs/day |
| | | sturgeon | juvenile | April 1- November 15[3] | 24 hrs/day |
| | | | | | |
| | Bascule Gate | eels | adult | September 1 – December 1 | 24 hrs/day |
| | | salmon | smolt | **Not required** | |
| | | salmon | adult | October 15 - December 31[1] | 24 hrs/day |
| | | shad | adult | April 1 - July 31 | 24 hrs/day |
| | | shad | juvenile | August 1 - November 15 | 24 hrs/day |

1 - Downstream passage operation, for adults will only be required if 50 or more adults are documented as passing upstream of a dam/facility.

2 – Downstream passage measures should be operational for American Shad at the same time as upstream passage is initiated.

3 – Fish passage operations/schedule may be adjusted by NOAA Fisheries, USFWS, and/or MADFW.

Epilogue. History of the Anadromous Fish Program

Native diadromous fishes (diadromy includes anadromous and catadromous fishes, with American Eel being the only catadromous species in this basin) were once abundant in the Connecticut River basin excluded from habitat only by natural barriers and their physiological limitations. Atlantic Salmon ascended the main stem Connecticut River to Beechers Falls, VT, nearly 400 miles upriver from its outlet at Long Island Sound. American Eel have been documented even farther upstream in the basin by early New Hampshire Fish Game Department studies in Pittsburgh, New Hampshire. No fishery management or scientific information exists that provides an accurate technical description of the pre-colonial diadromous fish populations. However, historical accounts of the region are filled with references to abundant American Shad, river herring and Atlantic Salmon runs that were known to have been an important food source in the spring for the native people and early European settlers. As colonization by Europeans and the development of waterpower sites expanded throughout the basin, anadromous fish populations notably declined. A major cause of the declines or loss of runs was from the construction of dams that blocked fish migrations from reaching their spawning habitat (Figure 1). Tributaries were more easily dammed initially, and so elimination of these species progressed rapidly in these areas first, with settlement and use of early waterpower for mill power. The first dam across the main stem Connecticut River was constructed as early as 1798, for barge/boat movement, near the present site of Turners Falls, Massachusetts. This dam blocked returning American Shad, river herring, Atlantic Salmon and Sea Lamprey from access to spawning and nursery habitat in the northern and central portion of the river basin. As a result, those species simply disappeared from areas of the basin in both New Hampshire and Vermont, not to be seen again for nearly 200 years.

An interagency state/federal program to restore Atlantic Salmon to the Connecticut River based on the stocking of fry hatched from eggs taken from Penobscot River Atlantic Salmon was initiated in the 1860s, decades after the construction of the Holyoke Dam, MA. 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. Concurrent with the salmon restoration effort were the state's American Shad culture and stocking efforts to enhance reduced runs of this valued species. Both species were fished heavily in the river, most notably at the river's mouth on Old Lyme and Old Saybrook, Connecticut. Work to restore and enhance these two species was conducted through developing fish culture techniques that were gaining popularity as an approach to achieve fishery management goals. The lack of knowledge on how to manage the fisheries, how to deal with fish passage all contributed to the collapse of this initial restoration effort. However, information gains did occur on fish culture practices as that strategy was an answer to these issues of fish population declines.

Although interest continued in restoring Atlantic Salmon to the basin, no action was taken for many decades due to the lack of funds and the lack of effective fish passage technology (an early design fish ladder had been installed at Holyoke Dam). The condition of the river environment continued to deteriorate in response to widespread pollution and dam construction through the early to mid-1900s. By the 1960s, some tributary dams were breached, 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 these events set the stage for coordinated anadromous species restoration. In 1967 the four basin states and

USFWS, (National Marine Fisheries Service later created from a branch within the USFWS in 1970) signed a statement of intent to restore anadromous fishes including American Shad, Atlantic Salmon, and river herring to the Connecticut River. A Connecticut River Policy Committee comprised of the administrative heads of the resource agencies was the mechanism used to advance on restoration goals and objectives. Atlantic Salmon was a focus species due to its appeal for recreational angling opportunities by the resource agencies. Early salmon stockings were initially comprised of two-year old smolts of Canadian origin reared in federal trout hatcheries that had recently been converted to salmon production. The term smolt defines a salmon life-stage when the transitional migration from freshwater to the marine environment occurs, typically in the months of April and May. The first adult salmon return from these hatchery smolt releases was documented in 1974.

Early in the Atlantic Salmon Program, the management emphasis was placed on stocking smolts with the USFWS building a salmon hatchery in Bethel, Vermont, and CTDEEP and MADFW converting trout hatcheries for salmon production. Production of stream-reared smolts, from juvenile stockings was combined with smolts produced in hatcheries to increase smolt emigration from the river. A major effort was begun in 1987 to stock fry into appropriate habitat in the basin, based upon in-river research results that demonstrated a ten-fold rate of return from stream reared smolts.

Beginning in 1994, the Program utilized only "Connecticut River" fish, with no introductions of genetic material from outside the basin. Genetic monitoring had demonstrated the development of some unique genetic characteristics (alleles) that distinguish the Connecticut River population from other populations at that scale. The use of conservation genetics enabled the Program to maintain a genetically healthy population to maximize genetic diversity and reduce risks from genetic issues.

Adult Salmon returns per 10,000 stocked fry 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 was 0.11 (refer to U.S. Atlantic Salmon Assessment Committee Report 27 – 2014 Activities). This later period is when the program shifted to fry stocking as the primary restoration strategy, coinciding with this unexpected decline in fry return rates (due to marine survival rate decreases). This situation translated to a sustained reduction approximately 1/6 of what had been observed for this rate prior to 1994, even as issues of safe downstream passage of smolts at hydropower facilities and ocean fishery closures were completed. Studies over time have shown shifts in salmon marine prey species abundance and distributions, shifts in predator assemblages, and shifts in marine habitat area use are likely contributing factors that can be related to climate change. The impacts from large scale shifts in marine conditions were also being observed in other Atlantic Coast salmon populations, both wild (Canada) and in various forms of active restoration (Maine, New Hampshire, Rhode Island).

The severe damage to the White River National Fish Hatchery (WRNFH) in fall of 2011, from a flood event, severely impacted the Salmon Program as it maintained a high proportion of the domestic broodstock and subsequently annual egg and fry production for all the states. WRNFH had been producing approximately 65% of the fry for the Program in the preceding 10 years. 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 and priorities, led the USFWS to announce its decision to conclude fish culture activities for the Connecticut River Atlantic Salmon Program. That announcement was made in public at the July

2012 Connecticut River Atlantic Salmon Commission meeting. Subsequently, in the fall of 2012, the Commonwealth of Massachusetts decided it would no longer culture salmon at its Roger Reed State Hatchery. The last spawning of domestic salmon broodstock occurred at that facility in 2012, with all fry and remaining Connecticut River salmon of various ages stocked out in 2013. The State of New Hampshire had concluded the restoration effort with a last stocking in 2012, while the final stocking in Vermont was in 2013.

The State of Connecticut currently operates a "Salmon Legacy Program," which is not a restoration program but serves other defined purposes. The goal of Connecticut's program is to maintain Atlantic Salmon in select watersheds, maintain existing genetics of the Connecticut River salmon, provide fish for their state broodstock fishery program (outside of the Connecticut River basin), and support educational programs such as the school egg/fry rearing program.

Action to provide upstream fish passage on the Connecticut River main stem in the mid-1900s occurred in 1955, when a rudimentary fish lift was constructed at Holyoke Dam to pass American Shad and river herring, that relied on humans pushing them in wheeled buckets for release upstream of the dam. At that time, and for approximately three decades after, the Enfield Dam remained a partial barrier, even though laddered; it eventually disintegrated completely in the late 1980s. The Holyoke Dam facility was expanded in 1976 when substantial upstream passage modifications occurred, with a new second lift installed in the spillway (or at the base of the dam, as opposed to the existing "tailrace" lift entrance where the turbines release). Although not studied, upstream passage efficiency appeared to improve greatly with corresponding increases in annual fish counts for species like American Shad and Blueback Herring (Figure 4). Other fishways built at dams on the main stem river and tributaries allowed returning Atlantic Salmon, American Shad, river herring, American Eel, and Sea Lamprey access into select portions of the basin (with varying degrees of fishway effectiveness) targeted for restoration. Major issues with several different fishways have been apparent relative to ineffectiveness at passing American Shad, river herring, American Eel (downstream) and Shortnose Sturgeon. These issues have been dealt with on a case-by-case basis, with varied degrees, of success. There has also been a greater emphasis placed addressing safe, effective, and timely downstream passage of fish and lifestages which has presented challenges that have been worked on through new approaches, research, and evaluations.

Upstream passage at Turners Falls Dam (Massachusetts) fishways (first operational in 1980) have been studied and modified for decades and is one of the projects in the FERC relicensing process at this time. Passage issues relative to American Shad are best explained by the fact that no ladders of the size required on the main stem had been designed for that species as the cooperative restoration effort took this management need on in the 1970s. The USFWS relied on the best information (no specific studies available) at the time that suggested West Coast fish ladders on the Columbia River were effective at passing introduced American Shad. This led to the adoption of these designs, downsized considerably from the Columbia River, for use on the main stem Connecticut River dams. The USFWS worked with the power companies in the design and construction, to develop operating parameters for flow, velocities, and turbulence measures. However, the downscaling created some unforeseen challenges in hydraulics for these species that the agencies, researchers (USGS CAFRC), and power company consultants have worked on understanding and attempted to resolve (some of these) over the years with our increasing knowledge.

Following on the Turners Falls ladders completions, the Vernon Dam (Vermont) fish ladder

became operational in 1981 with Bellows Falls and Wilder dam fish ladders in the subsequent years. As the number of salmon fry stocked in the basin increased during the late 1980s, concern grew for the potential negative effects of hydroelectric turbines or other passage routes on outmigrating smolts, as well as juvenile and post spawn adult American Shad. Efforts to provide safe and effective downstream fish passage on both main stem and tributary projects were initiated in the 1980s. In 1990, a Memorandum 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 fish passage construction. The Holyoke Dam and Hadley Falls Power Station is a good example of a very recent large-scale fish passage improvement project, designed specifically to address; downstream passage and protection of adult American Eel and Shortnose Sturgeon as well as upstream passage of Shortnose Sturgeon and other anadromous species that became operational in 2016, using new fish passage engineering approaches.

The state and federal agencies continue to work in close cooperation with many partners to address fish management, protection, enhancement, and restoration topics for both populations and habitats. This work is important for the ecological, recreational, and commercial benefits, derived from healthy native fish populations and the aquatic habitats they require. Currently, ongoing fisheries work includes continuing efforts to increase both diadromous species abundance levels and distributions (particularly upper basin and in tributaries) as well as stock structure characteristics (e.g., multiple age classes, repeat spawner component) to support population resilience and health (as characterized by status). The current FERC relicensing process for the five main stem facilities is important in this regard relative to the 30–50-year length of these federal licenses and the opportunity to seek conditions and measures that protect the public's fishery resources now and for future generations. The CRASC and its predecessor, the Connecticut River Policy Committee, have provided and continue to provide, a critical coordinated fishery leadership role from policy setting to project implementation, resulting in many positive outcomes not commonly observed in many other large East Coast river basins.