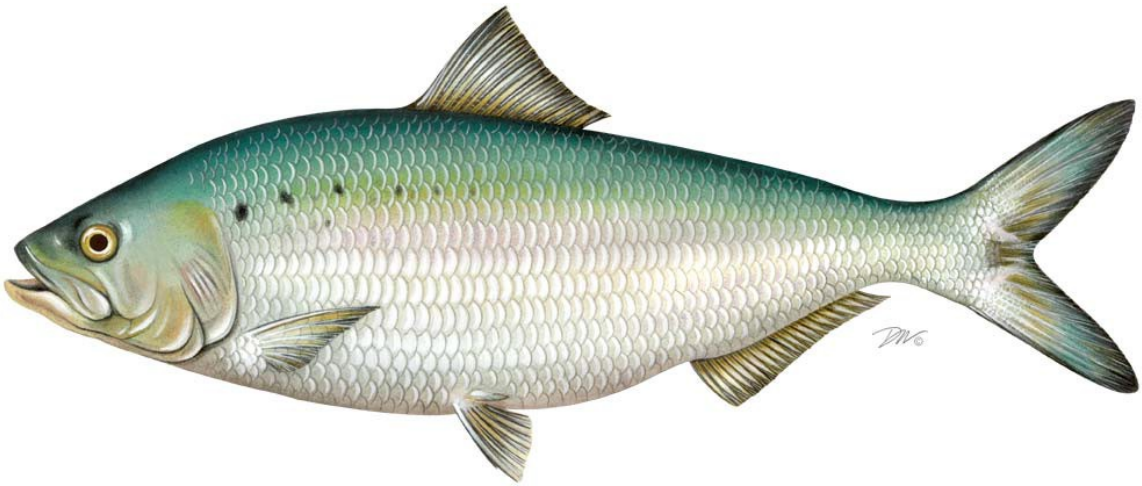
American Shad Habitat Plan for the Pawcatuck and Pawtuxet Rivers



Prepared by:
Patrick McGee and Phil Edwards, Rhode Island Department of Environmental Management, Fish and Wildlife Division

Submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring

Approved May 5, 2021

Rhode Island American Shad Fisheries Management Plan
Pawcatuck and Pawtuxet Rivers

Overview

Report submitted by the Rhode Island Department of Environmental Management, Division of Fish & Wildlife. This report provides river-specific information for the two known American shad runs in the state of Rhode Island, the Pawcatuck River and the Pawtuxet River. American shad restoration is an ongoing effort by the Division and its many partners. The Division continues to try to improve shad passage efficacy on these systems, while also seeking to expand passage to additional systems deemed to have the potential to provide suitable American shad habitat.

The 2020 Atlantic States Marine Fisheries Commission's American Shad Stock Assessment and Peer Review Report provides an extensive review of available literature and discussion on the topic of fish passage (ASMFC 2020). Specifically, it highlights the issues with lack of evaluation and performance from decades-old approaches, facilities designs/operations that are not effective, and therefore cannot reasonably be expected to achieve management and restoration goals without significant changes. The Assessment Report also provides an important quantitative modeling approach examining shad habitat and passage barriers, and the need to address status quo fish passage performance. The impacts of these barriers and status quo passage are described and also modeled as effects on spawner population size under three scenarios, 1) no barriers, 2) first barrier with no passage, and 3) realistic fish passage performance measures applied to barriers (e.g., upstream passage efficiency of 50%).

The Assessment Report used standardized data and modelling approaches that quantified the impacts of barriers and fish passage as significant in all three management areas examined based on shad life history and habitat (New England, Mid-Atlantic, and South Atlantic). The assessment determined that overall, dams completely or partly block nearly 40% of the total habitat once used by American Shad. The model results of the "no barriers" scenario yielded an estimated spawner production potential 1.7 times greater than that yielded by the scenario assuming no passage at the first barrier: 72.8 million versus 42.8 million fish. The results of the third model scenario, which applies "realistic" (i.e., current) fish passage efficiencies, resulted in a gain of less than 3 million fish. Conclusions include "losses in (spawner production) potential are significant in each state and region." The Assessment Report provides a strong justification for the need and benefits of requiring improved fish passage performance measures. Additionally, meeting such improved passage performance standards is now an achievable goal given the current state of knowledge on fish behavior, swimming performance, and fish passage engineering expertise.

I. Habitat Assessment: Pawcatuck River

Since the 1970s, RIDEM has accomplished substantial progress in the restoration of diadromous fish to the 308-mi^2 Pawcatuck River watershed. RIDEM has been successful to date at re-establishing low-levels of self-sustaining American shad and river herring populations in the

lower reach of the Pawcatuck River watershed. This work has included installation of structural fishways (1970s), limited structural fishway improvements, broodstock enhancement, fry stocking programs and monitoring of both adult returns and juvenile recruitment (e.g., fish trap counts, juvenile seine surveys, electrofishing, and radio telemetry). Although the Pawcatuck River has historic diadromous fish runs, each of the lower three dams (White Rock, Potter Hill, and Bradford) and poorly functioning structural fishways greatly reduced the passage efficiency of anadromous fish from accessing valuable spawning and nursery habitat. Starting in 2013, the State of Rhode Island Department of Environmental Management (RIDEM), Division of Fish and Wildlife (DF&W) committed funds and initiated a process to assess specific passage problems (via U.S. Army Corps of Engineers (ACOE) Section 22 of the Water Resources Development Act) to document passage deficiencies and passage restoration alternatives at each of the first three dams on the Lower Pawcatuck River. In 2015 partners began completing fish passage improvements at the lower three dams utilizing a multi-million dollar USFWS Sandy Flood Resiliency funds and other sources to remove the White Rock Dam, improve the Potter Hill Fishway and construct a rock ramp fishway at the Bradford Dam.

Since 2010, there has been a substantial effort to improve fish passage at the dams located upstream of the three dams described above that are on the lower portion of the Pawcatuck River. This three phase upper Pawcatuck River fish passage restoration project was awarded a multi-million dollar NOAA American Recovery and Reinvestment Act and involves numerous funding and project partners. The first of the three-phase project was the 2010 removal of the Lower Shannock Falls which included the installation of rock weirs and bank stabilization. In 2012, a Denil fishway and state-of-the-art eel pass was constructed at the Horseshoe Falls Dam and in 2013 a rock ramp fishway was completed at the sixth obstruction-Kenyon Mill Dam. The fish passage restoration improvements at the first three fishways complemented the new fish passage restoration projects completed on the upper Pawcatuck River watershed. Currently DFW and partners are looking at fishway options to enhance fish passage at a small USGS gauging station located at the Cronan fishing area. The dam is passable at certain flows, but improvements will enhance fish passage.

The six fish passage projects described below will enhance diadromous fish passage to over 22 miles of the main stem Pawcatuck River, 48 miles of tributaries, and access to over 1,967 acres of ponds providing critical spawning and rearing habitat. The goal is to improve river connectivity for target fish species and provide passage between Little Narragansett Bay and the high-quality waters of upper Pawcatuck River. An increase in abundance of the target diadromous species, to be monitored and documented by RIDEM and partners over time, will ultimately serve as the metrics for performance of the proposed restoration projects. The long-term goal of the project is to restore self-sustaining populations of anadromous and catadromous fish species. The unimpeded access to riverine and lacustrine habitats is expected to potentially result in an annual shad run in the thousands and river herring runs in the hundreds of thousands in the watershed. In addition, RIDEM, USFWS, USGS, URI and other partners initiated a two-year telemetry study in 2018 for shad and herring on the mainstem Pawcatuck River at each of the main fishways. Preliminary results show where radio tagged fish migrated to along the river and areas where migration delays may be occurring. The information will assist in prioritizing sites for fish passage improvements. Final fish telemetry results from the study are expected in 2020/2021.

Threats Assessment: Pawcatuck River

Barriers to Migration

Description:
Each of the three lowermost dams on the Pawcatuck River had a bypass system (breached canal and fish ladders) to provide fish passage for diadromous fish species including river herring and American shad. However, at each of these dams were known and documented problems with the bypass systems that could impact fish passage efficiency. The State of Rhode Island Department of Environmental Management, Division of Fish and Wildlife partnered and requested that the US Army Corps of Engineers (ACOE) provide planning assistance (Section 22 of the Water Resources Development Act of 1974) to determine the fish passage efficiency for species of diadromous fish at the three dam sites located on the lower Pawcatuck River in 2013. The study produced a detailed report that identified and documented the current conditions at each of the sites and determined the impact these conditions had on fish passage. Recommendations and preliminary plans for improving fish passage efficiency at each site were included in the report.

Action 1) White Rock Dam Removal

Description of Work: The study evaluated the White Rock Dam by-pass channel, which previously allowed for fish passage but had water flows at the existing dam which may have attracted anadromous fish towards a dead-end channel. The report revealed that even at adequate flows, the by-pass was inefficient at passing anadromous fish, and partners worked to remove the dam and restore the original river channel utilizing USFWS Sandy Resiliency Funds and other sources.

Agencies: Feasibility study by RIDEM, ACOE, TNC and WPWA.
Dam Removal-The Nature Conservancy (TNC) and USFWS, RIDEM, CTDEEP, WPWA, USACOE, CRMC, Griswold Textile, Fuss and O'Neil, Sumco and others.

Timeline/Progress: Report completion date 2013. Dam removal completed Fall 2015.

Action 2) Potter Hill Fishway Improvements

Description of Work: The feasibility study determined the fish passage efficiency of the 1970's constructed Potter Hill Denil fishway with current dam and false attraction flow conditions was poor. RIDEM and partners changed the baffles to decrease water velocities and improved the entrance channel utilizing a long-armed excavator.

Agencies: TNC, USFWS, RIDEM, US ACOE, TNC, WPWA and others.

Timeline/Progress: Completed October 2016

Action 3) Bradford Dam Rock Ramp Fishway

Description of Work: The feasibility study determined the fish passage efficiency of the 1970's Denil fishway with new modifications and current dam conditions was poor with numerous false attraction flow conditions. Recent modifications were made to the Bradford fishway to enhance American shad passage. Modifications included an extended fishway entrance and a decrease in the slope at the lower fishway section in 2008. The study determined the fishway was still inefficient to migratory fish and the best option was a rock ramp fishway funded by USFWS Sandy Resiliency Funds and other sources. The rock ramp fishway features a series of pools, constructed of natural stone weirs to facilitate fish passage.

Agencies: Feasibility study by RIDEM, ACOE, TNC and WPWA. Fishway modifications in 2008 by numerous partners. Rock Ramp in 2018 -TNC and USFWS, RIDEM, CTDEEP, WPWA, USACOE, CRMC, Bradford Dye, Fuss and O'Neil, Sumco and others.

Timeline/Progress: First fishway modifications completed 2008, Report 2013, Rock Ramp March 2018.

Action 4) Lower Shannock Falls Dam Removal

Description of Work: There has been a substantial effort to improve fish passage at dams located upstream of the three dams described above that are on the lower portion of the Pawcatuck River. This three phase upper Pawcatuck River fish passage restoration project was awarded a multi-million dollar NOAA American Recovery and Reinvestment Act grant due to its high level of restoration priority. The first of the three-phase project was the removal of the Lower Shannock Falls which included the installation of rock weirs and bank stabilization.

Agencies: Wood Pawcatuck Watershed Association (WPWA)-lead, NOAA, RIDEM, CRMC, USFWS, and many others project partners and funding sources.

Timeline/Progress: Completed, Fall 2010

Action 5) Horseshoe Falls Dam Denil Fishway

Description of Work: Construction of a new Denil fishway, juvenile bypass chute and self-regulating eel ramp.

Agencies: Wood Pawcatuck Watershed Association (WPWA)-lead, NOAA, RIDEM, CRMC, USFWS, and many others project partners and funding sources.

Timeline/Progress: Completed Fall 2012, RIDEM/Fish and Wildlife is currently operating and maintaining the Denil fishway and eel ramp.

6) Kenyon Mill Dam Rock Ramp Fishway

Description of Work: Removal of existing dam and installation of a new rock ramp fishway. The rock ramp fishway features a series of pools, constructed of natural stone weirs to facilitate fish passage.

Agencies: Wood Pawcatuck Watershed Association (WPWA)-lead, NOAA, RIDEM, CRMC, USFWS, Kenyon Mill Industries and many others project partners and funding sources.

Timeline/Progress: Completed March 2014.

Water Quality

Water Quality Restoration Program: RIDEM/Office of Water Resources administers the federal Clean Water Act program that undertakes studies and develops plans for restoring water quality known as "TMDLs". In collaboration with the State of Connecticut, RIDEM is undertaking a water quality study of the Pawcatuck River watershed to provide the technical basis for potential future actions to reduce nutrient pollutant to the downstream estuary. A previous TMDL for this watershed focused on bacterial pollution. http://www.dem.ri.gov/programs/water/quality/restoration-studies/ In the Pawtuxet River, implementation of a plan to upgrade wastewater treatment facilities to reduce nutrient pollutant loadings resulted in improved dissolved oxygen conditions in the Pawtuxet River that restored compliance with state water quality criteria (2008).

Water Quality Protection Programs: RIDEM/Office of Water Resources administers federal and state authorized programs which support a variety of actions to protect water quality and aquatic habitats. Programs include financial support for stormwater mitigation projects and other non-point pollution water quality protection actions including restoration of riparian buffers and stream connectivity as well as water quality monitoring and assessment, watershed planning and technical assistance activities.

Project Permit/Licensing Review Program: RIDEM/Office of Water Resources administers the federally delegated program for management of the point source discharge of pollutants (Rhode Island Pollutant Discharge Elimination System – RIPDES). This program encompasses sanitary, industrial and thermal discharges as well as stormwater runoff. http://www.dem.ri.gov/programs/water/permits/ripdes/ Additional RIDEM/OWR permitting programs also regulate and provide for the review of proposed water withdrawals and other hydromodifications, dredging projects, most land use development as well as other activities that would alter freshwater wetlands. http://www.dem.ri.gov/programs/water/permits/

Restoration Programs

RIDEM has partnered with the USFWS North Attleboro Fish Hatchery with the American shad fry stocking program. Each spring adults from the Connecticut River are delivered to the hatchery where they are allowed to naturally tank spawn. The fry are released throughout the summer into the upper reaches of the Pawcatuck River. The adult shad broodstock are allocated annually to RIDEM from the Connecticut River via CRASC approval

In the past, the state of Rhode Island has informally adopted a recovery target of 5,000 spawning adults, the restoration level recommended by Richard St. Pierre from the USFWS. Estimates for American shad carrying capacity per acre, were calculated from the models developed by St. Pierre, 1979; Hightower and Wong, 1997; and Weaver et al., 2003. These numbers are generally regarded as the benchmark for American shad restoration. The calculated target levels are greater than the past estimates of American shad observed at the Potter Hill fishway trap in any given year (1985-4,219 highest total).

Monitoring

Since 1979, American shad monitoring at the Potter Hill fishway trap in Ashaway, R.I is conducted using the standardized protocol described by O'Brien (1986). The trap located at the upstream end of the ladder is checked daily from late-March to July 1st. Data on the number of shad captured in the fishway trap, water temperature and water level are recorded daily. In addition, since 1986, weekly seining for juvenile shad and river herring is conducted in the lower Pawcatuck River from August to November. The five standard seine stations are sampled using the protocol established by O'Brien (1986). Juveniles of all anadromous species are enumerated, and lengths are measured. Presence and number of individuals of other species are also noted. Bottom water temperature, salinity and dissolved oxygen are measured.

Adult shad spawning stock size (SSS) and juvenile abundance indices (JAI's) are used as a guideline and metric to determine if the shad run on the Pawcatuck River is self-sustaining and restored. Target goals and baselines will be selected utilizing three year running averages and percentiles by RIDEM and partners following multiple years of increased SSS at the trap and seine survey JAI's. Since 2003, the SSS has been low.

Each year a sub-sample of adult shad are sampled at the fishway trap and growth, age, mortality, and percent of repeat spawner data is estimated to fulfil USFWS federal aid and ASMFC compliance requirements. American shad have been monitored since 1979 on the Pawcatuck River and numerous reports provide biological characteristic time series (Edwards, 1999, 2007. McGee, 2019).

Recommended Action(s)

- Explore passage improvements. Partners are currently working on improvement options at Potter Hill Dam and the Cronan gauge station.
- Continue Working with the USFWS and CRASC to stock American Shad fry into the Pawcatuck River.
- Collect genetic samples to identify origin of stock (hatchery reared).

- Continue monitoring via SSS counts and annual JAI surveys.

II. Habitat Assessment: Pawtuxet River

In 2011, the partial dam removal was completed at the Pawtuxet Falls Dam. The project included many partners including the Pawtuxet River Authority (PRA), NRCS, USFWS, NOAA, RIDEM, CRMC, Narragansett Bay Estuary Program (NBEP), Save the Bay, American Rivers, and many others. After an alternative analysis and review the partial dam removal option was considered the best alternative for American shad and river herring. Anadromous fish have access to over 7 miles of main stem river to the Pontiac Dam. The third obstruction is the Natick Pond dam. Feasibility for fish passage at both sites is at the preliminary stages. Since the dam being removed in 2011, RIFW has stocked adult broodstock river herring and has partnered with the USFWS North Attleboro Fish Hatchery to introduce American shad fry. Both stocking programs are planned to continue into the future.

Threats Assessment: Pawtuxet River

<u>Barriers to Migration</u>

Description:
In its *2002 Strategic Plan for the Restoration of Anadromous Fishes to Rhode Island's Coastal Streams* (Erkan 2002), the Rhode Island Department of Environmental Management (RIDEM) recognized the potential for significant expansion of river herring and American shad habitat by restoring fish passage to the mainstem Pawtuxet River. The plan identifies the first dam in Pawtuxet Village as an obstruction to migratory fish and with the removal opened over 7 miles of riverine habitat. Preliminary discussions have occurred for fish passage on the second obstruction, Pontiac Mills, which would open an additional 3 miles. Currently the 2002 plan is scheduled to be updated in 2020/2021. In addition, since 2001, RIDEM/Fish and Wildlife prepares an annual priority list of fish passage projects for river systems throughout the state. Since the inception, the Pawtuxet River fish passage projects have been a high priority (Edwards 2019).

Action 1) Partial dam removal at Pawtuxet Falls

Description of Work:
Partial dam removal at Pawtuxet Falls with a low channel slot to enhance migration during low water flows.

Agencies: NBEP, RIDEM, NRCS, NOAA, CRMC, PRA, Save the Bay, USFWS, American Rivers and many others.

Timeline/Progress: Completed during the Fall of 2011.

<u>Water Quality</u>

Water Quality Restoration Program: RIDEM/Office of Water Resources administers the federal Clean Water Act program that undertakes studies and develops plans for restoring water quality known as "TMDLs". In collaboration with the State of Connecticut, RIDEM has undertaken a water quality study of the Pawcatuck River watershed to provide the technical basis for potential future actions to reduce nutrient pollutant to the downstream estuary. A previous TMDL for this watershed focused on bacterial pollution. http://www.dem.ri.gov/programs/water/quality/restoration-studies/ In the Pawtuxet River, implementation of a plan to upgrade wastewater treatment facilities to reduce nutrient pollutant loadings resulted in improved dissolved oxygen conditions in the Pawtuxet River that restored compliance with state water quality criteria.

Water Quality Protection Programs: RIDEM/Office of Water Resources administers federal and state authorized programs which support a variety of actions to protect water quality and aquatic habitats. Programs include financial support for stormwater mitigation projects and other non-point pollution water quality protection actions including restoration of riparian buffers and stream connectivity as well as water quality monitoring and assessment, watershed planning and technical assistance activities.

Project Permit/Licensing Review Program: RIDEM/Office of Water Resources administers the federally delegated program for management of the point source discharge of pollutants (Rhode Island Pollutant Discharge Elimination System – RIPDES). This program encompasses sanitary, industrial and thermal discharges as well as stormwater runoff. http://www.dem.ri.gov/programs/water/permits/ripdes/ Additional RIDEM/OWR permitting programs also regulate and provide for the review of proposed water withdrawals and other hydromodifications, dredging projects, most land use development as well as other activities that would alter freshwater wetlands. http://www.dem.ri.gov/programs/water/permits/

Restoration Programs

RIDEM has partnered with the USFWS North Attleboro Fish Hatchery with the American shad fry stocking program. Each spring adults from the Connecticut River are delivered to the hatchery where they are allowed to naturally tank spawn. The fry are released throughout the summer into the upper reaches of the Pawtuxet River. The adult shad broodstock are allocated annually to RIDEM from the Connecticut River via CRASC approval.

Monitoring

Compared to the Pawcatuck River, the lower Pawtuxet River is a challenging system to monitor anadromous fish due to site access, lack of traditional fishways, and absence of past time series. During the construction of the partial dam removal a maintenance and emergency access ramp was built and left in place allowing RIDEM to monitor the presence and absence of juvenile anadromous fish utilizing boat electrofishing techniques. Electrofishing surveys for adults in the spring and juveniles in the fall were conducted with success, as juvenile shad were sampled in the fall showing fry survived the summer months following stocking. Currently the new RIFW electrofishing boat cannot be launched from the ramp due to its size, erosion issues at the launch, and previous materials used at the launch. Repairs with required permits are planned for the

ramp and in the future RIFW will conduct spring and fall electrofishing surveys for both adults and juveniles. RIDEM recently purchased a Smith Root SR-7 tote barge equipped with a 2.5 GPP electrofishing system. This equipment will be used to complete a spring adult shad survey and a fall juvenile abundance survey in order to initiate a monitoring time series in the Pawtuxet River. In combination with RIDEM Smith Root electrofishing boat equipped with a 7.5 GPP electrofishing at river locations where wading is not possible. Using a combination of the two types of equipment, RIDEM Fish and Wildlife will be able to adequately survey the Pawtuxet River and collect data on shad returns and reproductive success.

Adult shad CPUE and juvenile JAI's will be used as a guideline to determine if the shad run on the Pawtuxet River is self-sustaining and restored. Target goals and baselines will be selected by RIDEM and partners following a few years of monitoring spawning stock size CPUE and juvenile abundance indices via electrofishing techniques.

Recommended Action(s)

- Explore options for future passage installations and improvements.
- Fish passage options at the Pontiac Dam are being reviewed by partners, while passage options at the Natick Dam, and Pocassett tributary are also being explored.
- Continue Working with the USFWS and CRASC to stock American Shad fry into the Pawtuxet River.
- Address access issues in order to resume electrofishing surveys, including adult monitoring and JAI's.

References

ASMFC. 2020. American Shad Benchmark Stock Assessment and Peer Review Report. Washington, D.C.

Edwards, P. A. 2020. Fish Passage Improvements. Rhode Island Division of Fish and Wildlife, Freshwater and Anadromous Fisheries Section. Annual performance reports to USFWS, Project F-26-R-48, Washington, D.C.

Edwards, P. A. 2017. Restoration and establishment of sea run fisheries. Rhode Island Division of Fish and Wildlife, Freshwater and Anadromous Fisheries Section. Annual performance reports to USFWS, Project F-26-R-52, Washington, D.C.

Edwards, P. A. 2014. American Shad Habitat Plan for the Pawcatuck River. Rhode Island Division of Fish and Wildlife, Freshwater and Anadromous Section. Report submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring.

Edwards, P.A., Lee, L.M., Hattala, K., and Kahnle, A. 2007. Status of the Pawcatuck River, Rhode Island American shad stock. Section 5 of the stock assessment report No. 07-01 of the Atlantic States Marine Fisheries Commission. Washington, D.C.

Edwards, P. A. 1999. State of Rhode Island American shad recovery plan 2000-2004. Rhode Island Division of Fish and Wildlife, Freshwater and Anadromous Fisheries Section. Report to the Atlantic States Marine Fisheries Commission. Washington, D.C.

Erkan, D.E. 2002. Strategic Plan for the Restoration of Anadromous Fishes to Rhode Island Coastal Streams. RI DEM, Division of Fish and Wildlife. Completion Report in Fulfillment of Federal Aid in Sportfish Restoration, F-55-R.

Hightower, J. E., and R. Wong. 1997. Potential benefits to anadromous fishes of providing fish passage within the Roanoke River basin. Report to the U.S. Fish and Wildlife Service and Virginia Power, Raleigh, North Carolina.

McGee, P. 2020. Restoration and establishment of sea run fisheries. Rhode Island Division of Fish and Wildlife, Freshwater and Anadromous Fisheries Section. Annual performance reports to USFWS, Project F-26-R-53, Washington, D.C.

O'Brien, J.F. 1986. Shad Restoration Studies. Performance Report. Project F-26-R-2. Rhode Island Division of Fish & Wildlife. 15 p. Appendix.

Hyle, Reid. 2017. American Shad Sustainable Fishing Plan Update for Florida, St. Johns River. Report to the Atlantic States Marine Fisheries Commission. Washington, D.C.

St. Pierre, R. A. 1979. Historical review of American shad and river herring fisheries of the Susquehanna River. U.S. Fish and Wildlife Service, Special Report to the Susquehanna River Basin Committee, Harrisburg, Pennsylvania.

Weaver, L. A., M. T. Fisher, B. T. Bosher, M. L. Claud, and L. J. Koth. 2003. Boshers Dam vertical slot fishway: a useful tool to evaluate American shad recovery efforts in the upper James River. Pages 339–347 *in* K. E. Limburg and J. R. Waldman, editors. Biodiversity, status, and conservation of the world's shads. American Fisheries Society, Symposium 35, Bethesda, Maryland.

Figure 1: Location of the Pawcatuck River Fish Passage Restoration Sites.

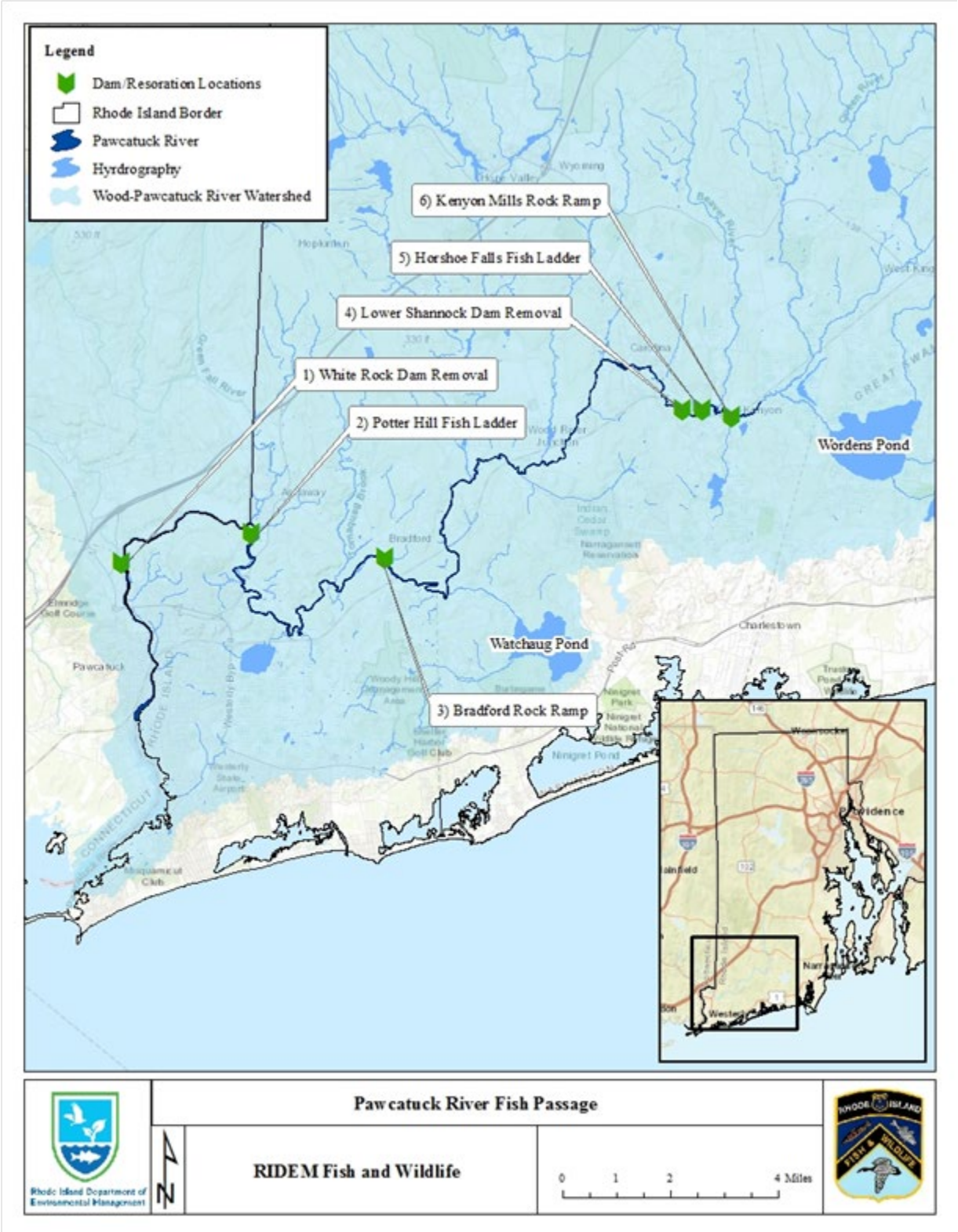
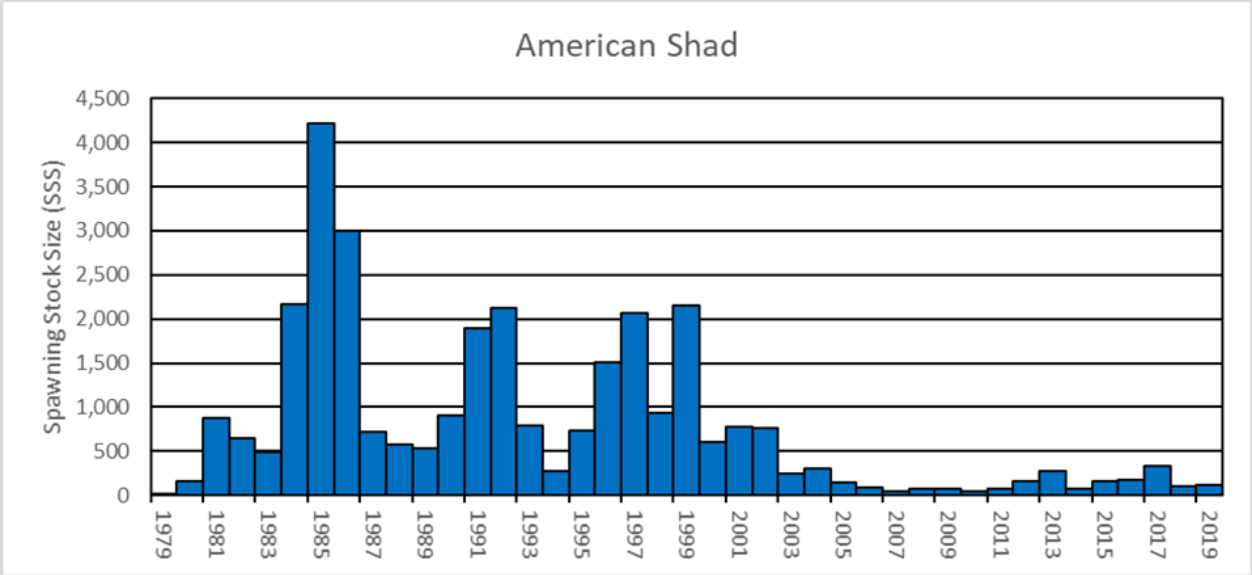


Figure 2: American shad spawning stock size from the Pawcatuck River.



Fishway Trap Counts Pawcatuck River				
Year	A. shad		Year	A. shad
1980	165		2000	608
1981	882		2001	774
1982	644		2002	768
1983	491		2003	243
1984	2,163		2004	301
1985	4,219		2005	151
1986	3,000		2006	92
1987	724		2007	44
1988	580		2008	70
1989	533		2009	69
1990	904		2010	44
1991	1,900		2011	78
1992	2,119		2012	156
1993	797		2013	279
1994	270		2014	72
1995	740		2015	159
1996	1,508		2016	169
1997	2,061		2017	331
1998	936		2018	103
1999	2,149		2019	115

Figure 3: Location of the Pawtuxet River Restoration Sites.

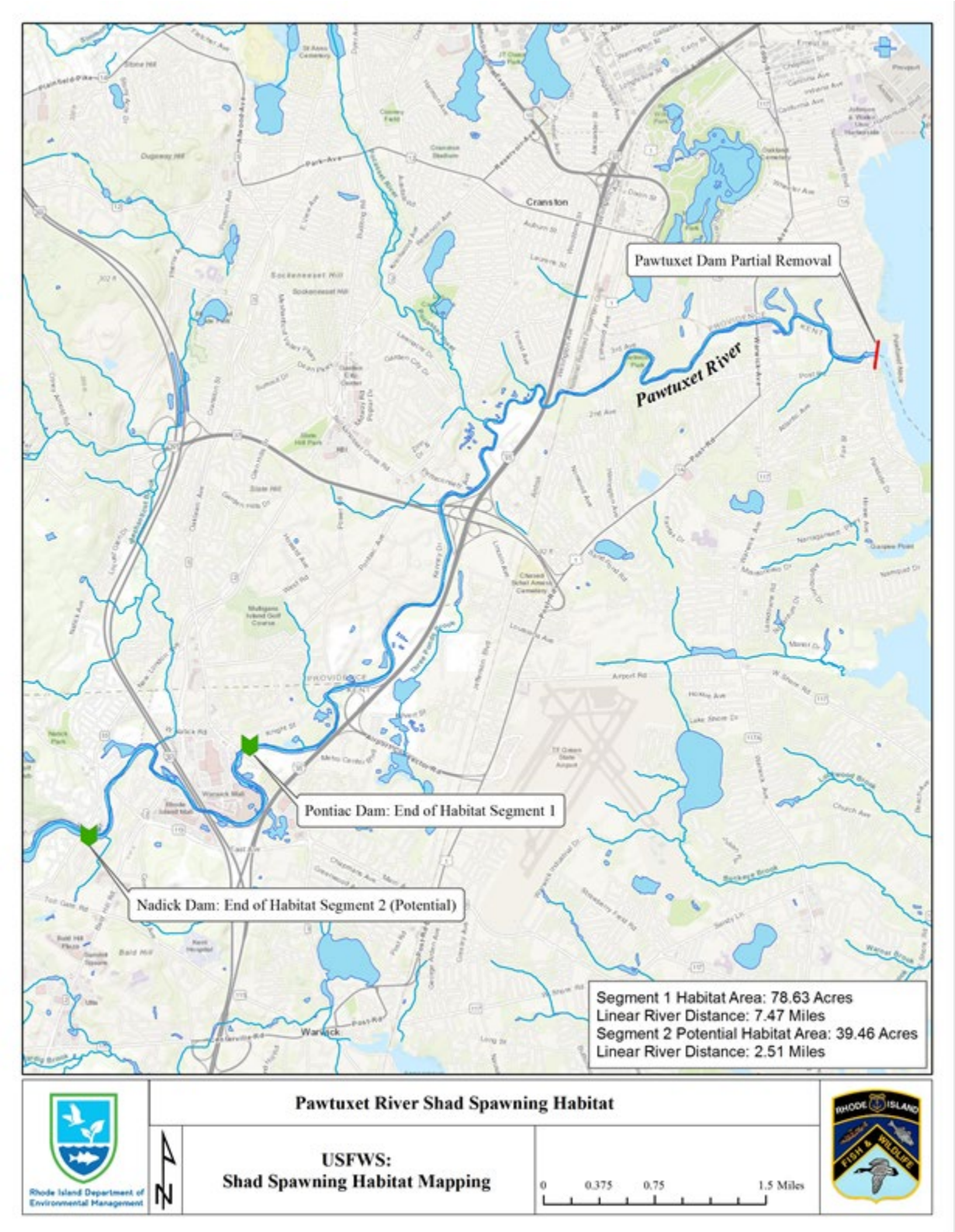


Table 1: Pawcatuck River segments and associated river miles.

Restoration Segments	Segment ID	Distance (Miles)
Route 1 (Westerly) to former White Rock Dam	1	2.26
Former White Rock Dam to Potter Hill Fish Ladder	2	3.34
Potter Hill Fish Ladder to Bradford Fish Ladder	3	7.12
Bradford Fish Ladder to former Lower Shannock Dam	4	12.02
Former Lower Shannock Dam to Horseshoe Falls Fish Ladder	5	0.48
Horseshoe Falls Fish Ladder to former Kenyon Mills Dam	6	0.87
Former Kenyon Mills Dam to Biscuit City Rd	7	0.73

Table 2: Pawcatuck River segments and associated river miles.

Habitat Segment	Segment ID	Linear Distance (Miles)	Habitat (Acres)
Mouth to Pontiac Dam	1	7.47	78.63
Pontiac Dam to Natick Dam (Potential)	2	2.51	39.46