

The Return of the King

Assessing Viable Habitat in Massachusetts for the Repopulation of Sea-Run Atlantic Salmon (*Salmo salar*)

Introduction

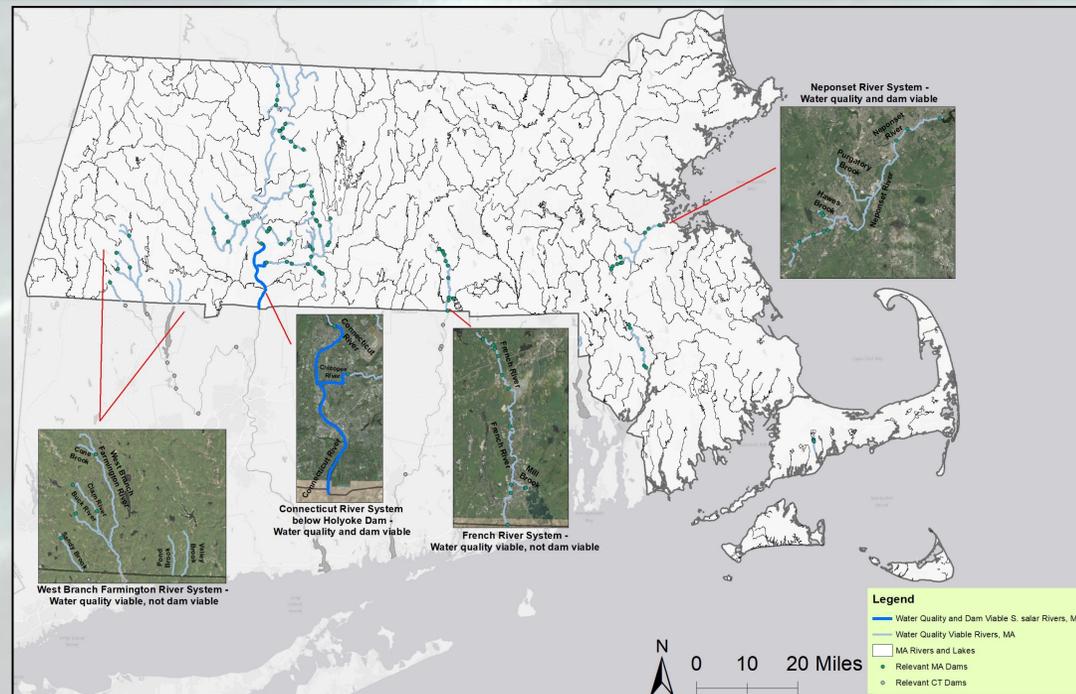


The Atlantic Salmon (*Salmo salar*) is an anadromous salmonid species native to the North Atlantic Ocean, often referred to as the "King of Fish" (NOAA). In the past, *S. salar* populations spawned throughout the rivers of New England from the Housatonic River in Connecticut northward. The advent of the industrial revolution (early 1800's) resulted in reduced water quality and dams prohibitive to anadromous fish spawning runs, at which point consistent US populations of Atlantic Salmon became limited to Maine's Penobscot River and its tributaries (notwithstanding the presence of stocked landlocked Atlantic Salmon in a select few MA reservoirs, illustrated below).

In recent years, MA and other New England states have sought to improve water quality and dam passability for anadromous fish spawning runs, mostly to increase sea-run populations of Blueback Herring (*Alosa aestivalis*) and Alewife (*Alosa pseudoharengus*). Although these efforts have mostly focused on adding fish ladders (which salmon are unable to use successfully), a side consequence of the dam removal portion of this work has been an increase in the possibility that *S. salar* populations may return to rivers in MA. Speculation about the return of *S. salar* was further fueled by the discovery of salmon eggs in Connecticut's Farmington River (a Connecticut River tributary) during November of 2015.

Therefore, an analysis of MA rivers was conducted to determine which locations would be most likely to support future *S. salar* spawning runs. To determine these locations, I considered both dam presence and salmon-specific water quality requirements.

Water Quality and Dam Viability of MA Rivers for *Salmo salar* Repopulation



Findings

My analysis found that the only currently viable waterways in MA for salmon spawning based on water quality requirements and dam presence are the Connecticut River below the Holyoke Dam and the lower reaches of the Chicopee River (a Connecticut River tributary) below the Chicopee Falls Dam. Multiple other waterways met water quality constraints but would need significant dam removal efforts in order to facilitate future salmon runs. Interestingly, very few water quality viable rivers with mouths north of Cape Cod were present (with the exception of the Neponset River system). This finding is unfortunate as salmon are a cold water species and climate change is likely to be an increasingly important factor that would prevent *S. salar* runs from returning to river systems that empty south of Cape Cod (where water is much warmer due to the Gulf Stream).

These findings show WQ improvement efforts have brightened the outlook for the return of *S. salar* spawning runs to MA, but increased dam removal efforts would be necessary to truly allow for the development of sustained spawning runs. Overall, despite current water quality viability for *S. salar* spawning in multiple MA rivers, high dam presence plus the increasingly ominous specter of climate change make it unlikely for salmon to return to the rivers of MA in the future.

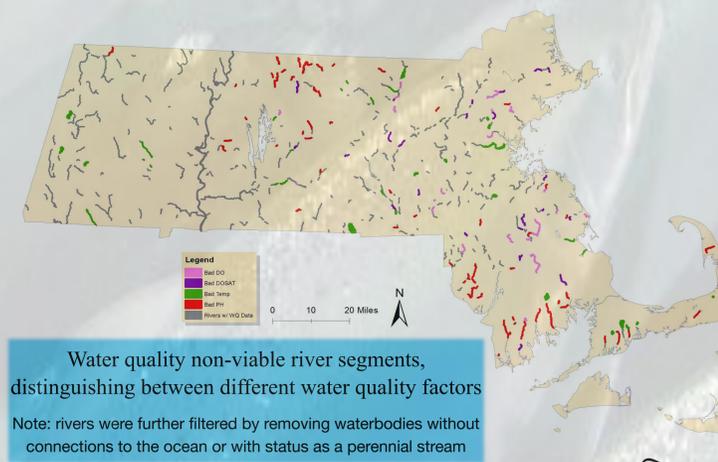
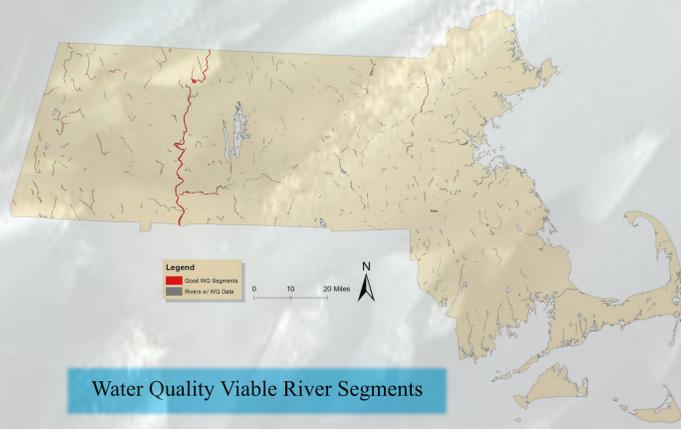
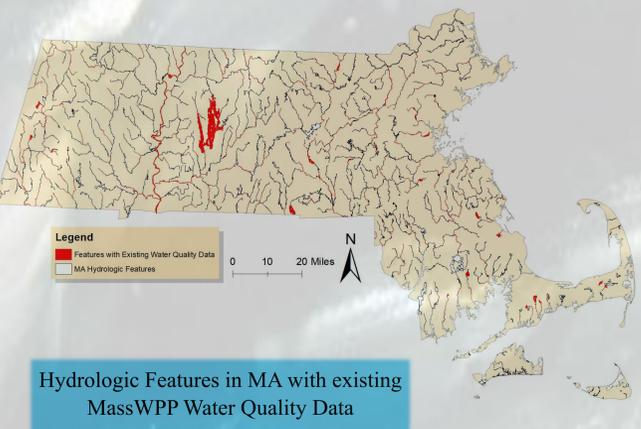
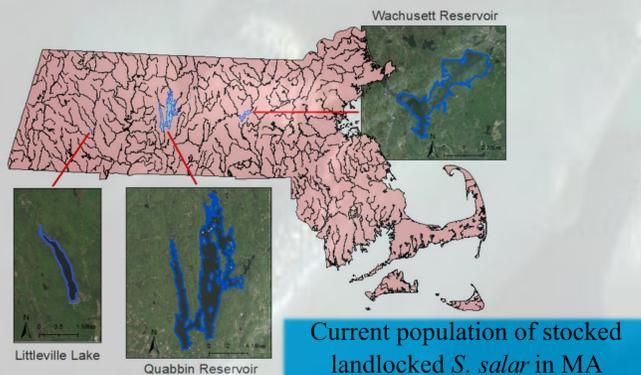
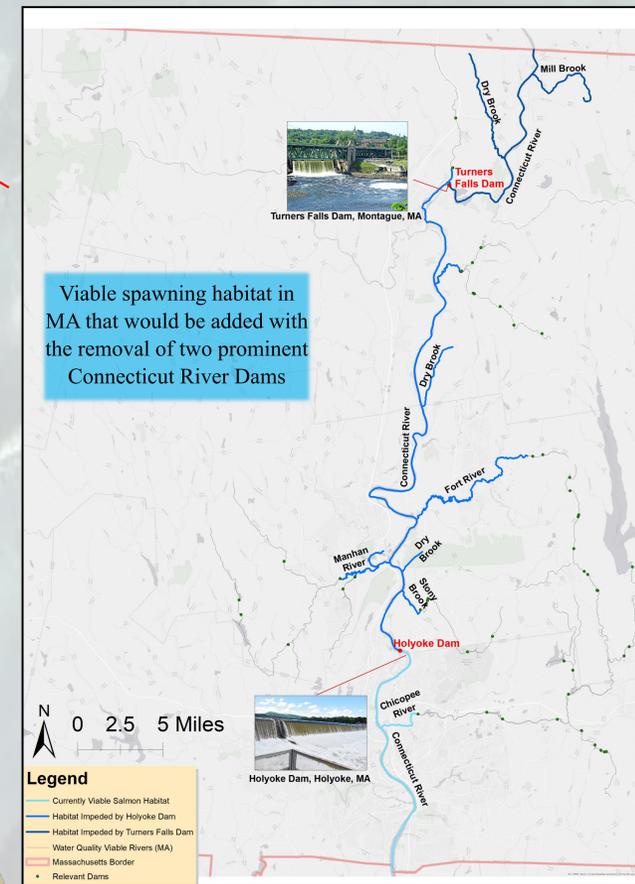
Methodology

To conduct this analysis, attended probe water quality data from the MASS GOV Watershed Planning Program (WPP) was used. These data included measurements for temperature, dissolved oxygen, saturated dissolved oxygen, and pH. It is important to note that water quality data has not been collected/published for all MA rivers; therefore, rivers without any listed water quality measurements were excluded from this analysis.

Suitable water quality was determined from background research on the survival requirements for salmon smolt (juveniles), as smolt have stricter water quality requirements than adult salmon. Rivers were further filtered by connection (both direct and indirect) to the ocean and status as a perennial or permanent stream.

Relevant dam point data was also included in analysis of viable habitat. An additional map was made showing key rivers that would be viable for spawning if dams were removed.

Water quality conditions necessary for <i>S. salar</i> survival	
Temperature (°C)	<22.5 °C
Dissolved Oxygen (DO)	>6 mg/l
Saturated Dissolved Oxygen (DOSAT)	>75% saturation
Acidity (pH)	>6.5



Luke Briccetti—5/7/2019
Intro to GIS (ENV 107)



Projection: Lambert Conformal Conic

Coordinate System: Massachusetts NAD State Plane (2001)

Data Sources: MassWPP, Mass.gov, MASSGIS, ESRI, NOAA, Tufts M-Drive

Photo Sources: World Wildlife Fund, NOAA fisheries, Bill Dickinson Photography, Daily Hampshire Gazette, Maphill