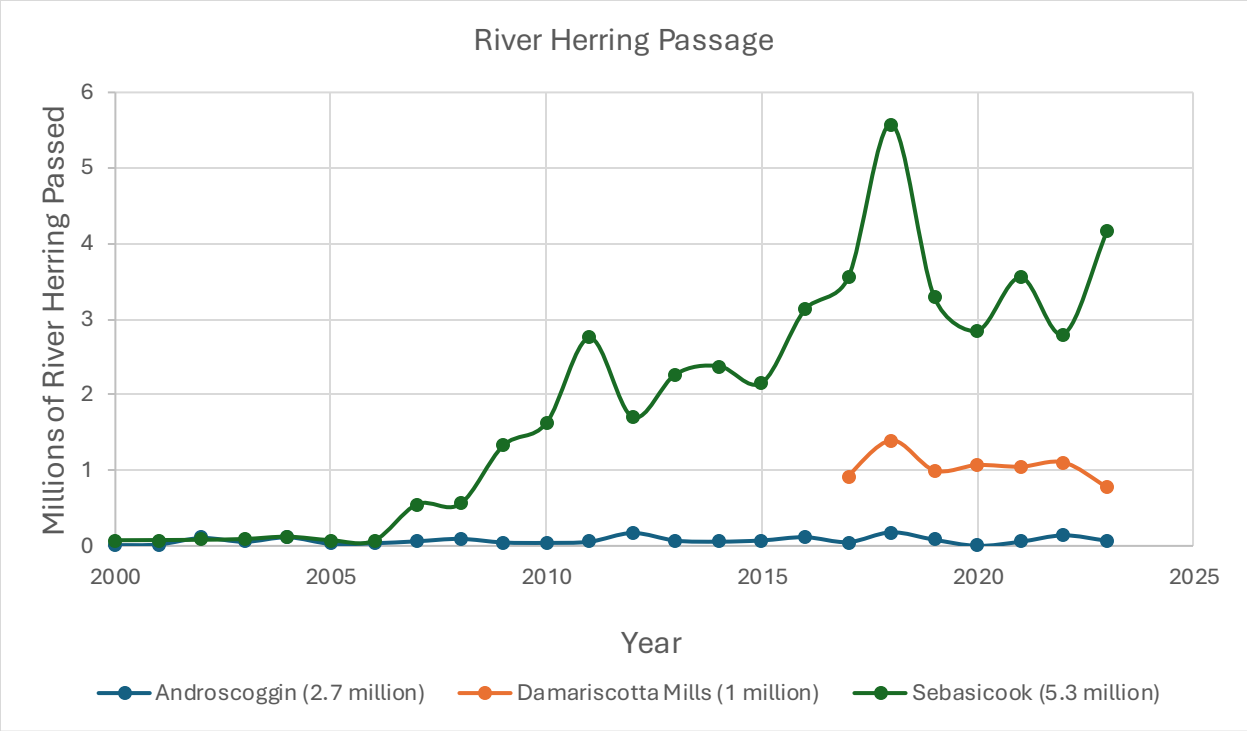

Figure 1. River herring passage at Brunswick on the Androscoggin River, Damariscotta Mills, and Benton Falls on the Sebasticook between 2000-2023 in millions of fish passed. Estimates of potential river herring production are given. By 2009, two dams had been removed and three fish lifts installed in the Sebasticook/Kennebec system allowing passage of millions of river herring. In 2017, the Damariscotta Mills fishway had been reconstructed allowing passage of ~1 million alewives each year into a single lake. The Androscoggin, however, has been left behind with inadequate fish passage. The fishway at Brunswick has only passed 71,087 river herring on average each year between 2000 and 2023, only 2.6% of its potential productivity.

Shad surveys

In 2011, Professor John Lichter and Bowdoin College students worked with NextEra Energy, the owner of the Brunswick hydroelectric at that time, along with the Maine Department of Marine Resources, U. S. Fish and Wildlife Service, and the Androscoggin River Alliance to conduct an experiment to determine whether upstream passage of American shad could be improved by increasing the water flow of the attraction stream at the Brunswick Fishway. In 2013, the experiment was repeated in collaboration with Brookfield Renewable Power. The results were reported in the American Shad Habitat Plan, Maine Dept. of Marine Resources, 2020. Relatively few shad made it to the entrance of the fishway despite thousands being in the tail race. Since 2013, Professor Lichter, Bowdoin College students, and the Friends of Merrymeeting Bay have used an ARIS hydroacoustic instrument to count American shad moving upriver toward the fishway from a point just below the F. W. Wood bridge on the Brunswick side of the river. The following student report and table 1 describe these surveys along with the results. To summarize, there were usually 1000 to 7500 American shad counted moving upriver in a single tidal cycle (4-6 hours) each year,

whereas only a few hundred at most were successful finding the fishway and scaling the ladder in a given year.

Relevant studies

Willelhauser, G. S. 2012. Shad passage study at Brunswick Project. Maine Dept. of Marine Resources.

Maine Department of Marine Resources. 2020. American Shad Habitat Plan. With contributions by M. LeBlanc (Brookfield Renewable Energy), J. Stevens (NOAA), J. Lichter (Bowdoin College).

Bowdoin student work in 2017

Efficacy of fish passage over the Brunswick-Topsham hydroelectric dam by American shad (*Alosa sapidissima*) in 2017

Meera Prasad ('19), Biology Department, Bowdoin College

Faculty mentor: John Lichter, Professor of Biology and Environmental Studies

Dams at Brunswick-Topsham have obstructed passage of anadromous fish species migrating upriver to preferred spawning habitat in the Androscoggin River since the early 19th century. The American shad is a key anadromous fish species that historically migrated as far as Lewiston, Maine to spawn each year. However, dam construction, overfishing, and water pollution decimated the shad population along with several other anadromous fish species over the last three centuries. Shad is an important component of Maine's river ecosystems. Their young-of-year consume and export excess nutrients out of the riverine ecosystem and after migrating out to sea, they serve as a prey base for several piscivorous fish species in the Gulf of Maine.

In 1982, a volitional fish ladder was constructed at Brunswick-Topsham to facilitate fish passage at the dam. However, the fish ladder has not been effective for American shad. To quantify shad attempting to migrate upriver at Brunswick-Topsham, I used an ARIS Sonar instrument to count fish moving past a point below the bridge connecting Brunswick and Topsham on the Brunswick side of the river. This acoustic technology provides video-like recordings of fish passing through an approximately 8 x 20-m footprint (Figure 1). Over six sample days lasting 5-6 hours each, I recorded an average of 3495 migrating shad between June 21 and July 18 moving upriver past the sonar footprint. The peak of the migration was on July 10 in which 4791 shad were observed. At the top of the fish ladder, an employee of the Department of Marine Resources or a volunteer counts the number of fish that successfully make it to the top of the ladder. Only a single shad made it to the top of the ladder indicating that there are many more shad attempting to scale the ladder than actually succeed. Although I was able to get clear video imaging of the river ecosystem, the sonar footprint only reached halfway across the river channel below the tail race of the dam (Figure 2). Thus, my counts were at best minimal estimates of the number of shad present.

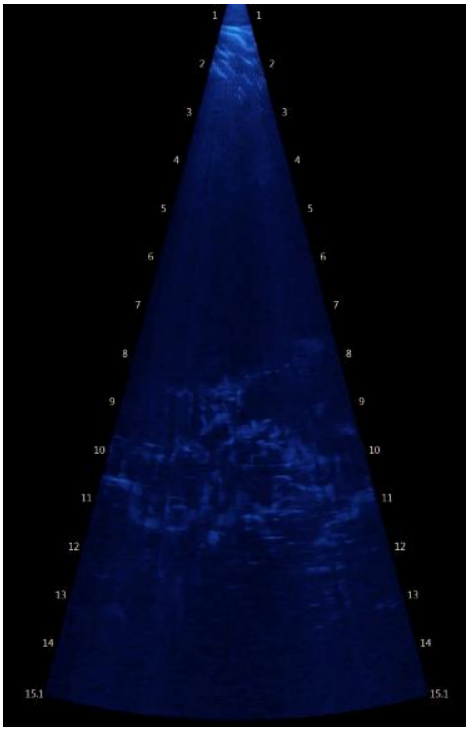

Figure 2. Underwater image from the ARIS Sonar. The light blue fish at the top of the sonar footprint are American shad. The rocky bottom is visible out at 9 to 12 meters.

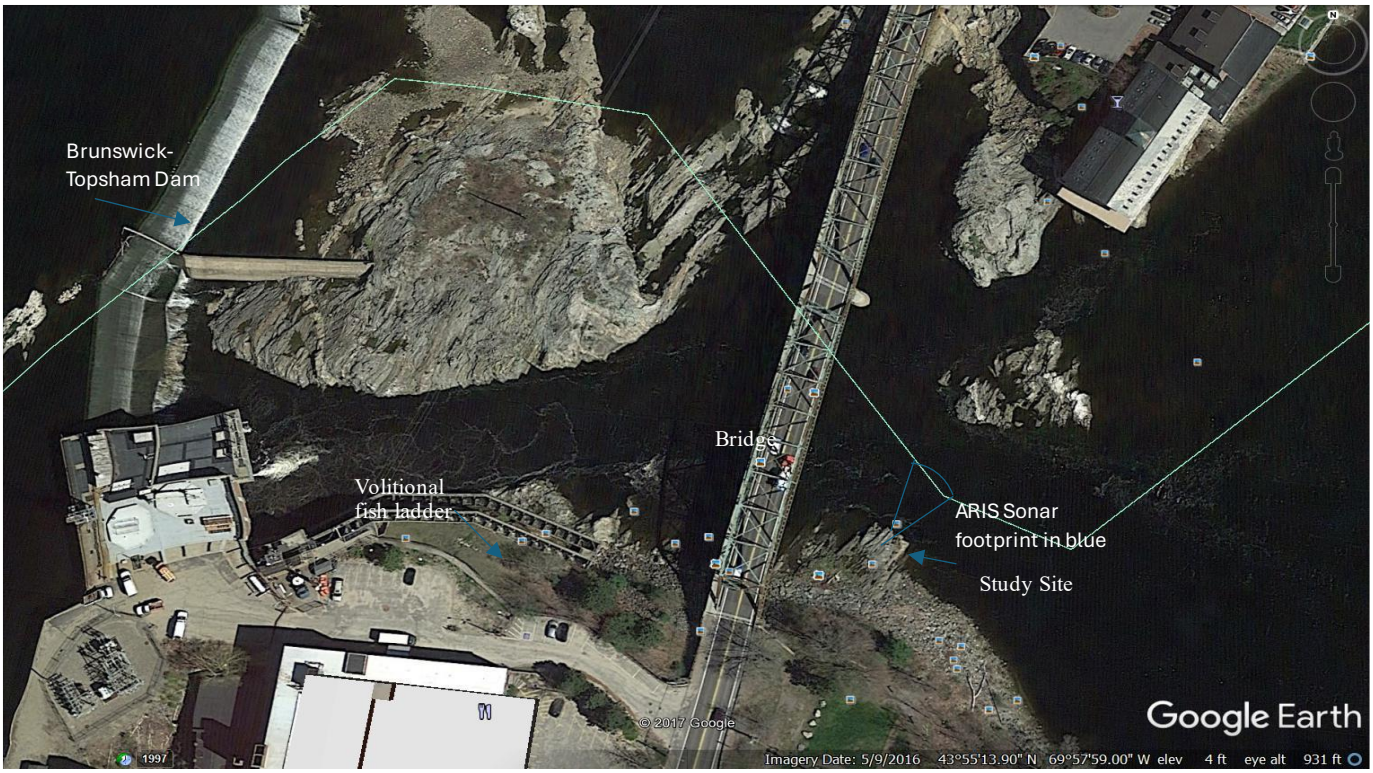

Figure 3. Aerial view of study site.

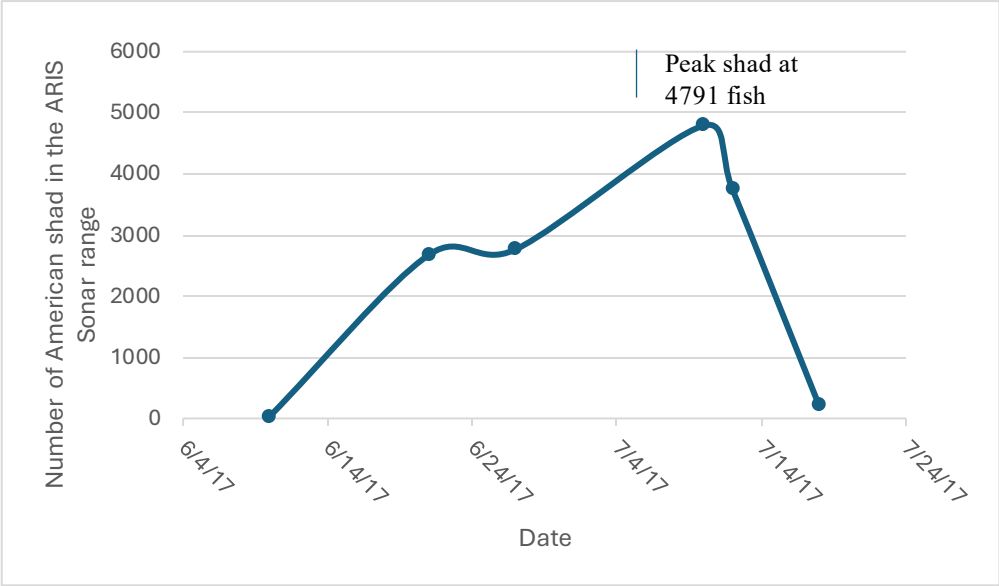

Figure 4. Number of American shad counted for 5 days over the 7-week period of the migration run.

Table 1: Minimum number of shad moving toward dam in a single tidal cycle recorded with ARIS sonar and the number of shad successfully finding and scaling the Brunswick Fishway ladder through the entire season.

	#Shad downriver	#Successful shad
7/10/2017	4791	1
7/5/2021	1459	550
6/24/2022	1382	228
5/15/2023	~7500	14
6/18/2024		

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