River Herring Telemetry Activity

Grade Level	Time	Topic
7	1 hour	River Herring Migration - Telemetry

Objectives	Standards
• Understand the importance of river herring in the ecosystem. • Understand how human changes to the habitat may affect river herring migration and reproduction.	**NGSS Standards** • **MS-LS2-4.** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. **Massachusetts STE Standards** • **7.MS-LS2-4.** Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations. **Ocean Literacy Principles** • **Ocean Literacy Principle 5**: The ocean supports a great diversity of life and ecosystems. • **Ocean Literacy Principle 6**: The ocean and humans are inextricably interconnected.

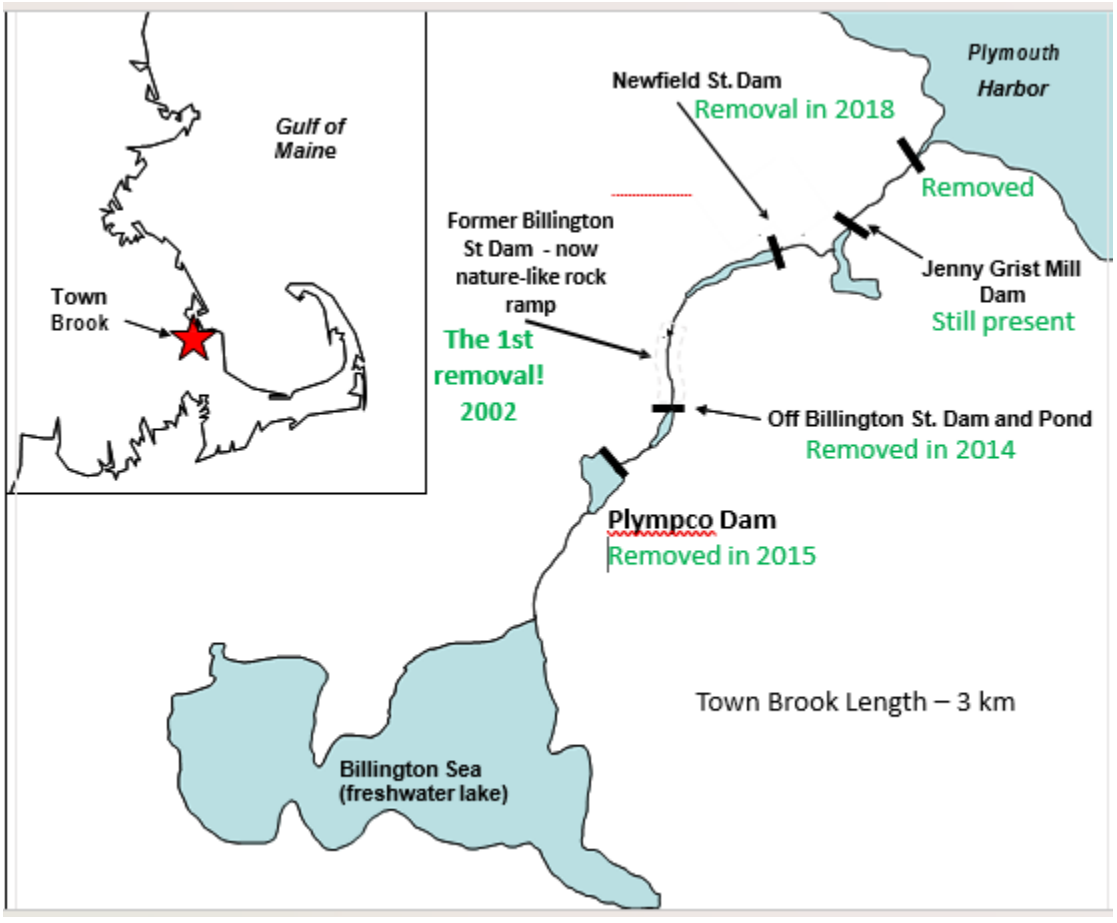
Background:

River herring (alewife or blueback herring) are migratory fish that range along the East Coast from Florida to Maine. They are diadromous fish meaning they spend part of their lives in saltwater and part of their lives in freshwater. There are 13 diadromous species in Massachusetts, including river herring, American eels, Atlantic sturgeon, American shad and more. Each spring, millions of river herring migrate to Massachusetts rivers returning to where they were born to lay their eggs. The young fish will stay in the freshwater until they are mature enough to migrate to estuaries (where the freshwater meets the saltwater). Eventually, adults will head out into the saltwater to eat and get bigger.

River herring are a key species within the food chain for other recreational and commercial fish, such as cod, haddock and striped bass. Their declining numbers due to predation, bycatch, and other human-made obstacles have been observed in recent years. Herring themselves feed on zooplankton, small fish, and the eggs and larvae of other species.

Herring are not jumpers, so obstacles such as dams and culverts can cause significant problems in their ability to successfully reach their spawning grounds. Fish ladders are often not that effective at offering the fish an alternative to getting by the dams. They are better than nothing - but sometimes the fish have a hard time finding the entrance, or swimming up the ladder if the water flows are too fast or if there are flood or drought conditions. They are most successful when they are traveling along streams and rivers that have overhanging vegetation that provides shade and protection from predators. Rocky bottoms allow for greater camouflage with their darker colors. Herring are schooling fish and will move together in groups as they travel up and down the rivers. Out in the ocean, they also maintain their numbers as a way to provide safety.

The data used in this lesson comes from a project done at Town Brook in Plymouth, Massachusetts. A series of dams located between Plymouth Harbor and Billington Sea (a freshwater lake used by river herring for spawning) were removed starting in 2002 and culminating in the removal of the Newfield Street/Holmes Dam in 2018.



From mid April to early May of 2018, 108 river herring were tagged with Passive Integrated Transponders (PIT) tags to track their journey in Town Brook. This is in essence a microchip that does not have internal power but relies on special "antennas" (loops of wire around the river) that activate the tag when it gets close. It is the same technology you see in an "E-Z Pass" you use when driving on the highway. The tag is inserted under the skin of the fish (it does not hinder them) and has a unique identifier so that we can track individual fish. While the dam was still in place, 25% of the river herring were able to travel up to their spawning pond. During the same time period, 75% of the river herring attempted fish passage or travel to their spawning grounds but did not reach them. The average transit time was 4.12 hours.

The same experiment was done in 2019 after the Newfield Street/Holmes Dam was removed. In 2019, post dam removal, 92% of the fish made it to their spawning grounds and 8% attempted but were not successful. The average transit time was 53.7 minutes. To learn more about the Plymouth project, visit: Swimming Upstream: Journey through 20 years of restoration of Town brook in Historic Plymouth, Massachusetts story map.

Understanding river herring migration and life history is important as river herring are key components of coastal communities and ecosystems serving as both a food source and indicator of environmental health.

In this activity, you will follow the path of your fish as it journeys up Town Brook to its spawning grounds. You will be given data for one fish in 2018 when the dam was still in place and one fish in 2019 after the dam was removed. You will track your fish and then answer questions about its journey.

Materials:

- River herring telemetry worksheet
- Dry erase marker
- Pencil
- 2 maps – "TownBrookMap_Dam Present" and "TownBrookMap_Dam Removed"
- Class set of river herring tracks from 2018, "Fish tracks_dam_present_class set"
- Class set of river herring tracks from 2019, "Fish tracks_dam_removed_class set"
- Teacher "cheat sheet" or answer key for 2018
- Teacher "cheat sheet" or answer key for 2019

Directions:

Each student will be tracking their own fish and then answering questions about their migration. Make sure each student gets a map of 2018 where the dam is still in place, a fish sheet from 2018, and a telemetry worksheet. Based on your class size, use the answer key to hand out fish to ensure 25% success in getting to the spawning pond. When you calculate your class success rate this will mimic the scientific findings.

Once the students have finished mapping their fish and filling out the front half of the worksheet, discuss your results.

Next, hand out a new map from 2019 where the dam is gone. Each student should be given a new fish from 2019. Use the answer key when handing out fish to ensure a 92% success rate to mimic scientific findings. They should map their fish's journey and fill out the back of the telemetry worksheet.

Use the worksheet to discuss things such as:

- How much effort or time did it take your fish to migrate upstream when the dam was in place? They may mention the time it took or the number of attempts their fish made to support their statements. Compare that to when the dam was removed. What do you observe?
- What was the class success rate in 2018 versus 2019? Was it what you expected? Why or why not?
- How does this data help us with river herring conservation?