IPSWICH RIVER
WATERSHED ASSOCIATION
The Voice of the River

Herring Count Volunteer Monitoring Program

2018 Annual Results Report

The Ipswich River Watershed Association (IRWA) is the voice of the Ipswich River. IRWA works to protect nature and make sure there is enough clean water for people, fish and wildlife today and for our children and theirs.

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Introduction to the Herring Count

The Ipswich River Watershed Association (IRWA) has organized one of the longest running annual herring counts in the region, which take place each spring at the fish ladder on the Ipswich Mills Dam in downtown Ipswich. Many groups conduct annual herring counts as a way to monitor the population status of this important fish that is now at historically low levels. The purpose of the count is to calculate statistically reliable run-size estimates and to determine when and under what conditions river herring use the fish ladder during the spring migration. Run size estimates are calculated and reported to the Massachusetts Division of Marine Fisheries (DMF) to track herring stocks and inform management of this fishery. This report describes the Ipswich River volunteer herring count and results for 2018. Also described are results from an underwater video camera, first installed in 2015 to supplement the volunteer counts.

Many volunteers are responsible for the success of this program. We would like to thank Kate Hone for her outstanding management of the herring count program as well as the many volunteers who have participated as counters over the years, including Lindsay Williams, Bruce Amazeen and Ben Flemer and the many other individuals who contribute their time to perform visual counts at the Ipswich Mills Dam fish ladder.

River herring is a collective term applied to the closely related Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*) (figure 1). Both species are anadromous, spending most of their lives at sea and migrating to freshwater in the spring to spawn. Both species are native to the Atlantic coast of North America. Historically these fish were present in most rivers and tributaries along the coast, but mostly due to overharvesting and loss of spawning habitat, many runs have declined by as much as 95% (Herring Alliance, 2007).

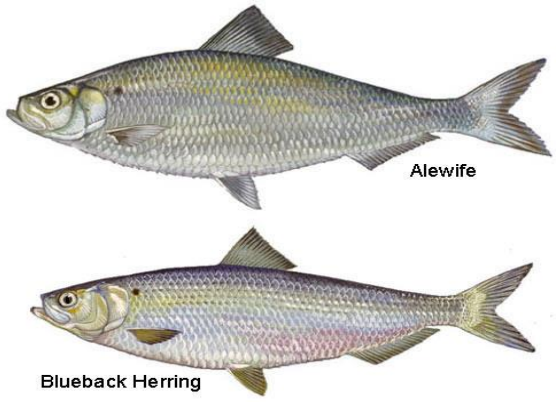

Figure 1. Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalus*) are collectively

River herring are an important link to the marine and freshwater food webs. By recycling nutrients, they can affect the productivity and water quality of freshwater and estuarine systems (MBL PIE-LTER, 2013, NMFS, 2012). They consume plankton and are themselves forage fish for many marine predators and birds.

Historically the Ipswich River, like many coastal rivers, supported a robust population of alewife. Since the early 1800's, a combination of factors has greatly diminished this population. The installation of the Ipswich Mills and Willowdale dams blocked fish passage and early fish ladders proved ineffective. The Ipswich Mills dam now has a relatively new denil fish ladder with wooden baffles, which is the most effective type of fish ladder; however, all fishways are inefficient for the passage of most species. The Willowdale dam has an older, mostly non-functional notched weir-pool fish ladder. The Bostik dam in Middleton has no fish ladder and is impassable (figure 2). There are currently over 70 dams or dam-like structures throughout the Ipswich River watershed with little or no fish passage. Furthermore, the transformation of historic alewife spawning lakes and ponds, such as Wenham Lake, into water supply reservoirs (Belding, 1921) and chronic low-flow and no-flow periods caused by water supply withdrawals may impair the herrings' spawning habitat and prevent migration of juvenile and returning populations. For these reasons, the herring population was driven to low numbers and few herring are now observed. Because river herring return to their natal rivers to spawn, their absence is a good indicator of a lack of access to suitable spawning habitat. As indicators of habitat connectivity, the low numbers of returning herring suggest that removing barriers to fish migration and increasing flows are critical steps to restoring migratory fish to the Ipswich River.

Figure 2. From left to right: Ipswich Mills Dam denil fish ladder, Willowdale Dam notched weir-pool fish ladder and Bostik dam with no fish passage.

If restored, the Ipswich River could provide significant spawning potential for river herring as well as other anadromous fish species such as American shad (Reback, *et al*., 2005). There are currently 278 acres of potential spawning habitat in the watershed comprised of 5 ponds, the Great Wenham Swamp and portions of the main channel of the Ipswich River with a spawning potential for over 500,000 river herring (Purinton, *et al*, 2003) (figure 3).

Restoration attempts, through restocking have not been successful, however. Over 46,000 river herring were introduced to the Ipswich River from 1990-2007. In order to determine the results of restocking efforts, DMF maintained a fish trap at the fish ladder on the Ipswich Dam during the spring of 2006-2008. Only modest numbers of herring were counted in the traps, so restocking efforts were discontinued in 2007. Subsequent studies have shown that release location may impact the success of restocking (Mather, *et al*., 2012) and this has been shown by modest gains after restocking herring to small streams and ponds in other north shore rivers (Sartwell, 2013).

Restoration of river herring has been the focus of ongoing work. Water quality monitoring took place during the spring and summer months from 2015-2017 on Hood Pond and Martins Pond according to the guidelines of a MassDEP approved Quality Assurance and Program Plan (Chase, 2010). The QAPP relates river herring life history to water quality standards to determine the suitability of a pond to support the spawning and development needs for river herring. The goal of this project is to reintroduce river herring to historic spawning ponds to restart the migration cycle.

The purpose of the herring count is to determine when and under what conditions river herring are migrating into the Ipswich River. Although restocking was discontinued, we are continuing to monitor herring to calculate statistically reliable run-size estimates as well as track environmental conditions. This report describes the counting procedure, analysis methods and results for 2018 and includes estimates for previous years. Results are discussed in light of the factors that have reduced numbers of herring and the need for continued monitoring including results from the video camera to capture the infrequent and sporadic timing and variety of species comprising the run.

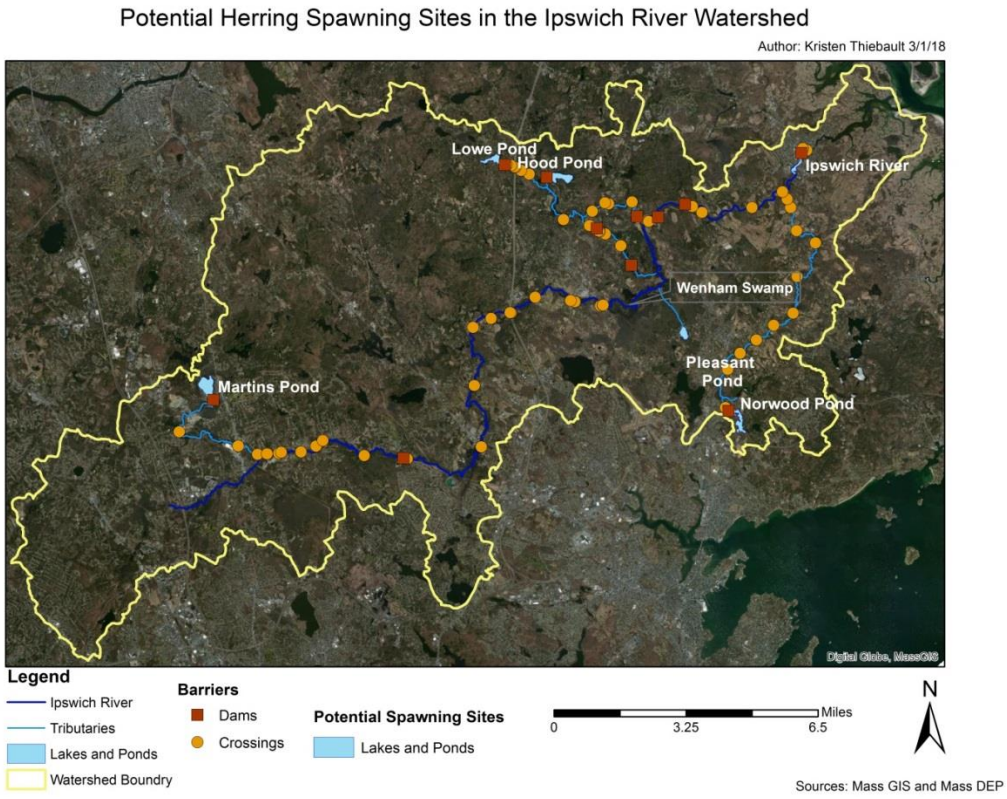

Figure 3. Lakes and ponds in the Ipswich River Watershed identified as potential spawning habitat for alewives in Purinton, *et al*. (2003).

Herring Count Description and Results

The 2018 volunteer herring count and video monitoring took place from April 1st to June 6th. During the 2018 counting period, trained volunteers looked for and counted returning herring during ten minute shifts between 7am-7pm. During each shift, volunteers watch the fish ladder for upcoming fish and record however many they see. Herring are only counted if they cross the counting board, heading upstream (figures 4 and 5). In 2018, 39 volunteers performed a total of 286 individual counts while recording 27 herring using the fish ladder. The first herring was sighted on April 22nd and the most daily sightings were 2 on May 9th, 12th 14th 18th and June 2nd. The last herring was observed on June 2nd.

Figure 4. Counting location at the top of the fish ladder on the Ipswich Mills Dam.

Figure 5. View of the counting board from the perspective of a fish counter standing on the walkway. The camera housing is on the left.

A statistically based run size estimate is determined using a program designed by DMF and based on the work of Nelson (2006). Volunteer count data are entered into a program and design parameters are chosen. The recommendations consist of having 3 ten-minute counts during three daily periods (7am-11am, 11am-3pm and 3pm-7pm) from April 1st to mid-June. There must be at least 2 mean counts per period and if this is not achieved with the 3 period design, then the two periods (7am-1pm, 1pm-7pm) are designated and a one-way design is used if there are less than 2 mean counts for the 2 period design. In 2018, 2.1 and 2.7 mean counts were achieved for 2 periods, so this design was used. The parameters entered for the 2018 analysis are recorded in Table 1. This resulted in a run size estimate of 486 +/-228. Annual count details are summarized in Table 2 and figure 6.

Survey Design Parameter	**Input value**
Count Interval (min.)	10
Day Length (hrs.)	12
Number of Periods	2
Counting Period Times (24 hr.)	07:00-13:00, 13:00-19:00

Table 1: Survey Design input parameters for 2018 run size analysis.

Visual Counts									
Year	Number of Volunteers	Herring Counted	Number of Counts	Days of Count	Mean Counts/Day	Run Size Estimate	Standard Error (+/-)	Herring Numbers from Division of Marine Fisheries trap	Herring Numbers from IRWA Video Camera
1999		53	248	47	5.3	949	284		
2000		35	282	38	7.4	440	92		
2001		77	211	64	3.3	1255	250		
2002		73	209	70	3.0	2726	1529		
2003		41	270	73	3.7	668	200		
2004		55	397	63	6.3	381	56		
2005		88	503	54	9.3	691	96		
2006		57	270	38	7.1	677	200	377	
2007		15	312	62	5.0	213	72	158	
2008		133	384	75	5.1	2125	436	131	
2009		117	309	60	5.2	1603	225	254	
2010	54	15	259	58	4.5	268	91		
2011	70	48	421	72	5.8	663	194		
2012	44	55	365	70	5.2	756	297		
2013	42	31	413	60	6.9	294	176		
2014	51	14	467	68	6.9	126	34		
2015	22	32	294	60	4.8	320	81		282
2016	49	95	328	63	4.6	1,107	847		295
2017	31	24	223	64	3.2	563	198		299
2018	39	27	286	69	4.1	496	228		359

Table 2. Summary of annual visual count data for river herring, including trap counts from Division of Marine Fisheries (2006-2009) and video camera counts (2015-2018).

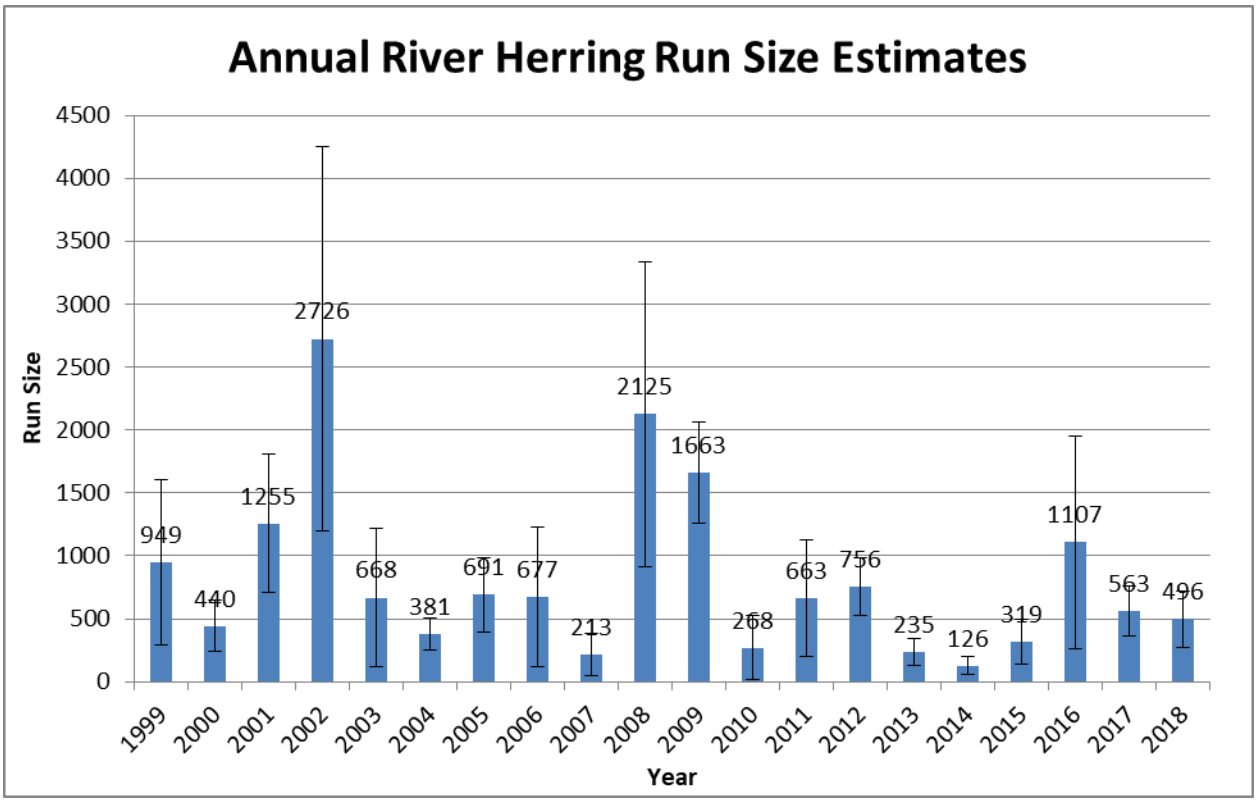

Figure 6. Annual run-size estimates for Ipswich River herring counts, 1999-2018.

Environmental data were also recorded by volunteers during each counting shift. Water temperature, air temperature and cloud cover are recorded to track under what conditions herring are seen. Over 95% of herring have been observed through visual counts while water temperatures are between 10 and 22°C with run numbers peaking around 18°C. The cumulative volunteer data show no clear trend in herring migration under certain cloud cover conditions.

The video camera was successfully utilized alongside the volunteer count. The video camera was operated through a laptop computer using free iSpy security software to record and store footage when activity reached a certain threshold. Footage was stored locally and downloaded at least weekly. Volunteers watched the footage and recorded however many herring or other species were present and the time. A summary of the video footage is presented in table 3. A total of 359 herring were recorded, less than the volunteer run size estimate of 496, but within the error range of +/-228. The occurrence of other species, particularly migratory species such as lamprey and eel are also noteworthy and the video camera will allow these species to be tracked more closely in the future to establish any trends.

Recording herring migration during the entire 24 hr. day was one of the goals of operating the camera. The volunteer count does not take place at night, however, the entire record of volunteer data since 1999 show about 50% of herring observed between 3pm and 7pm. Other runs in southern New England have observed herring during overnight hours, so the video data was reviewed to determine if herring were running at night in the Ipswich River. The video camera records in black and white and is equipped with infrared LED lights to record objects under low light conditions. A reflective background opposite the camera increases illumination in the camera box for clearer identification. The video data clearly show almost all herring migrating between 6am and 6pm in 2018 as well as prior years. Other migratory species; American eel and lamprey were also observed primarily during daylight hours.

Year	Herring	Lamprey	Eel
2015	428	34	33
2016	276		
2017	299	20	9
2018	359	12	3

Table 3: Total numbers of migratory species (herring, lamprey and eel) recorded through analysis of video footage.

Conclusions

The Ipswich River herring count has been successful from the standpoint of high volunteer participation, strong counting effort and as one of the longest running counts in the region. However, historically low numbers of river herring continue to be recorded despite the introduction of over 40,000 herring and upgrades to the Ipswich Dam fish ladder. Run sizes are healthier in the nearby Parker River indicating that habitat loss remains an obstacle to recovery. The goal of this program is to continue collecting valuable data to calculate run size estimates and monitor environmental conditions of the herring run while raising awareness of the need for continued monitoring and restoration efforts.

Thanks to funding from the Norcross Wildlife Foundation and the Quebec Labrador Foundation, we were able to purchase and install an underwater video camera system in 2015 to supplement the volunteer count. The video camera has been successfully deployed and maintained each year and the data has been valuable in documenting the timing of the herring run and verifying volunteer identifications.

There is an opportunity to more closely monitor environmental factors to give a more accurate understanding of how this may be related to herring migration. Water temperature was correlated with the herring run according to the recommendations of NMFS (2012). However, this is the temperature recorded in the impoundment, above the dam, by volunteers. Knowing the ocean surface temperature during each day of the run might also be useful since this may be the initial trigger for herring to migrate up river. Also, correlating the tide cycle with the timing of the run might show if this is related to when herring arrive at the fish ladder.

River herring are excellent indicators or habitat connectivity in a watershed. By documenting low numbers or herring returning to the Ipswich River during the spring migration, volunteer counters have contributed greatly to our understanding of the degree of this impairment. This understanding will benefit continued restoration efforts to improve access to suitable spawning habitat. Removal of barriers to migration will not only benefit river herring, but other anadromous and non-migratory fish that need access to different river habitats. Restoring river herring will have benefits for commercial fisheries, wildlife and improvements to water quality.

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