IPSWICH RIVER WATERSHED ASSOCIATION

Herring Count Volunteer Monitoring Program

2015 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 2015. Also described are results from an underwater video camera we first installed this year 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 volunteer counters over the years, including Lindsay Williams, the 2015 Golden Fish Award recipient for completing the most counts.

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).

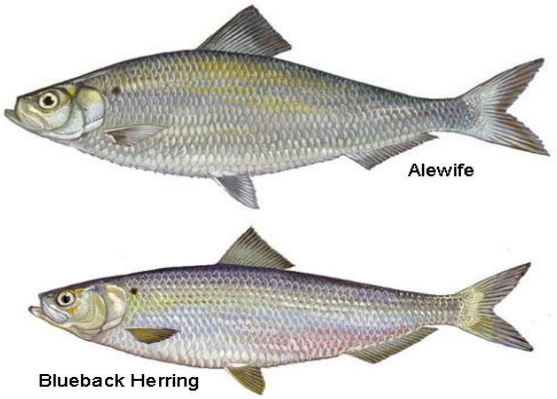

Figure 1. Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalus*) are collectively

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 dam 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 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).

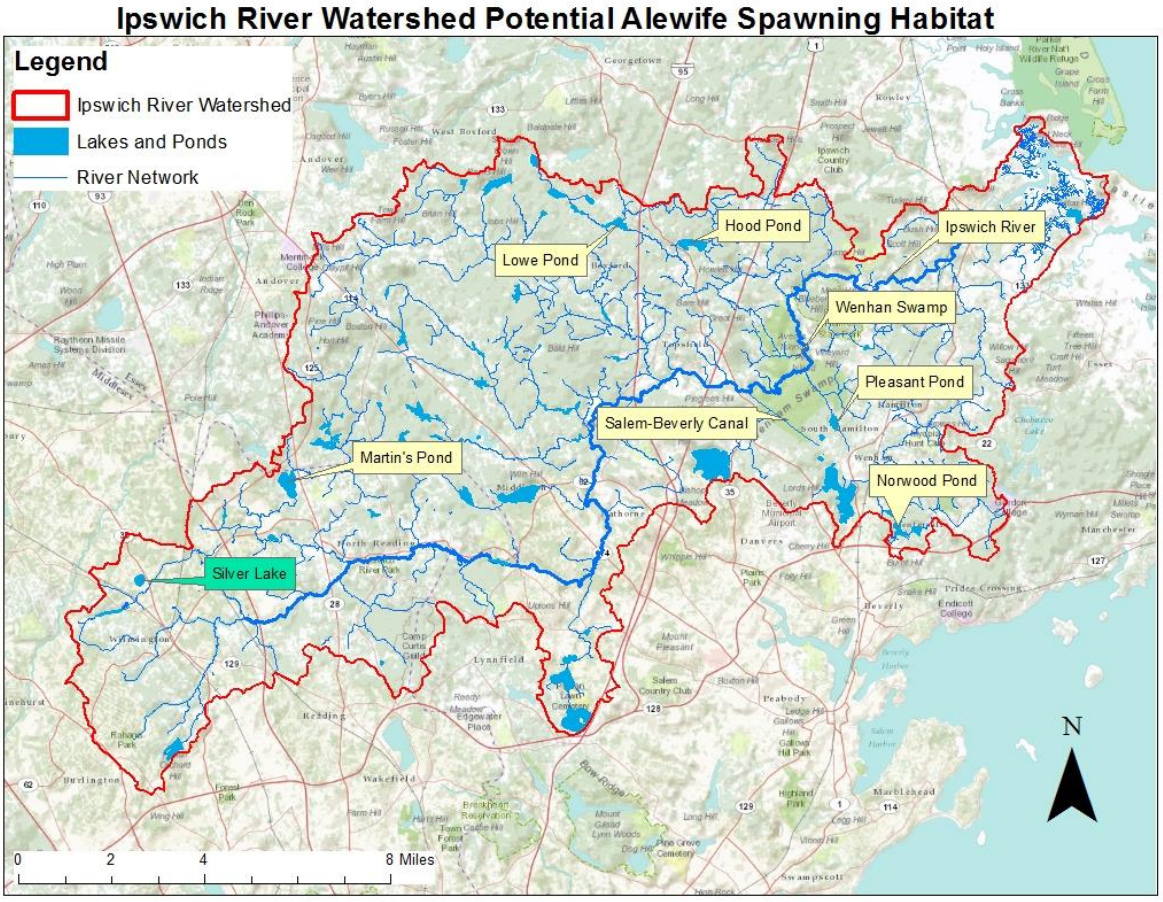

Figure 3. Lakes and ponds in the Ipswich River Watershed identified as potential spawning habitat for alewives in Purinton, *et al*. (2003) (beige). Silver Lake (green) is another potential site not included in this earlier report.

The Ipswich River herring count began in 1999 to monitor restocking efforts while recording 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 2015 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 first attempt using a video camera to capture the infrequent and sporadic timing and variety of species comprising the run.

Herring Count Description and Results

The 2015 volunteer herring count took place from April 8th to June 4th while the video camera operated from April 21 to June 9. Normally, we begin around April 1, but the longer than normal winter conditions delayed operations. During the 2015 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 2015, 23 volunteers performed a total of 293 individual counts while recording 32 herring using the fish ladder. The first herring was sighted on April 23rd and the most sightings occurred on May 6th (12). The last herring was observed on May 29th.

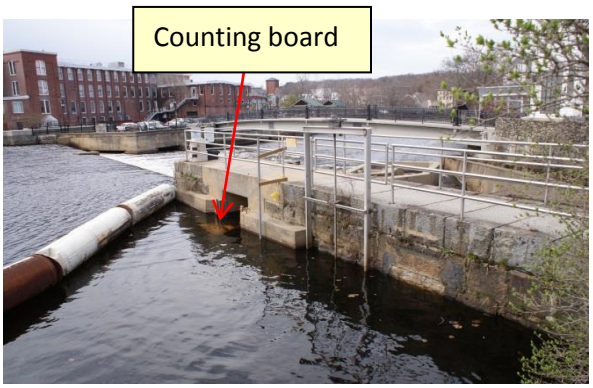

Figure 4. Counting location at the top of the fish ladder on the Ipswich Mills Dam. Note the location of the counting board in relation to the fish ladder visible in

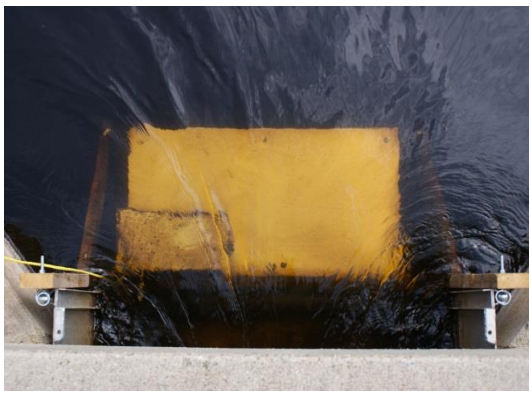

Figure 5. View of the counting board from the perspective of a fish counter standing on the walkway. The camera housing is not present in this photo.

A statistically sound 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. Three periods can be used as long as there are at least 2 mean counts per period or the design using two periods (7am-1pm, 1pm-7pm) must be used. In 2015, there were 1.5, 1.7 and 1.7 mean counts for each period respectively, so the two-way count design with 2 periods was used. The parameters entered for the 2015 analysis are recorded in Table 1. This resulted in a run size estimate of 319 +/-178. 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 2015 run size analysis.

Visual Counts							DMF trap (Alewife) and IRWA video results (2015)
Year	Number of Volunteers	Herring Counted	Number of Counts	Days of Count	Mean Counts/Day	Run Size Estimate	
1999		53	248	47	5.3	949	
2000		35	282	38	7.4	440	
2001		77	211	64	3.3	1255	
2002		73	209	70	3.0	2726	
2003		41	270	73	3.7	668	
2004		55	397	63	6.3	381	
2005		88	503	54	9.3	691	
2006		57	270	38	7.1	677	377
2007		15	312	62	5.0	213	158
2008		133	384	75	5.1	2125	131
2009		117	309	60	5.2	1603	254
2010	54	15	259	58	4.5	268	
2011	70	48	421	72	5.8	663	
2012	44	55	365	70	5.2	756	
2013	42	31	413	60	6.9	294	
2014	51	14	467	68	6.9	126	
2015	22	32	294	60	4.8	320	282

Table 2. Summary of annual herring count statistics. DMF trap results are included as well as the video camera total we determined in 2015.

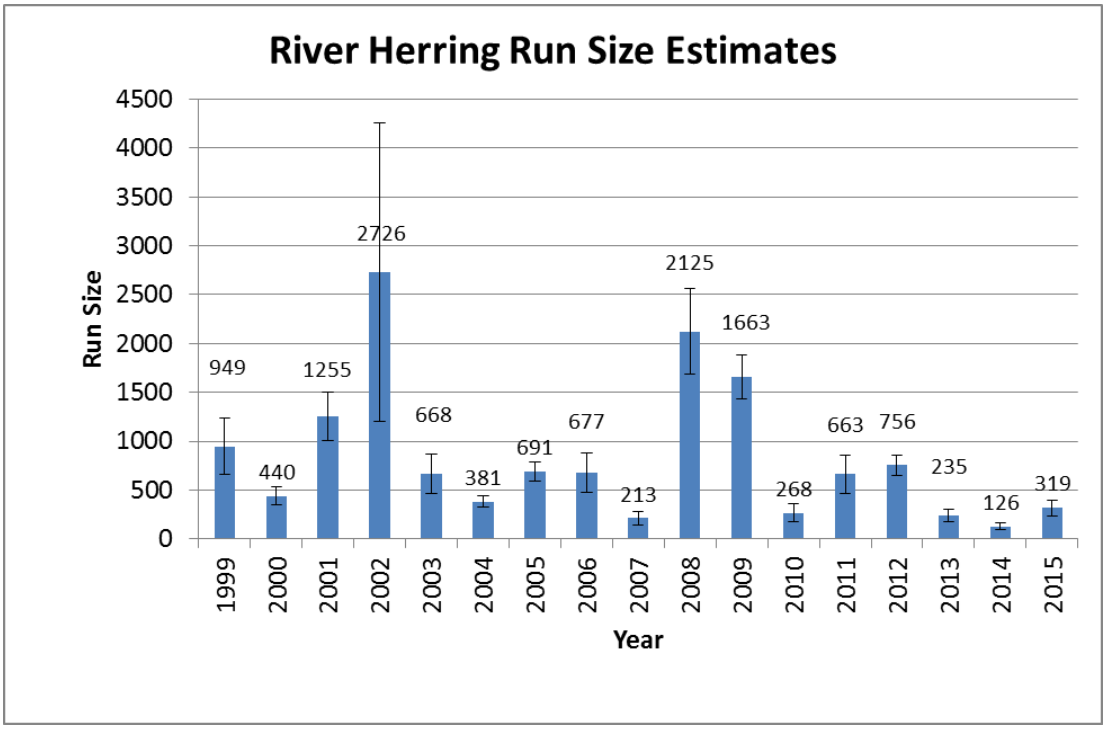

Figure 6. Annual run-size estimates for Ipswich River herring counts, 1999-2015.

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 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 a free version of iSpy security software to record and store footage when activity reached a certain threshold. Footage was stored locally and downloaded on a weekly basis. Volunteers watched the footage and recorded however many herring or other species were present. An example of the video footage with a link to a video compilation of species can be seen in figure 7. A summary of the video footage is presented in table 3. A total of 282 herring were recorded which is similar to the volunteer run size estimate of 320. The occurrence of other species, particularly 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. One of the questions was to find out if there are herring migrating at night as is the case with other herring runs in the region. The entire record of volunteer data since 1999 show about 60% of herring observed between 1pm and 6pm. The video data showed about 2/3 of the herring migrating between 1pm and 8pm and very few were present during the overnight hours.

2015 Video Results								
Week	**Herring**	**Perch**	**Eel**	**Lamprey**	**Largemouth Bass**	**Sunfish**	**Catfish (Bullhead**	**Trout**
19-Apr	13	1	2					
26-Apr	12	1		1	1			
3-May	125	7	5	23				
10-May	71		8	8				
17-May	47		1			1		
24-May	8		16	4			1	
31-May	1		1		1			
7-Jun	5		1			1	1	1
Total	**282**	**9**	**34**	**36**	**2**	**2**	**2**	**1**

Table 3: Total numbers of individual species recorded through analysis of video footage.

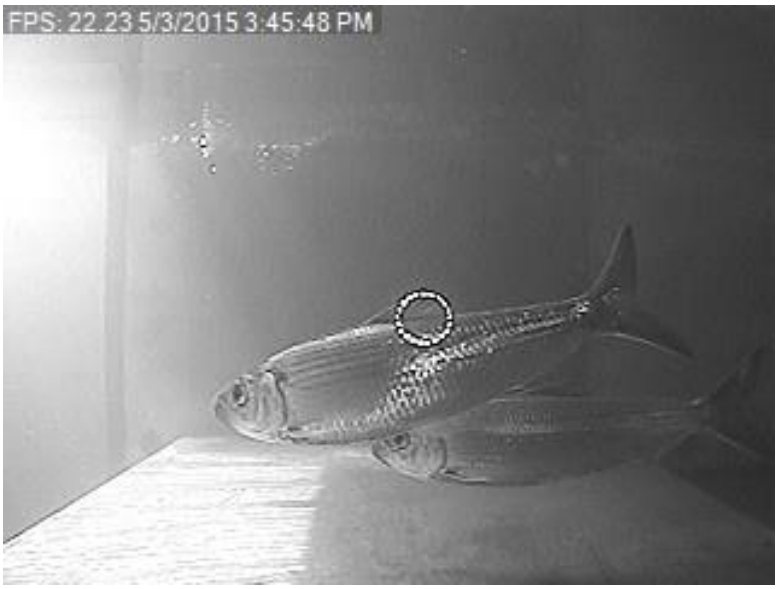

Figure 7. River herring captured in the field of view of the fish camera. Follow the link in the photo to see a compilation of all the different species we observed.

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 to supplement the volunteer count. The video camera confirmed there was no significant night run not being captured, as observed by the close agreement between the volunteer run size estimate and video totals.

There is an opportunity to more closely monitor environmental factors to give a more accurate understanding of when herring are migrating. 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 might be 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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