Town of Mount Desert – Mill and Long Ponds
River Herring Scale Sample Results
2008-2014

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Summary:

Biological samples have been taken by volunteers and staff with the Somes-Meynell Wildlife Sanctuary as well as students from the Mount Desert Island High School 2012-2014 from river herring making their annual spring migration into the spawning habitat of Mill and Long ponds (Table 1). Scale samples and biological sampling provide information that we can use to assess the health of fish populations including length at age, age distribution, and the amount of repeat spawning. The results of the Mill Pond and Long Pond data are below for 2012-2014 for all collected samples.

Table 1. Number of Samples Collected and Analyzed from Mount Desert

Year	Long Pond	Somes Pond
2012	12	50
2013	95	128
2014	50	150
Grand Total	**157**	**328**

Since the 1980s there has been concern that the run size had decreased to an extremely low level. In response, the commercial harvest of the run was suspended and any take of the alewives made illegal under a conservation closure. Local efforts to document the run size were made possible through the Somes-Meynell Wildlife Sanctuary, who coordinates an annual volunteer count. Efforts have also been made to improve connectivity in the stream by improving fish passage between Mill and Long ponds.

The DMR has supplemented the population by stocking alewives in spawning condition from the Androscoggin River (Brunswick Fishway), Union River (Ellsworth Dam), and the Sebasticook River (Ft. Halifax Dam) into Long and Somes ponds starting in 1985 (Table 2).

Table 2. Number of Alewives Stocked into Long and Somes Ponds by DMR

Year and Source	Long Pond	Somes Pond
1985		
Source: Ellsworth, Union R.	2,700	
1986		
Source: Ellsworth, Union R.	3,800	
1987		
Source: Ellsworth, Union R.	5,280	
1988		
Source: Ellsworth, Union R.	3,060	
1989		
Source: Ellsworth, Union R.	1,000	
1990		
Source: Ellsworth, Union R.	1,725	
2006		
Source: Brunswick Fishway, Androscoggin R.		624
2007		
Source: Fort Halifax Dam, Sebasticook R.		760
2008		
Source: Brunswick Fishway, Androscoggin R.	1,574	
2010		
Source: Brunswick Fishway, Androscoggin R.	1,573	
2011		
Source: Brunswick Fishway, Androscoggin R.	1,515	
2013		
Source: Brunswick Fishway, Androscoggin R.	617	
Grand Total	**22,227**	**1,384**

Species Composition:

Alewife and blueback herring, collectively called river herring, are important species in Maine serving many roles. Both species are anadromous, meaning they spend their adult lives in the ocean, but ascend into freshwater to spawn. While alewives typically spawn far upstream in lakes and ponds, blueback herring spawn in the mainstems of rivers. Though they are different species, it is very difficult to visually tell the difference between the two. Moreover, even though the two species spawn in different places and the spawning peaks may occur at slightly different times (alewives typically spawn 2-3 weeks before blueback herring), many times the end of May finds the species together, both ascending the same rivers at the same time, all as one school of fish. Many problems leading to the population declines observed in both species are shared. For these reasons, state laws and regulations regarding these two species refer to them collectively as river herring. Not all runs and harvests are composed of both species, though.

Close examination of a few features enables us to tell the difference between alewife and blueback herring. From looking at a side view of the fish, we can identify alewives as having an eye that is bigger than its snout, or mouth, while a blueback herring's eye is smaller than the snout. Also, alewives are generally more deep bodied, while blueback herring are more streamlined. This method is useful when identifying the species when the fish needs to be kept alive, however, it can also be subjective and takes a lot of practice and usually requires a person to look at both species at the same time. The easiest way to determine the species is from the color of the inside of the belly of the fish, or the peritoneal cavity. The inside lining of the belly of an alewife will have a pinkish to grayish color, while blueback herring will have a black lining. This method provides the most accurate determination, but is only possible if the fish is killed. From scale samples, we can determine whether a fish was an alewife or a blueback herring with a fairly high amount of certainty. Scale samples can be taken from live or dead fish, so this method is useful for both harvested runs and restoration runs. Looking at the scales of each under a microscope, alewife scales are shaped more like a scallop shell, while blueback herring scales are more oval or diamond shaped. Other features, like the shading of certain areas of the scale, can also help determine the species.

Scale samples taken from Somes and Long ponds showed that the run is composed entirely of alewives.

Sex Ratio:

Populations dominated by males may be less robust than those containing an even number of males and females because the limiting factor for population growth is often the abundance of females and their eggs. Looking at the sex ratio gives us an idea whether this may be a problem within individual runs. The sex can only be determined from the fish at the time the sample is collected. The sex can sometimes be determined from a live fish by applying gentle pressure on the belly, pushing towards the tail of the fish. If a milky substance is seen, the fish is male. If small eggs are seen, the fish is female. If it is early in the spawning run, it may not be possible to tell the sex from a live fish. A dead fish can be cut open at the belly, and if eggs are present, the fish is female, if white smooth glands are seen, the fish is male.

While some information was collected in 2014 showing that ten samples were males and none were females, no information about sex was collected from any other samples.

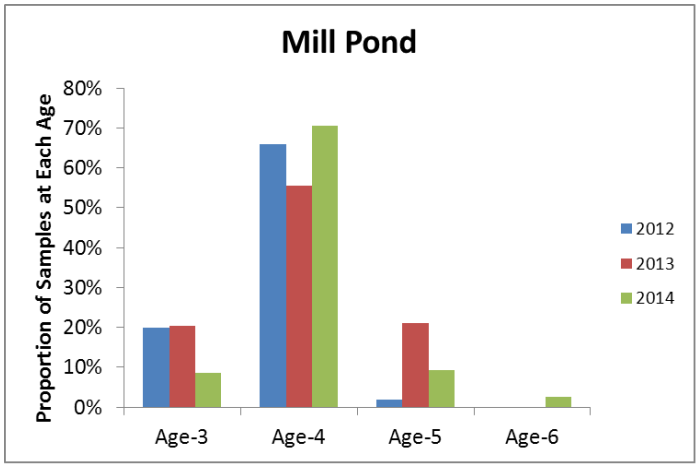
Age Distribution:

Both alewife and blueback herring are "recruited" to the spawning run at age-4. This means that the majority of 4-year-old river herring can physiologically spawn, and will make a spawning migration unless their migration route is blocked (e.g. by a dam) or in very few cases if their development was delayed because of stress in the marine environment. In these cases, we may see river herring first spawning at age-5. Further we find that as we move north, the age at first spawning increases. For example, in many runs in New York state, river herring first spawn at age 3, in the majority of runs in Maine, the age at first spawning is age-4, but some in some runs downeast and in Canada, the age at first spawning is age-5.

In Maine run, we see some age-3 river herring participate in the spawning runs, but we don't expect to see all age-3 river herring to make and upstream migration. Most river herring do not die after they spawn, but move back into coastal waters until the next spring, when they again make a spawning migration into freshwater rivers and streams. A river herring can make a spawning migration every year from age-4 until it dies, anywhere from age-5 to age-9.

While all alewife runs in Maine are dominated by age-4 fish, we find that runs with a more evenly distributed age distribution are more stable over time. Length and age information yields important insights into the health of a fish population. As a general rule, the presence of a variety of age classes is indicative of a healthy population. Further, populations containing older and larger individuals, which have a relatively high reproductive potential, are considered healthier than those containing only younger, smaller individuals. To get an accurate picture of the age distribution of a run, it is important to sample fish throughout the run. Early in the season, older fish dominate the run. Later in the run, there are more young fish. We recommend that 25 samples be taken every week of the run.

The samples taken from the alewives at Mill and Long ponds show that the run is dominated each year by age-4 fish, but that more older fish are found in the run with each sample year (Table 3, Figure below). During the first sample year (2012), mostly age-3 and age-4 fish were found, older ages may have been part of the run, but simply not sampled because very few samples were collected this year. In 2013 and 2014, a larger proportion of older ages (age-5, -6, and -7) are encountered. This may be reflective of the run rebounding and becoming more self-perpetuating. Samples should continue to be collected in the coming years to see if this trend continues.



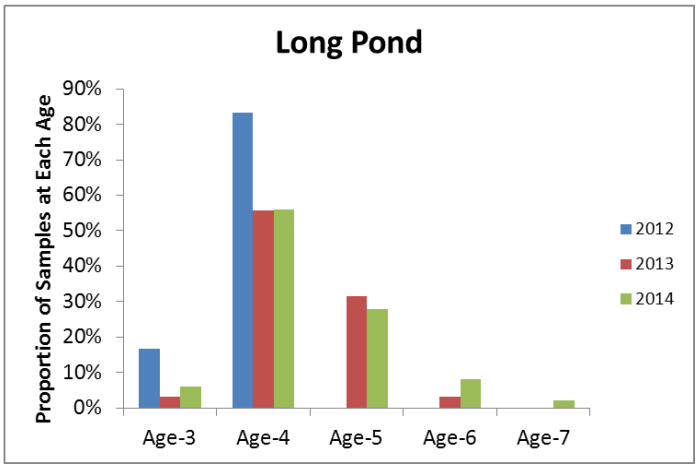


Table 3. Age Distribution (Proportion of Samples at Each Age) for Alewives at Mill and Long Ponds

Year	Somes Pond					Long Pond					
	Age-3	Age-4	Age-5	Age-6	No Age Given	Age-3	Age-4	Age-5	Age-6	Age-7	No Age Given
2012	20.00%	66.00%	2.00%		12.00%	16.67%	83.33%				
2013	20.31%	55.47%	21.09%		3.13%	3.16%	55.79%	31.58%	3.16%		6.32%
2014	8.67%	70.67%	9.33%	2.67%	8.67%	6.00%	56.00%	28.00%	8.00%	2.00%	
Grand Total	**14.94%**	**64.02%**	**12.80%**	**1.22%**	**7.01%**	**5.10%**	**57.96%**	**28.03%**	**4.46%**	**0.64%**	**3.82%**

Length Distribution and Length at Age:

In general, populations containing larger individuals, which have a relatively high reproductive potential, are considered healthier than those where fish are smaller. In some cases, we can identify a stressed fish population when the average size of all the fish in the run decreases over time. The average size of an alewife run may get smaller because of selective fishing pressure on larger individuals, or because of environmental constraints like limited food availability. Some populations may be smaller, however, not because of environmental stress or fishing pressure, but because they are a different "stock" of fish, whose genetic make-up influences their size. Comparing the average length at each age among different runs, and among different years at the same run, can show whether the population may be experiencing stress, or together with other information like genetics, if the run may be an individual "stock".

When sampling the length of spawning river herring, it is important to sample throughout the run. As the run progresses, it is composed of more and more small fish. These fish are not only younger than the fish from the beginning of the run, but also smaller at each age. For example, a four-year-old alewife sampled during the first week of the run might be larger than a four-year-old alewife that comes during the last week of the run.

On average, alewives sampled at Long Pond were larger than fish sampled at Mill Pond (Table 4). *Ages are given below in total length, from the tip of the nose to the tip of the caudal fin.* This may be a function of where the ponds are located, while Mill Pond is at head of tide, Long Pond is the most upstream pond in the watershed. As fish move upstream, smaller fish may drop out of the run and only the larger fish with more energy reserves are able to make the complete run. More years with of data are needed to better understand if this is a true observation.

While analyzing the samples from other years, we did note that the length on some dates in 2013 and 2014 seemed very large compared to the average length at each age. When the length was measured at Mill and Long Ponds, it was measured in fork length, however we suspect that on some dates total length was actually measured and recorded (May 7 and May 8, 2013). We adjusted these lengths accordingly (used the measured length as total length instead of fork length). This correction made the length at each age within the expected range. We suggest that the volunteers consider measuring in *total length* in the coming years as it is sometimes easier for new volunteers or students to understand.

Table 4. Average Length at Each Age for Alewives from Somes and Long Ponds

Year	Mill Pond						Long Pond						
	Age-3	Age-4	Age-5	Age-6	No Age Given	All Samples	Age-3	Age-4	Age-5	Age-6	Age-7	No Age Given	All Samples
2012	226.0	255.8	300.0		251.7	250.0	245.0	259.0					256.7
2013	253.1	267.2	283.3		295.0	268.6	243.3	277.5	290.0	296.7		290.8	281.9
2014	260.0	275.1	275.7	290.0	252.5	272.4	263.3	277.4	287.1	301.3	320.0		282.1
Avg. All Years	**246.4**	**266.0**	**286.3**	**290.0**	**266.4**	**263.7**	**250.6**	**271.3**	**288.6**	**299.0**	**320.0**	**290.8**	**273.6**

Repeat Spawning:

From river herring scales, we can determine if an individual is making its first spawning migration, or whether the fish spawned in one or more previous years. The migration between the ocean into freshwater to spawn requires a lot of energy, on top of the energy that the fish needs to develop its reproductive organs for the spawning event. During this phase, the fish will use any energy reserves it has to sustain itself. As a result, its scales become eroded during the spawning migration and during the time it remains in freshwater. On the scale, we can actually see the jagged line that resulted from the scale erosion. We term this behavior of returning in subsequent years to spawn "repeat spawning". When a fish is a "repeat spawner" it means it is successfully escaping predators, harvest, and not encountering obstructions, making it to the spawning grounds, then back out to the ocean, and then back to freshwater again the next year. A run with a high proportion of "repeat spawners" indicates a stable spawning population over time. Runs with low numbers of "repeat spawners" may have a problem with passage obstructions or over-harvesting.

Samples from Mill and Long ponds show varying proportions of "repeat spawners" in the runs (Table 5). Comparing the proportion of "repeat spawners" to the annual age distributions, we see that the years with fewer "repeat spawners" also had fewer fish at older age classes (2012), while in 2013 and 2014, when more ages were represented in the samples, we see a greater number of repeat spawners. It is a good trend that we are seeing more repeat spawners, and older fish, with each year. We hope that this indicates a population that is rebounding and becoming self-sustainable. Continued data collection in future years will show if this trend continues.

Table 5. Proportion of Sampled Alewives that Spawned in Previous Years

Year	Mill Pond			Long Pond		
	Never Previously Spawned	Spawnedin 1 Previous Year	Spawned in 2 Previous Years	Never Previously Spawned	Spawnedin 1 Previous Year	Spawned in 2 Previous Years
2012	93.3%	6.7%		100.0%		
2013	79.8%	19.4%	0.8%	63.7%	34.1%	2.2%
2014	85.8%	12.2%	2.0%	72.0%	20.0%	8.0%
Avg. All Years	**86.3%**	**12.7%**	**1.4%**	**78.6%**	**27.0%**	**5.1%**

Comparing Mill and Long Ponds to Other Runs:

Samples from Mill and Long Ponds have been analyzed for all years 2010-2014. Samples collected from other runs have only been analyzed through 2014. Comparing the proportion of "repeat spawners" at Mill Pond to other runs, 26 of 35 other sampled runs have more "repeat spawners", while 8 have a lower proportion of "repeat spawners". This puts the Mill Pond run into the "2nd Quartile", where 50% of the other runs have a higher proportion of "repeat spawners" compared to Mill Pond, and 25% of the other runs have fewer repeat spawners compared to the Mill Pond run. Comparing the average length of fish at Mill Pond to other runs, we find that 20 other runs have fish larger than Mill Pond, and 13 have smaller fish. For average length, this puts Mill Pond into the "2nd Quartile" again, where 50% of the other runs have, on average, larger fish compared to Mill Pond, and 25% of the other runs have smaller fish.

Looking at Long Pond, only 9 of 35 other sampled runs have more "repeat spawners", while 19 have a lower proportion of "repeat spawners". This puts the Long Pond run into the "3rd Quartile" of all runs, where 50% of the other runs have fewer repeat spawners compared to Long Pond, and 25% of other runs have more repeat spawners. It should be noted that we are only considering the proportion of fish that have never previously spawned, and not comparing the number of times the alewives have previously spawned. While many runs have fewer numbers of repeat spawners, the fact that no alewives at Long Pond have repeat spawned more than 2 times still shows that the run is stressed. Comparing the average length of fish at Long Pond to other runs, we find that 3 other runs have fish larger than Long Pond, and 30 have smaller fish. This puts the Long Pond run into the top 10% of all runs, where 90% of the other runs have, on average, smaller fish compared to Long Pond. This may be a function of where the ponds are located, as Long Pond is the most upstream pond in the watershed. As fish move upstream, smaller fish may drop out of the run and only the larger fish with more energy reserves are able to make the complete run. More years with of data are needed to better understand if this is a true observation.