Pennsylvania Fish & Boat Commission Biologist Report

American Shad Passage through the Easton and Chain Fishways, Lehigh River

Northampton County

Final Report 2011

Since the mid 1990's, the Pennsylvania Fish and Boat Commission (PFBC) has annually monitored passage of American shad at the Easton and Chain fishways located in the Easton (RM 0.0) and Chain (RM 3.0) dams, respectively on the Lehigh River. The objective of this program is to characterize the returning run size into the Lehigh River for assessing the success of the PFBC hatchery stocking efforts for generating a self-sustaining annual spawning run.

Fish passage monitoring commenced on 4 April 2011 at the Easton and Chain fishways with monitoring ending at both facilities on 1 July, 2011. A minimum of 558 adult American shad passed the Easton fishway in 2011 (Table 1; Figure 1). The passage of the first recorded American shad was on 24 April with shad being recorded through 29 June. At the Easton Dam multiple peaks in passage were observed 24 April through 27 April (n = 79 shad), 25 May through 2 June (n = 228 shad), and 17 June through 18 June (n = 40 shad). Generally passage was sporadic prior to 24 May, with less than 10 individuals observed passing. Throughout June, passage of shad occurred daily although typically less than 10 individuals were observed within each day.

A minimum of 29 adult American shad passed the Chain fishway in 2011 (Table 1, Figure 1). The passage of the first recorded American shad was on 25 April with shad being recorded through 26 June. Generally passage of shad through the Chain fishway was sporadic with low numbers (n < 6) of shad passing on any given date. Greatest passage occurred 24 - 25 June when at least 11shad passed, respectively representing 37.9% of the total passage. By month, shad passage for April was low (3 shad, 1 each on 25, 27 and 30 April). Total passage during May was exceptionally poor, with only three shad passing prior to 28 May. Passage in early June remained low and inconsistent with only four shad passing prior to 13 June; after which, the remaining shad passed on 17, 18, 21, 23-26 June.

Daily passage was recorded throughout the 24-hour period for both fishways. The greatest movement of shad occurred during the daylight hours (0500 through 2100 hours) at both the Easton (98.4%, n = 549 shad) and Chain (96.5%, n = 28) fishways (Figure 2). Regardless of month, shad passage was characterized by increased movement throughout the daylight hours to a peak in the early evening (1600 – 1900 hours). American shad passage during the nighttime hours (2000-0500 hours) was minimal, accounting for only 1.9% (n = 11) and 3.4% (n =1) of the total American shad passage for the Easton and Chain fishways, respectively.

The 2011 passage of shad into the Lehigh River through the Easton fishway is suggestive of a poor movement of spawning shad into the Lehigh River. The direct cause-effect for relating to the observed poor passage of shad through the Easton fishway remains unknown. Multiple confounding factors likely contributed to the observed low passage of shad. It was anticipated the 2011 passage of shad would have benefited from the continued increasing trend of shad

abundance as observed from the Delaware River at Smithfield Beach (RM 218) in 2010 and 2011. Thus, based upon simple density effects we anticipated more shad movement though the Easton fishway, given that there were more shad available in the Delaware River. Yet in 2011, this was not realized. The persistent strong cold frontal activity that resulted in dynamic river discharge and stage differences between the Lehigh and Delaware rivers was one factor that likely contributed to poor shad passage. We surmise these differences resulted in dramatic overwhelming (>10 inch difference between the fishway entrance chamber stage vs. the Delaware River stage) or underwhelming (<4 inch difference) of attraction flows into the Delaware River from the fishway entrance during critical migration times. Indeed, for the majority of the monitoring period, staff noted the attraction flow was not within the optimal range (6-10 inch difference). In other words, shad find the entrance of the Easton fishway by orienting on the attraction flow. Without proper attraction flow, shad were unable to either locate the entrance due to a low attraction flow; or shad were unable to successfully swim through the attraction flow and enter the fishway entrance chamber because water velocities were too great. However flow issues, likely provide only a partial explanation of low passage into the Lehigh River.

A further issue complicating shad passage into the Lehigh River through the Easton fishway was the occurrence of heavy sedimentation. The 2011 spring floods prior to the shad spawning run, deposited excessive amounts of sediment directly in front of the fishway exit and along the dam ogee top for several feet. The result was twofold. First the auxiliary flow intake was not able to get sufficient water to bolster the attraction flow, causing aeration in the entrance chamber. This was also compounded by large woody debris lodge in the auxiliary intake chamber, which was partially removed by PA Department of Conservation and Natural Resources. Second, any shad successfully passing the fishway would be forced to either swim over the very shallow sediment bar, or navigate a slightly deeper channel along the dam ogee top. Thus, any shad swimming near the Dam's ogee may have resulted in being swept back into the Delaware River. The observed drop-back behavior of the 28 shad that failed to successfully pass might have been due to this blockage as well. This type of drop back behavior has not been evident at the Easton fishway since the early years of fishway operation.

The passage of shad into the immediate river reach above the Chain Dam appears to remain ineffective. Only a small percentage (5.19%) of the Easton passage actually passed the Chain fishway. American shad are known to utilize Riverview Park pool (RM 2.55) located below the Chain Dam (RM 3.0), for spawning. Thus, these shad may not behaviorally attempt to pass through the Chain fishway. Further, the continued presence of the sedimentation bars at the fishway entrance at the downstream entrance and the upstream fishway exit above the Dam more than likely significantly inhibit successful passage.

We continue to work with partners on solution to these passage problems and are hopeful for improved passage in the future. Our optimism stems, in part, from the increased run observed in 2011 in the Delaware River and anticipated increase in 2012 based upon previous year class production.

Table 1. Fishes observed (videotaped) migrating through the Easton (RM 0.0) and Chain fishways during spring from 1995-2011. No monitoring occurred at the Chain fishway in 2004.

	Year																
Fishes	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
									Easton fishway								
American shad	**873**	**1141**	**1428**	**3293**	**2346**	**2094**	**4740**	**3314**	**422**	**754**	**675**	**2023**	**1397**	**408**	**425**	**1935**	**558**
Herring sp.	0	0	0	0	0	0	0	0	0	1	11	0	0	0	0	0	0
Gizzard shad	51	23	15	45	1263	337	392	121	6	16	21	720	472	192	206	62	4
Striped bass	19	5	1	0	0	0	0	1	0	1	3	1	3	2	0	9	4
American eel	1	4	*	*	*	*	*.	12		1	35	20	6	24	1	1	1
Sea lamprey	6	27	38	22	181	253	894	490	233	6936	1882	1366	5657	4674	1738	1537	3659
Trout	109	43	79	193	111	231	267	309	75	199	313	282	160	129	170	354	205
Muskellunge	9	6	0	0	3	10	8	7	2	11	3	2	6	9	8	1	8
Chain pickerel	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	3	2	0	1	1	0	1	2	0	1	37	0	7	20	10	13	16
Yellow perch	2	31	2	0	2	0	3	1	0	0	1	6	0	0	0	0	0
Bass	303	348	218	483	358	1149	377	584	221	147	161	1026	398	592	719	349	515
Sunfish/Crappie	368	291	132	210	140	1214	504	346	77	83	225	893	167	491	513	437	603
Carp	338	1386	278	497	353	732	651	726	558	437	679	1322	600	640	567	334	249
Quillback	0	0	0	11	9	17	21	22	8	24	26	34	28	31	29	37	40
Catfish	284	503	330	268	237	790	367	381	122	262	340	830	378	525	573	490	688
Flathead catfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	11
Minnows/Fallfish	0	6	11	63	221	67	279	109	66	351	258	257	14	15	55	500	32
Sucker	1718	1607	435	209	2019	573	2292	1156	1867	3797	688	2549	9408	6960	3045	2986	2560
Unknown						190	32	177	72	142	123	81	334	58	95	64	123
Total	4041	5423	2964	5297	7250	7658	10828	7746	3729	13162	5471	11392	19029	14770	8154	9109	9276
									Chain fishway								
American shad		**496**	**126**	**694**	**479**	**645**	**2057**	**1479**	**40**	**.**	**324**	**588**	**215**	**84**	**60**	**169**	**29**
Herring sp.		0	0	0	0	0	0	0	0	.	0	0	0	2	0	0	0
Gizzard shad		39	11	15	958	307	416	72	3	.	38	383	188	71	76	24	0
Striped bass		2	0	0	0	0	0	0	0	.	0	0	0	0	0	1	1
American eel		34	*	*	*	*	*	80	5	.	401	30*	66*	1,923	59	403	606
Sea lamprey		7	2	1	165	58	570	1321	163	.	2346	4194	384	1,318	1,477	3296	5824
Trout		96	119	238	220	318	205	321	106	3	352	124	71	212	194	292	272
Muskellunge		1	1	0	1	4	0	2	2	.	4	6	0	0	1	1	0
Chain pickerel		0	0	0	0	0	0	0	0	.	0	0	0	0			2
Walleye		1	0	0	0	0	1	0	4	.	54	13	3	7	8	3	4
Yellow perch		90	10	5	19	75	59	2	0	.	10	0	0	0	2	1	2
Bass		557	389	823	765	1572	575	876	298	.	221	824	140	484	692	444	632
Sunfish/Crappie		828	335	456	395	1409	1089	850	215	.	605	617	186	502	350	472	511
Carp		1343	153	158	1201	137	193	244	138	.	266	247	94	220	208	86	76
Quillback		0	0	0	0	0	0	0	0	.	0	2	0	0	0	0	0
Catfish		545	427	279	215	592	318	210	93	.	184	337	193	298	341	271	445
Flathead catfish		0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	5
Minnows/Fallfish		188	27	567	1079	1280	320	158	84	.	793	245	30	15	62	64	21
Sucker		2899	852	326	2417	922	1143	621	1227	254	1741	1621	1812	862	9,533	3873	4107
Unknown						101	10	65	346		167	407	336	96	59	80	24
Total		7126	2452	3594	7914	7433	6956	6221	2719	257	7506	9608	3652	6094	13122	9500	12560

* No attempt was made to count elvers

Figure 1. Daily passage of American shad passage through the Easton and Chain fishways, 2011.

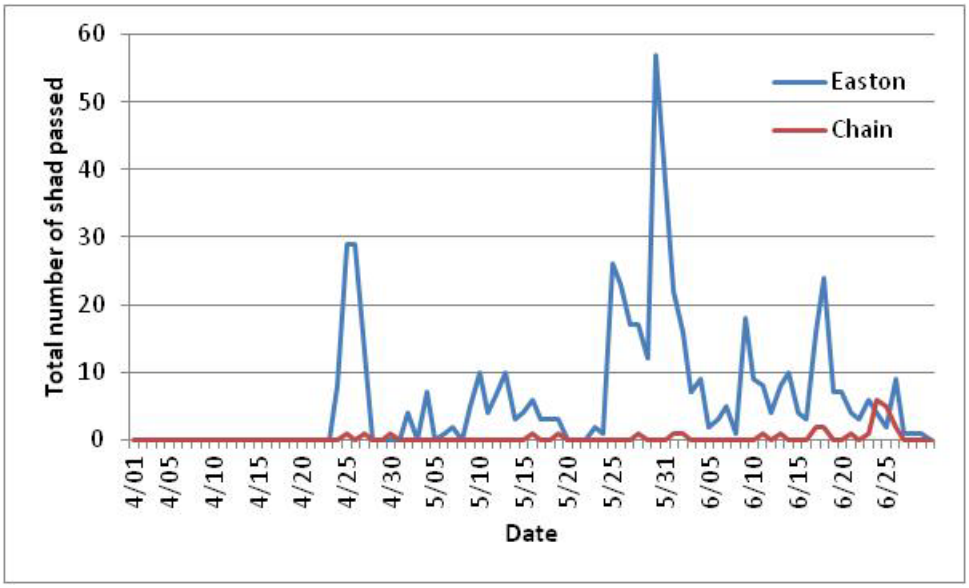
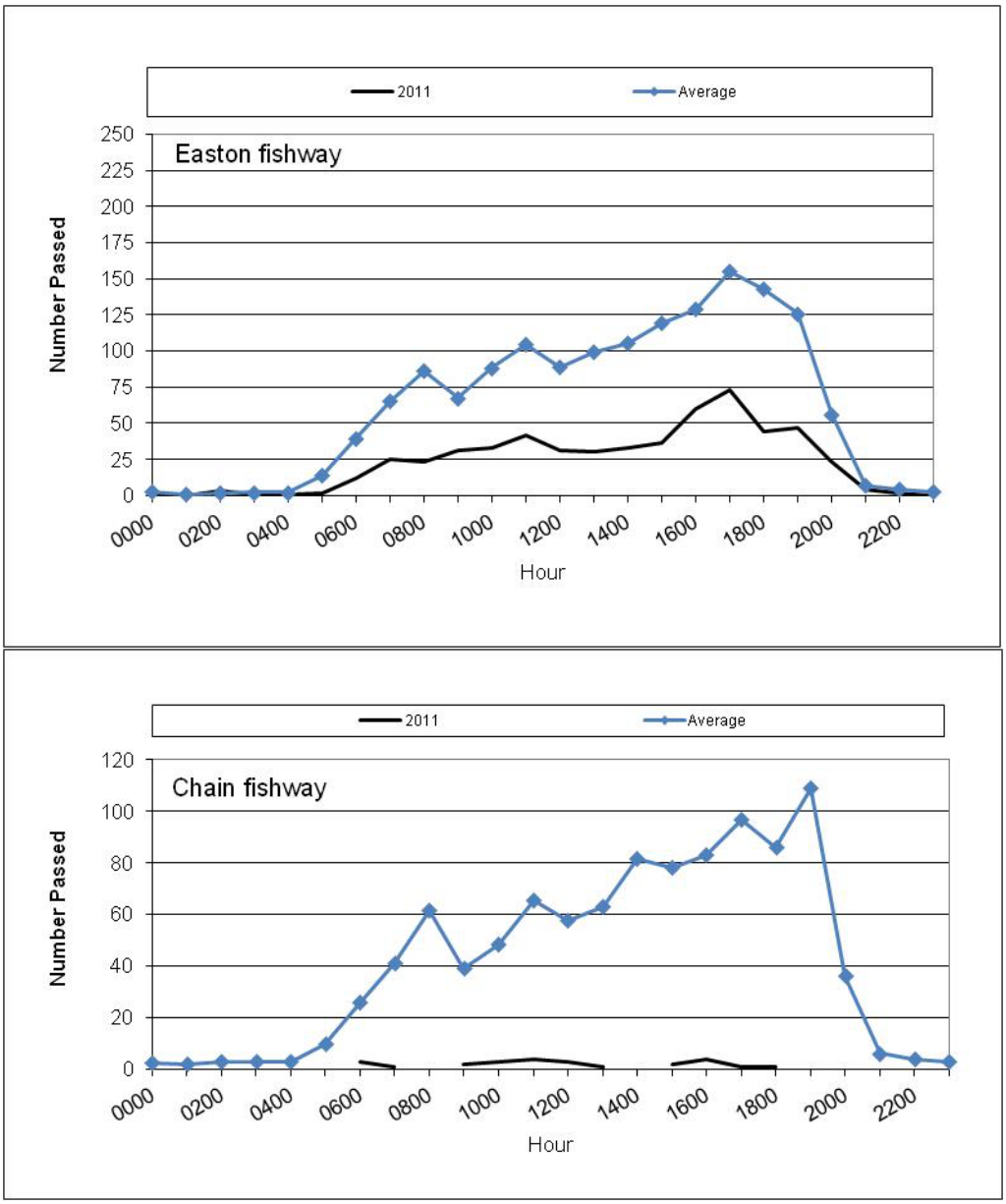


Figure 2. Hourly passage of American shad through the Easton (RM 0.0) and Chain (RM 3.0) fishways.



Daryl Pierce
Delaware River Biologist