

# AMERICAN SHAD HATCHERY OPERATIONS, 2012

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## INTRODUCTION

The Pennsylvania Fish and Boat Commission has operated the Van Dyke Research Station for Anadromous Fishes since 1976 as part of an effort to restore diadromous fishes to the Susquehanna River Basin. The objectives of the Van Dyke Station were to research culture techniques for American shad and to rear juveniles for release into the Juniata and Susquehanna Rivers. The program goal was to develop a stock of shad imprinted to the Susquehanna drainage, which will subsequently return to the river as spawning adults. With the completion of York Haven Dam fish passage facilities in 2000, upstream hydroelectric project owners were no longer responsible for funding the hatchery effort. Funding was provided by the Pennsylvania Fish and Boat Commission.

In 2003, a new effort in migratory fish restoration was undertaken. Adult hickory shad (*Alosa mediocris*) were collected and tank-spawned as part of the initial efforts to culture, release and restore runs of hickory shad to the Susquehanna and Delaware River basins. No hickory shad culture occurred in 2010 or 2012 due to budget constraints.

As in previous years, production goals for American shad for 2012 were to stock 10-20 million American shad larvae. All Van Dyke hatchery-reared American shad larvae were marked by immersion in tetracycline bath treatments in order to distinguish hatchery-reared shad from those produced by natural spawning of wild adults. All eggs received at Van Dyke were disinfected to prevent the spread of infectious diseases from out-of-basin sources.

## EGG SHIPMENTS

A total of 24.0 million American shad eggs (434.8 L) was received in 35 shipments in 2012 (Table 1). This was the second highest quantity of eggs received since 2003 (Table 2, Figure 1). Overall American shad egg viability (which we define as the percentage of eggs that ultimately hatch) was 30.4%, yielding 7.3 million viable eggs. Seventeen Potomac River egg shipments (11.1 million eggs) were received from March 28 to April 27, 2012, with an overall viability of 50.7% (Table 1), resulting in 5.7 million viable eggs.

Delaware River egg shipments were received from May 14 to June 1. A total of twelve shipments, consisting of 9.0 million eggs were processed at Van Dyke. This was the second largest egg take since 1998 (Table 3, Figure 1); however, overall egg viability of 7.7% was the lowest on record for the Delaware River (Figure 2).

American shad eggs were also obtained from tank-spawning efforts at Conowingo Dam, operated by Normandeau Associates. Broodstock were obtained from the West Fish Lift at Conowingo Dam.

All American shad were injected with hormones and allowed to spawn naturally. The tank-spawn array at Conowingo uses water pumped directly from the river and is subject to natural fluctuations in water temperature. Spawning trials of American shad in 2012 produced 3.8 million eggs, in six shipments delivered to the Van Dyke Hatchery. Overall viability of those eggs averaged 27.1% (or some 942 thousand hatched eggs). This has become a consistent source of American shad eggs for the restoration program, but viability has been low, ranging from 9% to 33%.

No eggs were collected from the Hudson River in 2012 due to concerns over declines in the Hudson River stock. The loss of the Hudson River as an egg source is unfortunate because of its consistent production of high quality eggs. Egg production from the Potomac River has been consistently below the historical production from the Hudson River and it has become apparent that additional or expanded sources of eggs will be required to meet the goal of 10-15 million larvae stocked.

## **SURVIVAL**

Survival of individual tanks followed patterns similar to those observed in the past in that the majority of the tanks experienced their highest mortality after nine days of age (Figure 3). No tanks suffered complete mortality in 2012.

The fluidized bed system installed in 2008 worked extremely well and pH of the fish culture water ranged from 6.86 to 7.45 with a mean of 7.2. Daily monitoring of gas saturation and adjustment of the oxygen injection system maintained nitrogen, oxygen and total gas saturation at acceptable levels. Oxygen saturation averaged 100.9% with a maximum of 105.8%. The high value occurred on May 11 when warm air temperatures occurred. Oxygen injection was turned down and the fish monitored, with no negative effects noted. Nitrogen saturation averaged 100.2% with a maximum of 102.1%. Total gas saturation averaged 100.3% with a maximum of 101.2%. As a result, no incidents of gas bubble disease occurred. Larvae stocked in 2012 appeared active and robust.

## **LARVAL PRODUCTION**

Production and stocking of American shad larvae, summarized in Tables 2, 3, and 4, totaled 3.9 million. A total of 2.8 million were released in the Juniata River, 150 thousand in the North Branch Susquehanna River in Pennsylvania, 172 thousand in the West Branch Susquehanna River and 271 thousand in Bald Eagle Creek. Due to an inability to test and certify that the larvae were VHS free, no larvae were stocked in the Potomac River or New York waters of the Susquehanna River.

Delaware River egg collections in 2012 yielded the second greatest quantity of eggs since 1998. However, eggs collected from the Delaware River were not sufficient to meet the goals for stocking larvae in the Delaware River Basin, largely because of low egg viability. Larvae were stocked in the Lehigh River (301 thousand), the Schuylkill River (200 thousand). No larvae were stocked in the Delaware River.

## **TETRACYCLINE MARKING**

All American shad larvae stocked received marks produced by immersion in tetracycline (Table 6). Immersion marks for American shad were administered by 4h bath treatments in 427-ppm oxytetracycline. In addition to immersion markings, cultured fingerling shad were fed tetracycline lace feed (88g tetracycline per one kilogram of feed) for three consecutive days prior to stocking, producing a fingerling tag.

All American shad larvae were marked according to stocking site and/or egg source (Table 6). Some 172 thousand larvae received marks on days 3 and 18 and were stocked in the West Branch Susquehanna River. Bald Eagle Creek, a tributary to the West Branch, received some 271 thousand larvae marked on days 3, 6, 9, 12, and 15. Some 425 thousand larvae were marked on days 3, 6 and 9 (Susquehanna River egg source) and stocked in the Raystown Branch immediately below Raystown Dam. This is a new stocking site this year and was added due to prolonged muddy water in the main Juniata River. This site maintains clear water, has prolific insect life and appears to be a good site to stock shad larvae. Some 2.4 million larvae were given an OTC mark on day 3 and stocked in the Juniata River at Millerstown or the Raystown Branch below Raystown Dam. Unfortunately, we did not give unique marks to these fish to determine stocking site. Of the 2.4 million larvae marked on day 3, 1.5 million were stocked in the Juniata River and 1.3 million were stocked in Raystown Branch. The North Branch Susquehanna River in Pennsylvania received some 150 thousand larvae, marked on days 3, 6, 9, and 15. The Lehigh River received 301 thousand larvae marked on days 9, 12, and 15. The Schuylkill River received 200 thousand larvae marked on days 3, 6, 9, and 12.

Verification of mark retention was accomplished by stocking groups of marked fry in raceways at the Benner Spring State Fish Hatchery and examining otolith samples collected later. Otoliths were extracted and mounted in Permount on microscope slides. A thin section was produced by grinding the otolith on both sides. Otolith sections were examined for marks with an epi-fluorescent microscope with a UV light source.

Raceway culture was successful in 2012, yielding specimens for verification of each mark produced. All fingerling American shad examined exhibited marks, conforming to the marking protocol on Table 6. Digital photographs have been archived from representative samples of the marks detected for future reference. These will assist in identifying the origin of marks detected in out-migrating juveniles and returning adults from the 2012 cohort.

Groups of American shad which exhibited the intended mark in 100 percent of the specimens examined included the West Branch Susquehanna (3, 18), Bald Eagle Creek (3,6,9,12,15), Juniata River (3), Raystown Branch Juniata River (3, 3,6,9), North Branch Susquehanna (3,6,9,15) and the Schuylkill River (3,6,9,12). The Lehigh River group (9,12,15) exhibited mark retention of 97 percent with one of 30 specimens exhibiting a 3,6,9,12,18,21,24 tag. This specimen likely received 4 tags in tank H31 ending on 5/26, and was then inadvertently transferred to adjacent tank H41 on a squeegee where it received 3 more tags on days 18,21 and 24. The Bald Eagle Creek group (3,6,9,12,15) exhibited mark retention of 97 percent with one of 30 specimens exhibiting a 9,12,15 tag. This specimen was similarly transferred from tank H31 to tank H41 before it had received any tags in H31, but after H41 had already received the first two of its planned tags. American shad larvae grown out to fingerlings were fed OTC laced feed prior to stocking. None of those examined had retained the mark. This may have been due to not using vegetable oil in mixing the OTC powder and the feed. We speculate that the OTC may have dissolved in the water before the fish consumed the food and thus was not available to the fish.

## **SUMMARY**

A total of 35 shipments of American shad eggs (24.0 million eggs) were received at Van Dyke in 2012. Total egg viability was 30.4% and survival of viable eggs to stocking was 47%, resulting in production of 3.9 million larvae. Larvae were stocked in the Juniata River (1.5 million), Raystown Branch (1.3 million) the West Branch Susquehanna River (172 thousand), Bald Eagle Creek (271 thousand), and the North Branch Susquehanna River in Pennsylvania (150 thousand). Delaware River source American shad larvae were stocked in the Lehigh (301 thousand) and the Schuylkill (200 thousand) rivers. No American shad larvae were stocked in the Delaware River because our stocking goals in the Lehigh and Schuylkill Rivers were not met.

No major mortality occurred due to disruption of flow. Installation of a fluidized bed system in 2008 and closer monitoring of the oxygen injection system resulted in pH and gas saturation levels that contributed to high survival.

All American shad larvae cultured at Van Dyke were marked by 4-hour immersion in oxytetracycline. Marks for American shad were assigned based on release site and/or egg source river. All raceway cultured shad examined for marks had marks as intended except for a few specimens that were not marked. Fingerling shad fed OTC laced food did not retain the feed mark.

## **RECOMMENDATIONS FOR 2013**

1. Disinfect all egg shipments at 50 ppm free iodine.
2. Slow temper eggs collected at river temperatures below 55°F.
3. Routinely feed all larvae beginning at hatch.
4. Continue to hold egg jars on the incubation battery until eggs begin hatching (usually day 7), before transferring to the tanks. Transfer incubation jars to the tanks on day 7 without sunning. Sun the eggs on day 8 to force hatching.
5. Continue to siphon eggshells from the rearing tank within hours of egg hatch.
6. Continue to feed left over AP-100 only if freshly manufactured supplies run out.
7. Use MSXXX jars preferentially to promote egg layering and maintain good egg survival.
8. Continue to collect American shad eggs from the Potomac River as an additional source of out-of-basin eggs.
9. Mark American and hickory shad at 427ppm OTC.
10. Continue using PENNOX 343 (now FDA approved) for marking alosines.
11. Continue to utilize a fluidized bed system, using limestone sand to buffer the Van Dyke source water, neutralize the pH and reduce dissolved aluminum.
12. Continue to record pH, hardness and alkalinity on a regular basis to monitor fish culture water quality.
13. Continue to utilize additional packed column de-gassers to reduce the need for oxygen injection.

14. Continue to measure and record oxygen and nitrogen saturation on a daily basis. Use the oxygen injection system only when needed and monitor oxygen saturation and larval condition when the system is in use.
15. Mark all tanks of larvae beginning at 11:00AM, to ensure consistency in daily mark application.
16. Consider other options for hickory shad restoration, including direct stocking of eggs or stocking of pre-spawn adults, based on the absence of adult hickory shad in extensive collections conducted at the release sites during 2009-2012 by the Philadelphia Water Department.
17. Investigate the potential of increasing egg production at Conowingo Dam by constructing a new tank-spawn facility with the capability of controlling temperatures in order to tank-spawn without the use of hormone injections.
18. Rear raceway cultured juvenile shad in warming pond water regardless of pH.
19. Utilize Raystown Branch, Juniata River, below Raystown Dam as a primary stocking location for American shad larvae.

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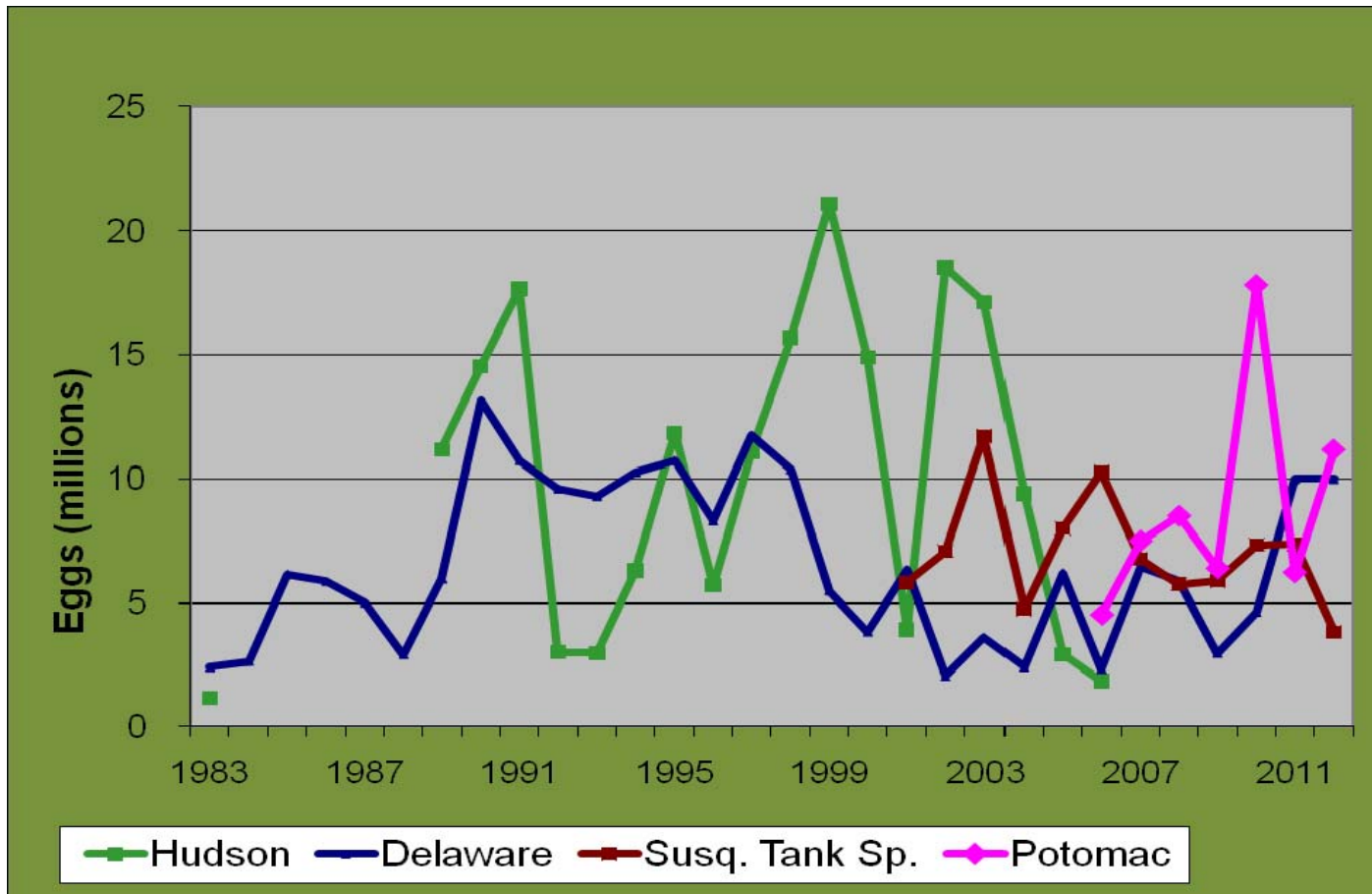


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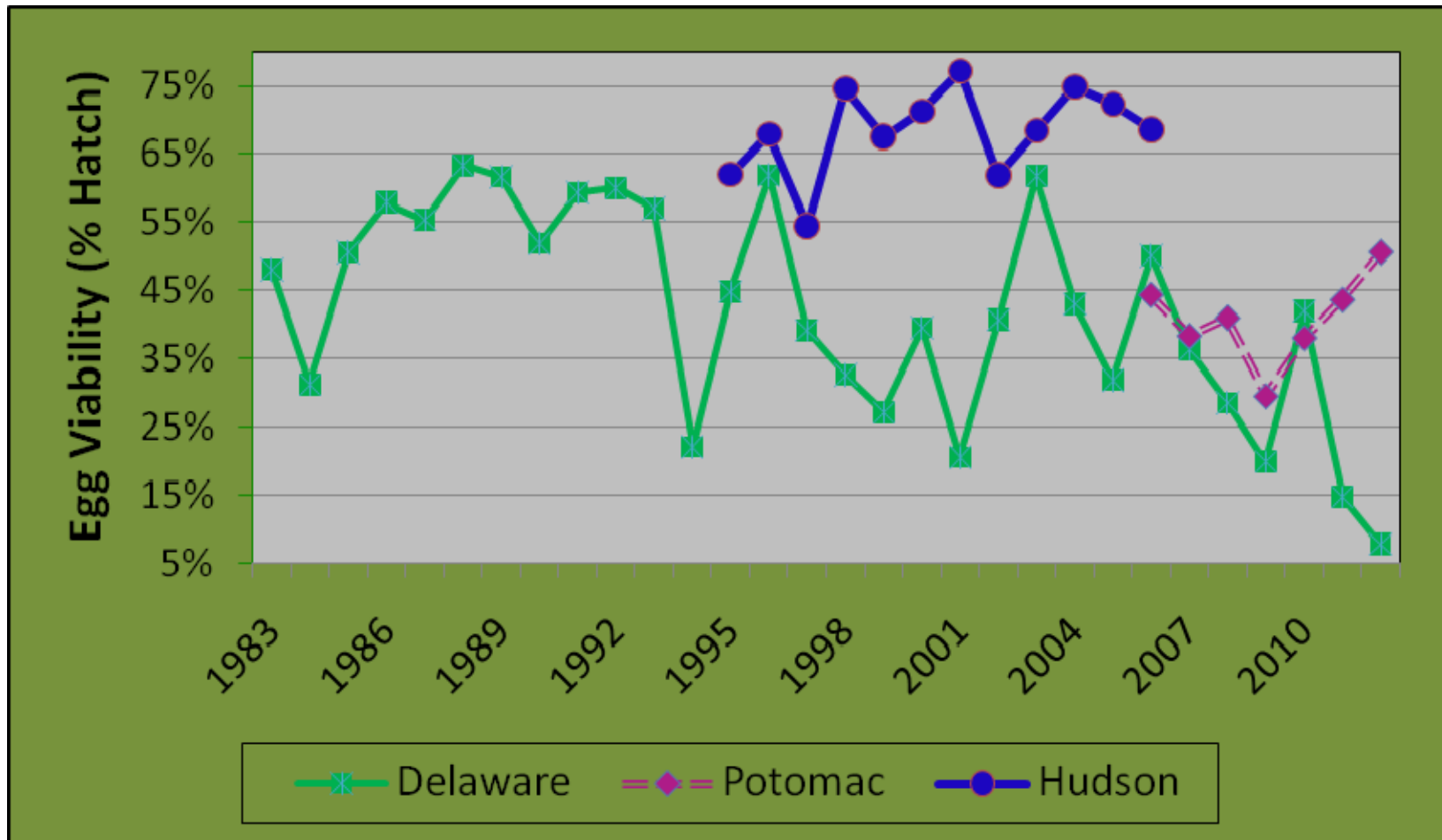
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# FIGURES

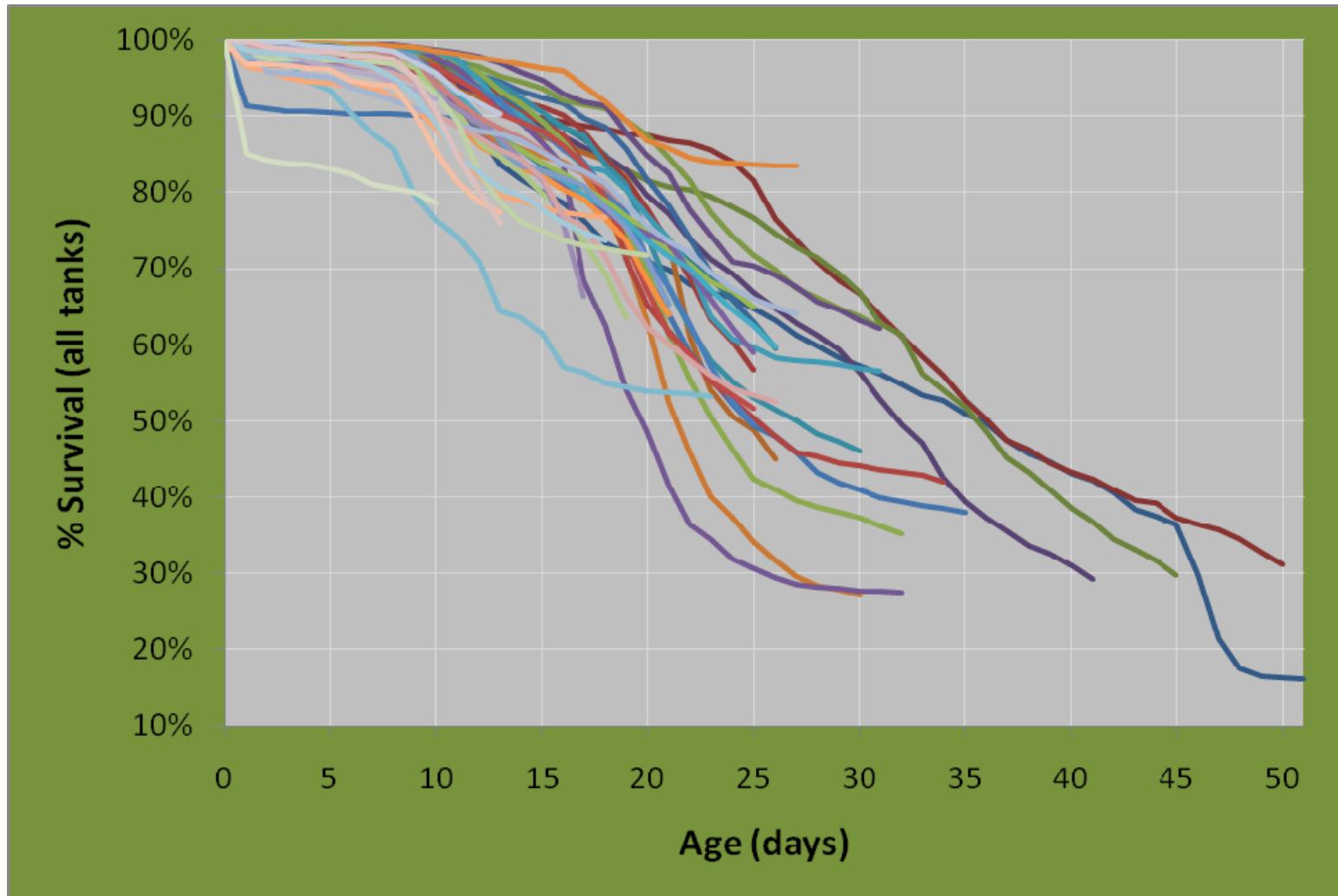
FIGURE 1. AMERICAN SHAD EGGS INCUBATED AT VAN DYKE, 1983-2012.



**FIGURE 2. EGG VIABILITY (PERCENTAGE OF COLLECTED EGGS THAT ULTIMATELY HATCH) FOR AMERICAN SHAD STRIP SPAWNING OPERATIONS ON THE DELAWARE, POTOMAC AND HUDSON RIVERS.**



**FIGURE 3. SURVIVAL OF AMERICAN SHAD LARVAE, ALL TANKS, VAN DYKE, 2012.**



## TABLES

**Table 1. Egg shipments received at Van Dyke, 2012.**

No.	Species	River	Date	Date	Volume (L)	Eggs	Viable Eggs	Percent Viable
			Spawned	Received				
1	American shad	Potomac	3/27/12	3/28/12	9.0	357,894	174,485	48.8%
2	American shad	Potomac	3/28/12	3/29/12	15.1	650,480	390,888	60.1%
3	American shad	Potomac	3/29/12	3/30/12	13.7	533,825	371,087	69.5%
4	American shad	Potomac	4/1/12	4/2/12	14.8	547,762	213,441	39.0%
5	American shad	Potomac	4/2/12	4/3/12	17.1	678,010	378,236	55.8%
6	American shad	Potomac	4/3/12	4/4/12	15.8	603,173	380,251	63.0%
7	American shad	Potomac	4/4/12	4/5/12	19.4	877,635	559,703	63.8%
8	American shad	Potomac	4/5/12	4/6/12	16.6	612,531	313,616	51.2%
9	American shad	Potomac	5/10/12	5/11/12	21.2	817,665	454,599	55.6%
10	American shad	Potomac	4/11/12	4/12/12	16.6	606,195	358,699	59.2%
11	American shad	Potomac	4/12/12	4/13/12	8.1	294,856	153,356	52.0%
12	American shad	Potomac	4/15/12	4/16/12	8.8	521,038	306,885	58.9%
13	American shad	Potomac	4/16/12	4/17/12	9.7	512,645	31,184	6.1%
14	American shad	Potomac	4/17/12	4/18/12	10.2	409,738	227,364	55.5%
15	American shad	Potomac	4/18/12	4/19/12	25.7	1,129,104	673,087	59.6%
16	American shad	Potomac	4/23/12	4/24/12	18.5	789,108	522,839	66.3%
17	American shad	Susquehanna	4/26/12	4/26/12	14.6	768,492	150,037	19.5%
18	American shad	Potomac	4/26/12	4/27/12	18.0	1,241,798	155,199	12.5%
19	American shad	Susquehanna	4/29/12	4/29/12	10.3	929,657	236,061	25.4%
20	American shad	Susquehanna	5/3/12	5/3/12	7.1	353,400	47,453	13.4%
21	American shad	Susquehanna	5/6/12	5/6/12	14.9	921,945	358,954	38.9%
22	American shad	Delaware	5/13/12	5/14/12	6.4	681,306	32,116	4.7%
23	American shad	Delaware	5/14/12	5/15/12	17.5	912,661	156,365	17.1%
24	American shad	Delaware	5/15/12	5/16/12	3.0	133,098	29,947	22.5%
25	American shad	Delaware	5/20/12	5/21/12	11.7	984,404	84,939	8.6%
26	American shad	Delaware	5/21/12	5/22/12	8.7	828,402	64,828	7.8%
27	American shad	Susquehanna	5/22/12	5/23/12	8.2	507,379	74,385	14.7%
28	American shad	Delaware	5/22/12	5/23/12	6.0	371,253	80,488	21.7%
29	American shad	Delaware	5/23/12	5/24/12	30.8	1,759,652	236,917	13.5%
30	American shad	Delaware	5/24/12	5/25/12	5.9	480,897	9,160	1.9%
31	American shad	Susquehanna	5/26/12	5/26/12	5.6	346,503	74,705	21.6%
32	American shad	Delaware	5/28/12	5/29/12	7.9	775,253	0	0.0%
33	American shad	Delaware	5/29/12	5/30/12	9.8	1,219,906	0	0.0%
34	American shad	Delaware	5/30/12	5/31/12	3.9	400,202	0	0.0%
35	American shad	Delaware	5/31/12	6/1/12	4.5	444,920	0	0.0%
<b>Totals</b>			<b>No. of shipments</b>					
	<b>American shad</b>	<b>Potomac</b>	<b>17</b>		<b>258.0</b>	<b>11,183,457</b>	<b>5,664,920</b>	<b>50.7%</b>
		<b>Delaware</b>	<b>12</b>		<b>116.1</b>	<b>8,991,955</b>	<b>694,762</b>	<b>7.7%</b>
		<b>Susq.- Conowingo</b>	<b>6</b>		<b>60.7</b>	<b>3,827,377</b>	<b>941,595</b>	<b>27.1%</b>
		<b>Grand total</b>	<b>35</b>		<b>434.8</b>	<b>24,002,789</b>	<b>7,301,277</b>	<b>30.4%</b>

**TABLE 2. ANNUAL SUMMARY OF AMERICAN SHAD PRODUCTION, 1976-2012.**

Year	Egg Vol. (L)	No. of Eggs (exp.6)	Egg Viability (%)	No. of Viable Eggs (exp.6)	No. of Fry stocked (exp.3)	No. of Fingerling stocked (exp.3)	Total stocked (exp.3)	Fish Stocked/ Rec'd	Fish Stocked/ Viable Eggs
1976	120	4.0	52.0	2.1	518	266	784	0.19	0.37
1977	145	6.4	46.7	2.9	969	35	1,003	0.16	0.34
1978	381	14.5	44.0	6.4	2,124	6	2,130	0.10	0.33
1979	164	6.4	41.4	2.6	629	34	664	0.10	0.25
1980	347	12.6	65.6	8.2	3,526	5	3,531	0.28	0.43
1981	286	11.6	44.9	5.2	2,030	24	2,053	0.18	0.39
1982	624	25.9	35.7	9.2	5,019	41	5,060	0.20	0.55
1983	938	34.5	55.6	19.2	4,048	98	4,146	0.12	0.22
1984	1157	41.1	45.2	18.6	11,996	30	12,026	-	0.73
1985	814	25.6	40.9	10.1	6,960	115	7,075	0.28	0.68
1986	1535	52.7	40.7	21.4	15,876	61	15,928	0.30	0.74
1987	974	33.0	40.7	15.8	10,274	81	10,355	0.31	0.66
1988	885	31.8	38.7	12.3	10,441	74	10,515	0.33	0.86
1989	1220	42.7	60.1	25.7	22,267	60	22,327	0.52	0.87
1990	896	28.6	56.7	16.2	12,034	253	12,287	0.43	0.76
1991	902	29.8	60.7	18.1	12,963	233	13,196	0.44	0.73
1992	532	18.5	68.3	12.6	4,645	34	4,679	0.25	0.37
1993	558	21.5	58.3	12.8	7,870	79	7,949	0.37	0.62
1994	551	21.2	45.9	9.7	7,720	* 140	7,860	0.31	0.68
1995	768	22.6	53.9	12.2	10,930	* -	10,930	0.43	0.79
1996	460	14.4	62.7	9.0	8,466	* -	8,466	0.59	0.94
1997	593	22.8	46.6	10.6	8,019	25	8,044	0.35	0.76
1998	628	27.7	57.4	15.9	11,757	2	11,759	0.42	0.74
1999	700	26.6	59.2	15.7	14,412	-	14,412	0.54	0.92
2000	503	18.7	64.8	12.1	10,535	-	10,535	0.56	0.87
2001	423	21.1	35.0	7.4	6,524	7	6,531	0.31	0.88
2002	943	35.6	38.8	13.8	2,589	-	2,589	0.07	0.19
2003	1005	33.0	49.4	16.3	12,742	-	12,742	0.39	0.78
2004	462	17.3	54.0	9.3	5,637	-	5,637	0.33	0.60
2005	372	17.1	36.6	6.0	5,208	1	5,209	0.30	0.87
2006	394	19.0	35.2	6.7	4,945	-	4,945	0.26	0.74
2007	404	20.7	27.7	5.8	2,509	-	2,509	0.12	0.43
2008	441	20.1	28.3	5.7	4,020	-	4,020	0.20	0.71
2009	282	15.2	25.2	3.8	3,073	-	3,073	0.20	0.81
2010	576	29.8	31.8	9.9	5,471	3	5,474	0.18	0.55
2011	416	23.6	22.6	5.3	4,169	9	4,178	0.18	0.78
2012	435	24.0	30.4	7.3	3,437	2	3,439	0.14	0.47

\*Includes fry reared at Manning Hatchery.

**Total 268,058**

**Total since 1985 (OTC marked) 236,661**

**TABLE 3. AMERICAN SHAD EGGS USED IN PENNSYLVANIA'S SHAD RESTORATION PROGRAM, BY EGG SOURCE.**

Year	Delaware Hudson Gill Net	Susquehanna Conowingo Gill Net	Susquehanna Lapidum Gill Net	Susquehanna Muddy Run Gill Net	Susquehanna Lamar Tank Spawn	Connecticut Gill Net	Pamunkey Gill Net	Mattaponi Gill Net	James Gill Net	Savannah Gill Net	Columbia Gill Net	Potomac Gill Net	Total
1971			8.42										8.42
1972			7.10										7.10
1973			4.74			4.30	8.45	6.48				34.64	58.61
1974						0.53	9.75	6.80	19.20		8.18	5.56	50.02
1975							1.88		7.15		18.42	5.70	33.15
1976		4.10									54.80		58.90
1977						0.35	4.40	0.57	3.42		8.90		17.64
1978							6.90		10.11		0.00		17.01
1979							3.17		4.99		0.00		8.16
1980							6.73		6.83		0.00		13.56
1981							4.58		1.26		5.78		11.62
1982							2.03		1.25		22.57		25.85
1983	1.17	2.40					5.49		5.91		19.51		34.48
1984		2.64					9.83		0.74		27.88		41.09
1985		6.16					5.28		2.05		12.06		25.55
1986		5.86					5.62		1.07		39.97		52.52
1987		5.01					4.35		0.11		23.53		33.00
1988		2.91					1.92		0.05		26.92		31.79
1989	11.18	5.96					1.91		0.53		23.10		42.68
1990	14.53	13.15			0.33		0.48			0.12			28.61
1991	17.66	10.75			0.30	1.10							29.80
1992	3.00	9.60				5.71			0.17				18.49
1993	2.97	9.30				7.45	1.78						21.50
1994	6.29	10.27				4.09	0.53	0.03					21.22
1995	11.85	10.75											22.61
1996	5.69	8.31			0.41								14.41
1997	11.08	11.76											22.84
1998	15.68	10.38			1.66								27.72
1999	21.10	5.49											26.59
2000	14.88	3.83											18.71
2001	3.92	6.35	5.81		5.05								21.13
2002	18.51	2.04	7.08		7.99								35.62
2003	17.12	3.61	11.72	0.56	0.02								33.04
2004	9.39	2.41	4.74	0.75									17.29
2005	2.92	6.21	8.00									0.00	17.14
2006	1.86	2.33	10.28									4.51	18.98
2007	0.00	6.46	6.77									7.49	20.72
2008		5.87	5.75									8.50	20.12
2009		2.96	5.89									6.38	15.23
2010		4.63	7.34									17.84	29.82
2011		9.99	7.36									6.22	23.57
2012		8.99	3.83									11.18	24.00
Total	190.81	200.49	84.57	21.57	0.02	15.74	23.53	85.08	13.88	64.84	0.12	291.62	1,100.30



**TABLE 4. AMERICAN SHAD STOCKING, 2012.**

Date	Tank	Species	Number	Location	OTC mark (days)	Origin	Age	Size
5/25/12	A1 1	American shad	28,172	North Branch Susq. River	3,6,9,15	Potomac	51	Fry
5/25/12	A2 1	American shad	121,501	North Branch Susq. River	3,6,9,15	Potomac	50	Fry
5/21/12	A3 1	American shad	109,991	West Branch Susq. River	3,18	Potomac	45	Fry
5/21/12	A4 1	American shad	62,329	West Branch Susq. River	3,18	Potomac	41	Fry
5/7/12	B1 1	American shad	117,138	Juniata R.	3	Potomac	26	Fry
5/7/12	B2 1	American shad	81,684	Juniata R.	3	Potomac	26	Fry
5/7/12	B3 1	American shad	123,953	Juniata R.	3	Potomac	25	Fry
5/7/12	B4 1	American shad	103,808	Juniata R.	3	Potomac	25	Fry
5/14/12	C1 1	American shad	173,938	Juniata R.	3	Potomac	30	Fry
5/14/12	C2 1	American shad	100,000	Juniata R.	3	Potomac	30	Fry
5/14/12	C3 1	American shad	84,275	Juniata R.	3	Potomac	29	Fry
5/14/12	C4 1	American shad	35,273	Juniata R.	3	Potomac	29	Fry
5/21/12	D1 1	American shad	84,047	Juniata R.	3	Potomac	34	Fry
5/21/12	D2 1	American shad	98,375	Juniata R.	3	Potomac	34	Fry
5/21/12	D3 1	American shad	62,459	Juniata R.	3	Potomac	32	Fry
5/21/12	D4 1	American shad	49,675	Juniata R.	3	Potomac	32	Fry
5/22/12	E1 1	American shad	86,686	Raystown Br. Juniata R., below Raystown Lake	3	Potomac	31	Fry
5/21/12	E2 1	American shad	256,381	Juniata R.	3	Potomac	27	Fry
5/21/12	E3 1	American shad	128,267	Juniata R.	3	Potomac	25	Fry
5/22/12	E4 1	American shad	87,595	Raystown Br. Juniata R., below Raystown Lake	3	Potomac	25	Fry
5/22/12	F1 1	American shad	115,140	Raystown Br. Juniata R., below Raystown Lake	3	Potomac	26	Fry
5/22/12	F2 1	American shad	101,072	Raystown Br. Juniata R., below Raystown Lake	3	Potomac	26	Fry
5/23/12	F3 1	American shad	92,910	Raystown Br. Juniata R., below Raystown Lake	3	Potomac	26	Fry
5/23/12	F4 1	American shad	171,857	Raystown Br. Juniata R., below Raystown Lake	3	Potomac	21	Fry
5/23/12	G1 1	American shad	166,029	Raystown Br. Juniata R., below Raystown Lake	3	Potomac	21	Fry
5/23/12	G2 1	American shad	117,530	Raystown Br. Juniata R., below Raystown Lake	3,6,9	Susquehanna	19	Fry
5/24/12	G3 1	American shad	98,628	Raystown Br. Juniata R., below Raystown Lake	3	Potomac	19	Fry
5/24/12	G4 1	American shad	156,737	Raystown Br. Juniata R., below Raystown Lake	3,6,9	Susquehanna	18	Fry
6/8/12	H1 1	American shad	23,311	Raystown Br. Juniata R., below Raystown Lake	3,6,9	Susquehanna	28	Fry
6/2/12	H2 1	American shad	271,120	Bald Eagle Cr.	3,6,9,12,15	Susquehanna	19	Fry
6/18/12	H3 1	American shad	87,492	Lehigh R.	9,12,15	Delaware	26	Fry
6/18/12	H4 1	American shad	44,642	Lehigh R.	9,12,15	Delaware	26	Fry
6/18/12	I1 1	American shad	107,814	Lehigh R.	9,12,15	Delaware	20	Fry
6/8/12	I2 1	American shad	68,676	Raystown Br. Juniata R., below Raystown Lake	3,6,9	Susquehanna	10	Fry
6/18/12	I3 1	American shad	61,164	Lehigh R.	9,12,15	Delaware	18	Fry
6/14/12	A1 2	American shad	59,139	Schuylkill R.,	3,6,9,12	Delaware	13	Fry
6/14/12	A2 2	American shad	78,289	Schuylkill R.,	3,6,9,12	Delaware	13	Fry
6/14/12	A3 2	American shad	63,001	Schuylkill R.,	3,6,9,12	Delaware	13	Fry
6/13/12	A4 2	American shad	58,780	Raystown Br. Juniata R., below Raystown Lake	3,6,9	Susquehanna	10	Fry
10/1/12	Race way Culture	American shad	1,500	Juniata River, Lewistown Narrows	various imm. tags, single feed tag	Potomac/ Delaware/ Susquehanna		Fing.

**TABLE 5. SUMMARY OF JUVENILE ALOSINES STOCKED FROM THE VAN DYKE HATCHERY, 2012.**

	Site	Fry
<b>American shad Releases</b>	Millerstown (Rt. 17 Bridge)	1,499,272
	Raystown Br. Juniata R., below Raystown Lake	1,344,952
	<b>Juniata River Subtotal</b>	<b>2,844,223</b>
	Bald Eagle Creek	271,120
	North Branch Susquehanna River (PA)	149,672
	West Banch Susquehanna River	172,320
	<b>Susquehanna River Basin Subtotal</b>	<b>3,437,335</b>
	Schuylkill River	200,429
	Lehigh River	301,112
	<b>Total American Shad Fry</b>	<b>3,938,876</b>
	Juniata River	<b>American Shad Fingerling 1,500</b>
	<b>Total</b>	<b>3,940,376</b>

**TABLE 6. SUMMARY OF MARKED ALOSINES STOCKED IN PENNSYLVANIA, 2012.**

<b>Number</b>	<b>Size</b>	<b>Immersion mark (days)</b>	<b>Stocking Location</b>	<b>Egg Source</b>	<b>Immersion mark</b>	<b>Immersion Mark Retention (%)</b>	<b>Feed Mark</b>	<b>Feed Mark Retention (%)</b>	<b>Fry Culture</b>	<b>Fingerling Culture</b>
<b>American shad</b>										
172,320	Fry	3,18	W. Br. Susq. R.	Potomac	427ppm OTC	100%	-	-	Van Dyke	-
271,120	Fry	3,6,9,12,15	Bald Eagle Creek	Potomac	427ppm OTC	97%	-	-	Van Dyke	-
425,034	Fry	3,6,9	Raystown Branch Juniata R.	Susquehanna	427ppm OTC	100%	-	-	Van Dyke	-
2,419,189	Fry	3	Raystown Branch Jun. R. or Juniata R.	Potomac	427ppm OTC	100%	-	-	Van Dyke	-
149,672	Fry	3,6,9,15	N. Br. Susq. R.(PA)	Potomac	427ppm OTC	100%	-	-	Van Dyke	-
3,437,335	Fry	Total Susquehanna River Basin								
301,112	Fry	9,12,15	Lehigh R.	Delaware	427ppm OTC	97%	-	-	Van Dyke	-
200,429	Fry	3,6,9,12	Schuylkill R.	Delaware	427ppm OTC	100%	-	-	Van Dyke	-
501,541	Fry	Total Delaware River Basin								
1,500	Fing.	various	Juniata R.	various	427ppm OTC	0	single	-	Van Dyke	Benner Spring
<b>3,940,376</b>	<b>Total American shad stocked</b>									