
**U.S. Fish & Wildlife Service Susquehanna River American
Shad (*Alosa sapidissima*) Restoration: Potomac River Egg
Collection, 2014**

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15 August 2014

Abstract

During March and April, 2014 we used monofilament gill nets to collect 3,089 adult American Shad from the Potomac River, 1,848 of those shad were used for spawning purposes. The purpose of sampling was to supply fertilized eggs to Pennsylvania's Van Dyke American Shad Hatchery in support of Susquehanna River American Shad restoration efforts. This year we sampled 16 days and supplied a total of 317 L of American Shad eggs (14.4 million) with a 39% fertilization rate resulting in 5.7 million viable eggs. The U.S. Fish and Wildlife Service's ninth season delivering eggs for Susquehanna River American Shad restoration resulted in our second highest number of viable eggs.

Introduction

American Shad (*Alosa sapidissima*) are an anadromous pelagic species ranging from Labrador to Florida, along the Atlantic coast (U.S. Fish and Wildlife Service 2006). American Shad are the largest of the clupeids native to North America (Stier and Crance 1985) and an important planktivore and prey species for bluefish (*Pomatomus saltatrix*) and striped bass (*Morone saxatilis*) (U.S. Fish and Wildlife Service 2006). American Shad return to their natal river to spawn after four to six years at sea. Spawning movements follow a latitudinal cline and although variable, spawning generally peaks from 14 to 21 °C (Stier and Crance 1985). Generally, April is the peak spawning month for American Shad in the Potomac River.

Shad were a valuable resource for Native Americans and have been economically important since European colonization of North America. In Pennsylvania, American Shad are said to have once ruled the waters of the Susquehanna River and its tributaries (The Native Fish Conservancy 2005). However, American Shad have undergone population fluctuations as a result of anthropogenic effects. Initial population declines resulted from commercial harvest coinciding with increases in human population and gear efficiency. Habitat loss (damming) and degradation (pollution) followed and remain significant challenges to restoration. Attempts to mitigate dam effects on American Shad and other Susquehanna River species began in 1866. In that year Pennsylvania drafted an Act, which directed dam owner/operators to maintain fish passage structures (The Native Fish Conservancy 2005). The Act established a commissioner's office that evolved in to the Pennsylvania Boat and Fish Commission (The Native Fish Conservancy 2005).

The Service is partnered with state, Federal, and hydro-power companies, through the Susquehanna River Anadromous Fish Restoration Cooperative to restore American Shad to the Susquehanna River and its tributaries. The Service's current Potomac River egg harvest operation is part of this, nearly forty year, multi-agency restoration effort. The Service's Maryland Fishery Resources Office's (MFRO) role is to deliver viable American Shad eggs to the Van Dyke American Shad Hatchery near Thompsettown, PA. Once there, the shad eggs are incubated until hatching and larvae are grown and marked before stocking into the Susquehanna River drainage.

Study Area

The Potomac River is approximately 1.5 km wide at Marshall Hall, MD (rkm 150), where American Shad gill netting occurs. The collection site is bounded by Dogue Creek (North) and Gunston Cove (South) and has long been linked to shad harvest and culture. Bottom habitat is characterized by an abrupt transition from the deep channel (≈ 18.3 m) area to relatively shallow depths (≤ 3.5 m). Channel substrate consists of firm sandy mud with intermittent shell. Sand increases in the shoal area forming a comparatively harder substrate.

Materials and Methods

Two Service boats with a crew of three each, fished for American Shad nightly. Two different types of net were used in previous year's egg collections. One net size targeted ripe females and the other ripe males. The net used to target females was 6.1 m deep by 91.4 m long floating monofilament gill net with 14.0 cm stretch mesh panels. The net to target males was 5.2 m deep by 91.4 m long floating monofilament gill net with 11.7 cm stretch mesh. During the 2014 egg collection we added a third type of net,

a net that allowed us to target males and smaller females. This net was 5.48 m deep by 91.4 m long floating monofilament gill net with 12.7 cm stretch mesh panels. Up to five nets per boat were joined in series and drifted parallel to shore in water depths ranging from approximately 6.1 to 12.2 m. Gill nets were set shortly before the evening's slack tide and fished approximately 45 minutes. Fishing was timed so that the nets' drift stalled parallel to a sharply defined shoal area where depth abruptly decreased to less than 4.0 m.

Tidal condition (transitioning high or low) was noted and surface temperature ($^{\circ}\text{C}$), dissolved oxygen (mg/L), conductivity (microsiemens) and salinity (ppt) were recorded (Yellow Springs Instruments Model 85) each night (Figure 1). The number of running, green, or spent female American Shad, ripe male American Shad, and bycatch were recorded (Table 1, Figure 2). Gill net effort was recorded but varied since the goal was to maximize catch during each sampling event. Catch per unit effort (CPUE) was calculated as daily combined male and ripe female catch per total hours fished per total net square footage ($\text{CPUE} = (\text{n/hr/m}^2)$). American Shad were sub-sampled for otolith extraction, total length (nearest mm) and weight (nearest 0.25 kilogram), as a permit requirement of the Potomac River Fisheries Commission.

Results

During spring 2014 the Potomac River was sampled a total of 16 days from April 13th through May 14th. During the sampling timeframe ≥ 5.0 L of eggs were collected 12 times (75%). MFRO shipped a total of 316.7 L (Range = 5.1 – 77.1 L, $\bar{x} = 24.4$ L/shipment) of eggs from the Potomac River (J. Tryniewski, pers. comm.). The overall

egg viability was 39.4%, although daily shipments had a range of 0 – 66.6% (J. Tryniewski, pers. comm.).

Gill netting produced 4,177 fish from the Potomac River, representing fourteen fish species from eight families (Table 1). In 2014, green females were more common than ripe females with a 1.09:1 ratio, but ripe females were more common than ripe males with a 1.44:1 ratio (Figure 2).

From early April through the first part of May, surface water temperature and dissolved oxygen remained fairly consistent (Figure 1). Surface water temperatures ranged from 14.5 to 21.5 °C ($\bar{x} = 16.6$ °C) while dissolved oxygen ranged from 8.8 to 10.6 mg/L ($\bar{x} = 9.8$ mg/L) (Figure 1). CPUE for shad was variable and there was no apparent relation to tide or lunar cycle. CPUE was the highest on the ninth day (4/28/2014) of sampling (0.089/hr/m²) and lowest on the tenth day (5/1/2014) of sampling (0.004/hr/m²). The highest CPUE values were between the fifth day (4/21/2014) and ninth day (4/28/2014) of sampling. During this time the CPUE ranged from 0.044/hr/m² to 0.089/hr/ft² with an average of 0.074/hr/m² (Figure 1).

Discussion

American Shad harvest in numbers sufficient enough to yield egg shipments was consistent on the Potomac River. The greatest numbers of ripe/running male and female American Shad were caught between surface water temperatures of 15.4-16.3 °C as opposed to 2013 sampling when the greatest numbers of ripe/running male and female American Shad were collected between water temperatures of 16.5-18.2 °C. As in past years, males were caught continuously throughout the spawning season (Table 2). Catching males throughout the entire sampling season can be directly attributed to

continuing to use a smaller mesh gill net during the 2013 season. In the Potomac River males are substantially smaller than females. To collect a higher number of males, at least one smaller mesh gill net (11.75 cm or 12.7 cm) was set, along with up to eight larger mesh gill nets (14 cm stretch mesh “female” nets). The smaller mesh nets were used in an effort to keep the sex ratio consistent with one male to two females throughout the entire season. Constant availability of sperm was expected to increase overall egg viability, thus resulting in more fry stocked into the Susquehanna River watershed.

Conclusion

The USFWS provided Pennsylvania with 316.7 L of eggs, with an overall viability of 39.4% (5,671,992 viable eggs) (Table 3). A significant storm event occurred during the peak of our collection efforts (4/29/2014); this resulted in high flows and a significant amount of debris in the river. After six calendar days (5/4/2014) we were able to resume our normal sampling regime, but CPUE was lower and river temperature steadily increased. On seven occasions this year, fishing did not occur due to poor weather conditions. The 2014 overall viability of 39.6% is slightly higher than the nine year average (39%) since Potomac River egg collection began in 2006, however this year we were still able to provide Pennsylvania with the second largest amount of viable eggs in the project history.

Project Summary

Over the past nine years the USFWS has provided Pennsylvania with almost 33 million viable shad eggs.

Year	Volume (L)	Viable Eggs (N)	Viability (%)
2014	316.7	5,671,992	39%
2013	118.1	1,603,498	21%
2012	258.0	5,664,920	51%
2011	137.4	2,714,435	44%
2010	375.0	6,874,712	39%
2009	132.2	1,885,500	30%
2008	194.4	3,491,069	41%
2007	183.9	2,875,455	42%
2006	99.3	2,003,222	44%

Acknowledgements

The MFRO thanks those who participated in this year's sampling Kendra Bullock, Christine Caprenter, Christina Conover, Julie Devers, Sheila Eyler, Ashlee Horne, Scott Oliver, Josh Newhard, and Emily Starnes.

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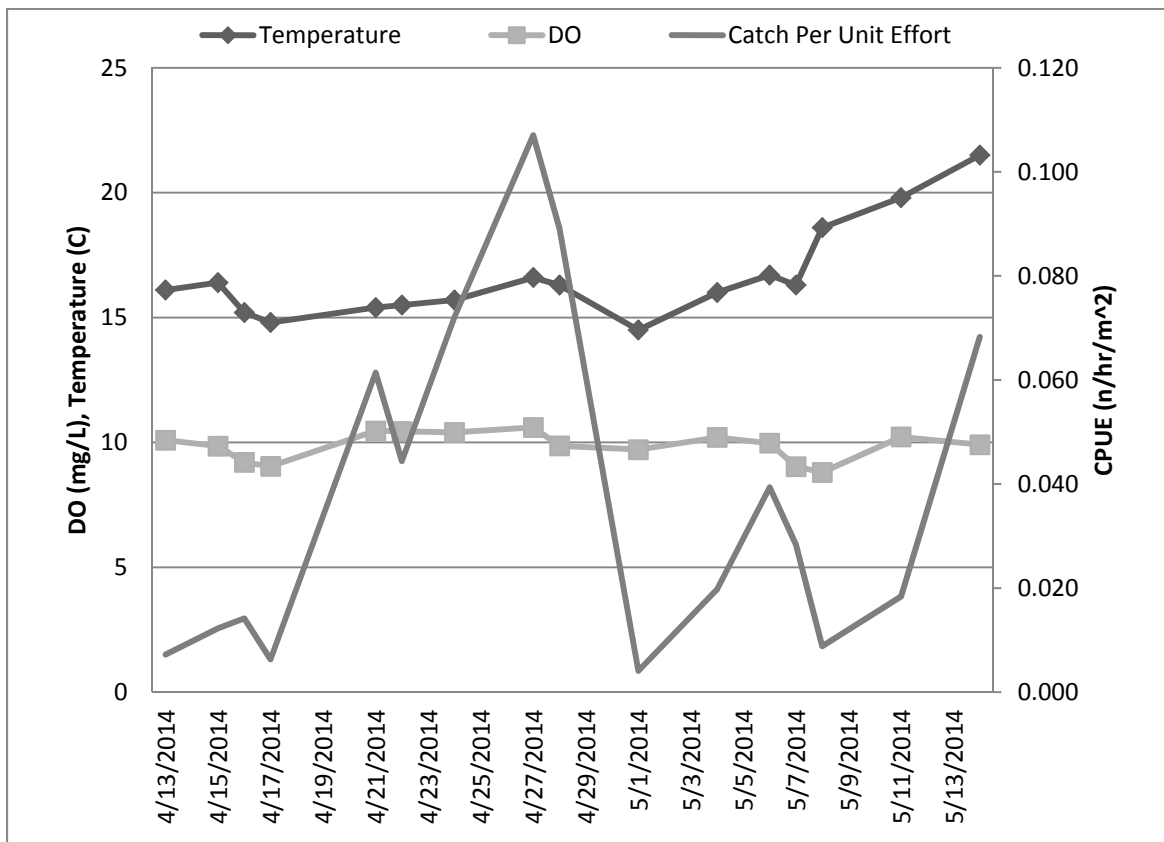


Figure 1. Spring 2014 American Shad catch per unit effort, surface dissolved oxygen, and surface temperature, by sample date, for the Potomac River at Marshall Hall, MD. Surface salinity (not depicted) was always ≤ 0.2 ppt.

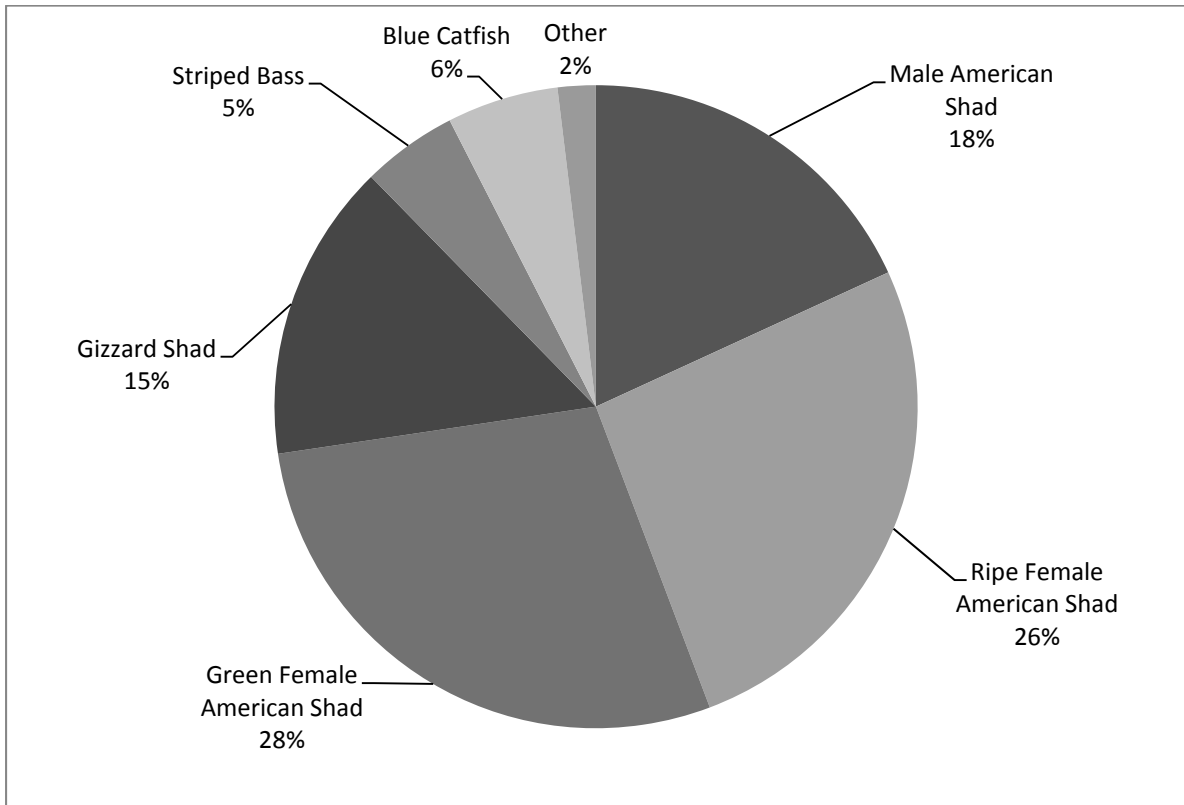


Figure 2. Spring 2014 species composition from Potomac River gill net sampling at Marshall Hall, MD. Other species and number caught listed in Table 1.

Table 1. List of species and number collected in gill nets from the Potomac River during spring, 2014.

Family	Scientific Name	Common Name	Number Captured
Catostomidae	<i>Carpionodes cyprinus</i>	Quilback Sucker	2
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	5
Channidae	<i>Channa argus</i>	Northern Snakehead	1
Clupeidae	<i>Alosa mediocris</i>	Hickory Shad	1
	<i>Alosa sapidissima</i>	American Shad	3089
	<i>Brevoortia tyrannus</i>	Atlantic Menhaden	1
Cyprinidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	627
	<i>Carassius auratus</i>	Goldfish	1
	<i>Cyprinus carpio</i>	Common Carp	1
Ictaluridae	<i>Ameiurus catus</i>	White Catfish	1
	<i>Ictalurus furcatus</i>	Blue Catfish	234
	<i>Ictalurus punctatus</i>	Channel Catfish	7
Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose Gar	7
Moronidae	<i>Morone saxatilis</i>	Striped Bass	201

Table 2. American Shad catch totals with respect to male and female ratio, the associated viability and liters of eggs produced during spring, 2014. * represents eggs stocked into river, the viability for these eggs is unknown

Date	Ripe Male	Ripe Female	Ratio Male:Female	Liters	% Viability
4/13/2014	8	15	0.53:1	4*	
4/15/2014	16	23	0.7:1	5.1	42.7
4/16/2014	27	18	1.5:1	3.6	27.8
4/17/2014	16	4	4:1	1.5*	
4/21/2014	116	79	1.47:1	26.7	54.3
4/22/2014	73	68	1.07:1	23.3	51.0
4/24/2014	61	168	0.36:1	59.6+5*	51.4
4/27/2014	84	275	0.31:1	77.1+5*	32.0
4/28/2014	127	117	1.09:1	38.9	33.2
5/1/2014	0	2	0:1	0	0.0
5/4/2014	20	39	0.51:1	12.3	33.2
5/6/2014	72	53	1.36:1	13.1+4.5*	65.6
5/7/2014	35	55	0.64:1	20.4+2.25*	62.5
5/8/2014	4	24	0.17:1	6.8+5*	0.0
5/11/2014	15	50	0.3:1	14.4+3.75	39.6
5/14/2014	84	100	0.84:1	15.4	13.7

Table 3. 2014 Shipment and viability summary for American Shad eggs, delivered to the Van Dyke Hatchery from various collection sites (J. Tryninewski, unpublished).

Site	Shipments (N)	Volume (L)	Eggs (N)	Viable Eggs (N)	Viability (%)
Potomac R.	13	316.7	14,407,614	5,671,992	39.4