JOB II, PART 1. SUSQUEHANNA RIVER AMERICAN SHAD RESTORATION: POTOMAC RIVER EGG COLLECTION, 2011

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ABSTRACT

During April and May, 2011 we used monofilament gill nets to collect 772 adult American shad from the Potomac River (rkm 150). 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. Sampling took place over a total of 19 days and supplied a total of 137 L of American shad eggs (6.2 million) with a 44% fertilization rate resulting in 2.7 million viable eggs. The U.S. Fish and Wildlife Service's sixth attempt to deliver eggs for Susquehanna River American shad restoration resulted in a similar number of viable eggs as in previous years with the exception of 2010.

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 ^{o}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 U.S. Fish and Wildlife Service (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 role is to deliver viable American shad eggs to the Van Dyke American Shad Hatchery near Thompsontown, 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. We used two different types of net in 2011 egg collections. One net was used for targeting ripe females and the other was used for targeting 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 used to target males was 5.2 m deep by 91.4 m long floating monofilament gill net with 11.7 cm stretch mesh. Up to five nets per boat were joined in series and drifted parallel to shore in water depths ranging from approximately 7.6 to 16.8 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 (^{o}C), dissolved oxygen (mg/L), conductivity (microsiemens) and salinity (ppt) were recorded (Yellow Springs Instruments Model 85) each night gill nets were set (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 (CPUE= (n/hr/m^2)). All CPUE values were multiplied by 1000 as a scalar for data display (Figure 1). A subsample of American shad otolith samples, total length (nearest mm) and weight (nearest 0.1 gram) were taken from American shad captured. The samples were taken as a permit requirement of the Potomac River Fisheries Commission.

RESULTS

During spring 2011 we sampled the Potomac River a total of 19 days from April 12- May 12. During the 19 days of fishing we collected ≥ 5.0 L of eggs 10 times (67%). We shipped a total of 137.4 L (Range = 5.0 – 21.3 L, $\bar{x}$ = 13.7 L/shipment) of eggs from the Potomac River (M. Hendricks, pers. comm.). The overall egg viability was 44%, although daily shipments had a range of 5.6 – 63.3% (M. Hendricks, pers. comm.).

Gill net sampling produced 3,837 fish from the Potomac River, representing fourteen fish species from eight families (Table 1). In 2011, green females were more common than ripe females with a 1.71:1 ratio, but males were more common than ripe females with a 1.1:1 ratio (Figure 2).

From early April to early May, surface water temperature and dissolved oxygen displayed a slight rising trend on the Potomac River. However, during the second week of May there was a sharp increase in surface water temperature (Figure 1). Surface water temperatures ranged from 13.3 to 20.0 ^{o}C ($\bar{x}$ = 17.3 ^{o}C) while dissolved oxygen ranged from 10.5 to 114.6 mg/L ($\bar{x}$ = 11.8 mg/L) (Figure 1). CPUE for shad was variable and there was no apparent relation to tide or to lunar cycle. The CPUE was the highest on the third day (4/14/2011) of sampling (0.195/hr/m^2) and lowest on the last day (5/122011) of sampling (0.000/hr/m^2). The highest CPUE values were between the thirteenth day (5/4/2011) and fifteenth day (5/8/2011) of sampling. During this time the CPUE ranged from 0.114/hr/m^2 to 0.189/hr/ft^2 with an average of 0.153/hr/m^2 (Figure 1).

DISCUSSION

American shad harvest in numbers sufficient to yield egg shipments was very inconsistent on the Potomac River. The greatest numbers of ripe/running male and female American shad were caught between surface water temperatures of 16.8-18.6 ^{o}C as opposed to 2010 sampling when the greatest numbers of ripe/running male and female American shad were collected between water temperatures were of 16.5-17.2 ^{o}C. In contrast to other 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 2011 season. In the Potomac River males are substantially smaller than females. To

collect a higher number of males, we set at least one smaller mesh gill net (11.75 cm) along with up to eight of the larger mesh gill net (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 to be stocked into the Susquehanna River watershed.

CONCLUSION

The USFWS provided Pennsylvania with 137 L of eggs, with an overall viability of 44% (6,874,612 viable eggs) (Table 3). Unstable river flows and variable water temperature made collection of viable eggs more difficult than in previous years. Due to weather, high flows, or large amounts of debris we were unable to fish on five occasions (Figure 3). Our 2011 viability of 44% is equal to the greatest viability to date and greater than our six year average (40%) since Potomac River egg collection began in 2006.

PROJECT SUMMARY

Over the past six years the USFWS has provided Pennsylvania with close to 20 million viable shad eggs.

Year	Volume (L)	Viable Eggs (N)	Viability (%)
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

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U.S. Fish and Wildlife Service Chesapeake Bay Field Office Home Page. 2006. American shad *Alosa sapidissima*. <http://www.fws.gov/chesapeakebay/SHAD

.HTM>. August 8, 2006.

FIGURES AND TABLES

Figure 1. Spring 2011 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 ≤ 0.10 ppt.

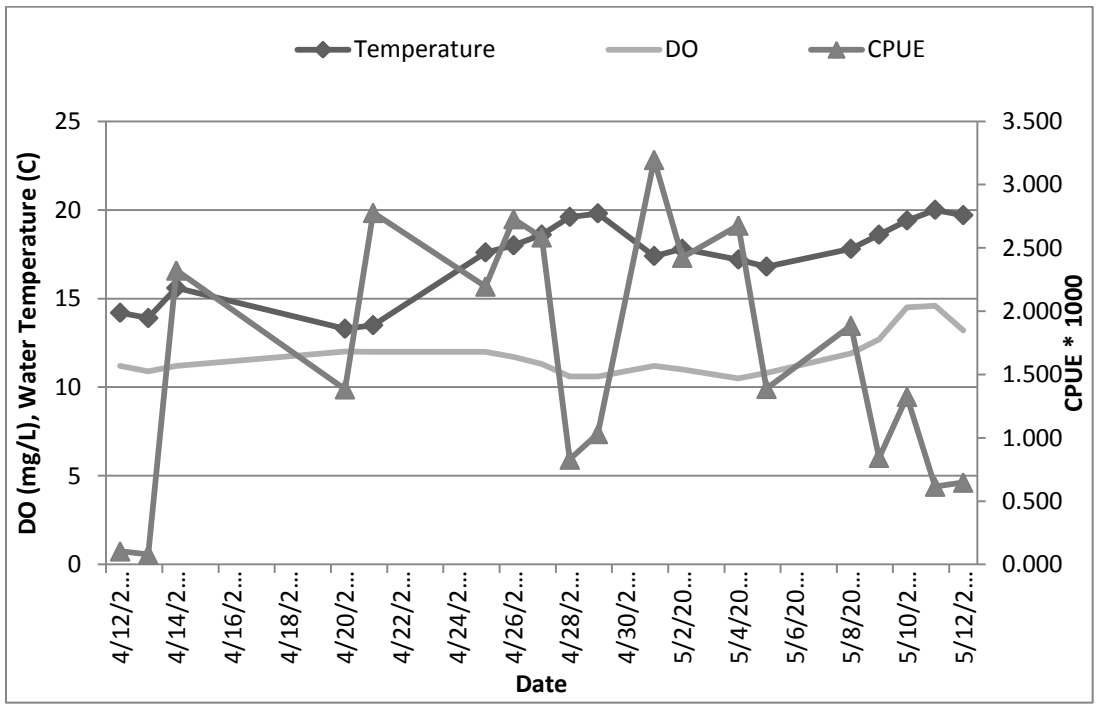

Figure 2. Spring 2011 species composition from Potomac River gill net sampling at Marshall Hall, MD. Other species and number caught listed in Table 1.

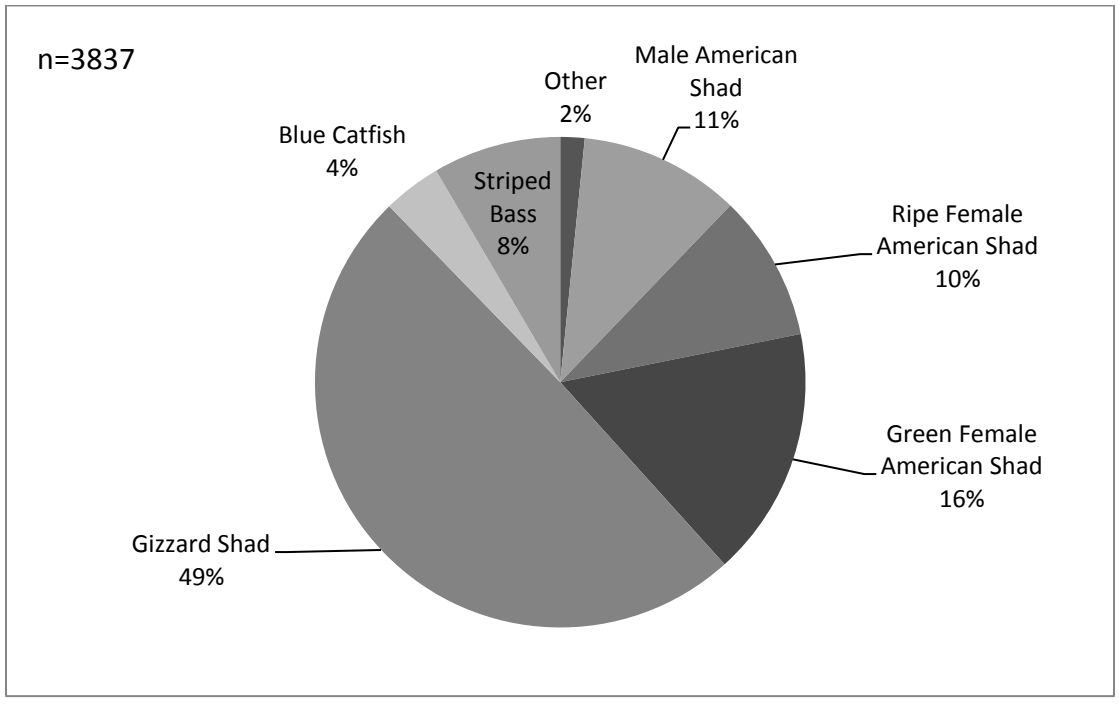

Figure 3. Daily discharge at Little Falls Pump Station during the American shad egg collection on the Potomac River.

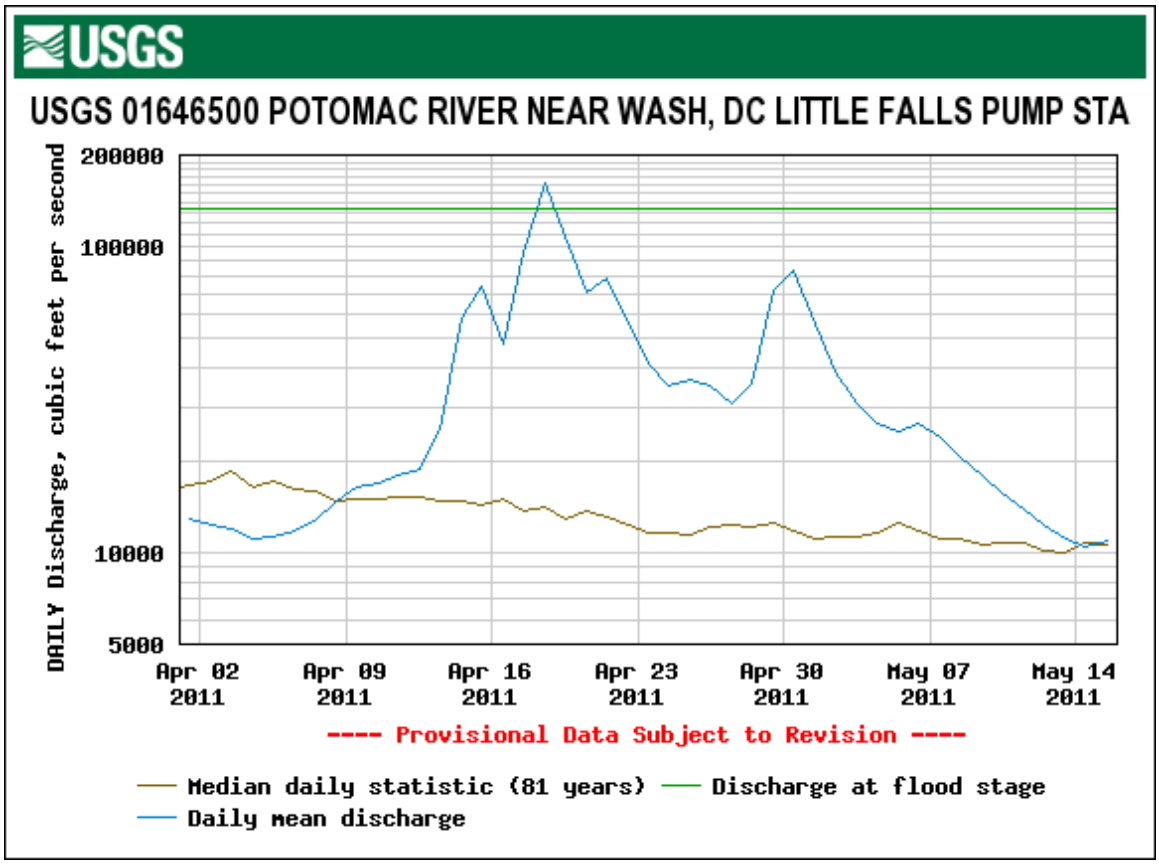

Table 1. List of species and number collected in gill nets from the Potomac River during spring, 2011.

Family	Scientific Name	Common Name	Number Captured
Belonidae	*Strongylura marina*	Atlantic needlefish	1
Catostomidae	*Carpiodes cyprinus*	quilback sucker	4
Centrarchidae	*Micropterus salmoides*	largemouth bass	2
Clupeidae	*Alosa mediocris*	hickory shad	1
	Alosa sapidissima	American shad	1424
	Dorosoma cepedianum	gizzard shad	1884
Cyprinidae	*Carassius auratus*	goldfish	6
	Cyprinus carpio	common carp	5
Ictaluridae	*Ictalurus furcatus*	blue catfish	146
	Ictalurus nebulosus	brown bullhead	1
	Ictalurus punctatus	channel catfish	7
Lepisosteidae	*Lepisosteus osseus*	longnose gar	33
Moronidae	*Morone americana*	white perch	1
	Morone saxatilis	striped bass	322

Table 2. American shad catch totals with respect to male and female ratio and the associated viability and liters of eggs produced during spring, 2011.

Date	Ripe Male	Running Female	Ratio Male:Female	Liters	Viability
4/12/2011	17	8	2.12:1	0	0
4/13/2011	11	5	**2.2:**1	0	0
4/14/2011	19	57	1:3	19.8	34.1
4/20/2011	12	1	12:1	0	0
4/21/2011	10	5	2:1	0	0
4/25/2011	29	15	1.93:1	7.1	33.9
4/26/2011	23	15	1.53:1	5	5.6
4/27/2011	9	2	4.5:1	0	0
4/28/2011	8	30	1**:3.75**	10.3	14.1
4/29/2011	7	46	1:6.57	21.3	43.1
5/1/2011	47	29	1.62:1	14.8	60.4
5/2/2011	90	9	10:1	0	0
5/4/2011	26	36	01:01.4	20.2	63.3
5/5/2011	18	26	1:1.44	17	61.3
5/8/2011	28	50	1:1.78	13.4	34.5
5/9/2011	24	17	1:1.41	8.5	45.4
5/10/2011	5	6	1.2:1	0	0
5/11/2011	21	11	1**:**2.6	0	0
5/12/2011	0	0	1**:**2.5	0	0

Table 3. 2011 Shipment and viability summary for American shad eggs, delivered to the Van Dyke Hatchery from various collection sites (Hendricks 2011, unpublished).

Site	Shipments (N)	Volume (L)	Eggs (N)	Viable Eggs (N)	Viability (%)
Potomac	10	137.36	6216484	2714435	44
Delaware	13	171.85	9990842	1467015	15
Susq. Conowingo	8	106.4	7362615	1156431	16
Grand total	31	415.61	23569941	5337880	23