U.S. Fish & Wildlife Service Susquehanna River American Shad (*Alosa sapidissima*) Restoration: Potomac River Egg Collection, 2009

Ian Park*, Steve Minkkinen, Mike Mangold

To: Mr. Mike Hendricks
Fish Production Services
PABFC
1735 Shiloh Road
State College, PA 16801

From: U.S. Fish and Wildlife Service
Maryland Fishery Resources Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

15, August 2009

Ian_Park@fws.gov, (410) 573-4503

Abstract

During April and May, 2009 we used monofilament gill nets to collect 994 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. This years sampling took place over a total of 31 days and supplied a total of 138 L of American shad eggs (6.4 million) with a 30% fertilization rate resulting in 1.9 million viable eggs. The U.S. Fish and Wildlife Service's fourth attempt to deliver eggs for Susquehanna River American shad restoration resulted in a lower number of viable eggs than in previous years.

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^o (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. Shad have undergone population fluctuations as a result of anthropogenic effects. In Pennsylvania, American shad are said to have once ruled the waters of the Susquehanna River and its tributaries (The Native Fish Conservancy 2005). 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 2009 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 four 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 (C^o), dissolved oxygen (mg/L), conductivity (micromos) 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/ft^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 2009 we sampled the Potomac River a total of 31 days over a 46 day timeframe. During the 31 days of fishing we collected ≥ 5.0 L of eggs 15 times (48%). We shipped a total of 138 L (Range = 3.7 – 19.5 L, $\bar{x}$ = 9.21 L/shipment) of eggs from the Potomac River (M. Hendricks, pers. comm.). The overall egg viability was 30%, although daily shipments had a range of 0.0 – 60.7% (M. Hendricks, pers. comm.).

Gill net sampling produced 4,429 fish from the Potomac River, ten fish species from seven families were represented (Table 1). In 2009, green females were more common than ripe females with a 1.32:1 ratio, but ripe females were almost equal to males with a 1.1:1 ratio (Figure 2).

From early April to late-May, surface water temperature gradually increased and dissolved oxygen displayed a slight descending trend on the Potomac River (Figure 1). However during this years sampling there were several rain events that caused the turbidity and flow to increase dramatically (April 18th – May 16th). This made sampling difficult as the slack tide that is used to drift the gill nets never occurred, resulting in low catch numbers. The Potomac River surface water temperatures ranged from 11.9 to 20.3 C^{o} ($\bar{x}$ = 16.9 C^{o}) while dissolved oxygen ranged from 5.9 to 8.3 ($\bar{x}$ = 7.0 mg/L) (Figure 1). As time progressed CPUE for shad was variable and there was no apparent relation to which tide was fished or to lunar cycle. The CPUE was the highest on the twenty-eighth day (5/18/09) of sampling (0.003/hr/ft^2) and the lowest were on the second (4/13/09) and twenty- third day (5/11/09) of sampling (0.000/hr/ft^2). Generally speaking the highest value of CPUE was between the twenty-fourth day (5/12/09) and twenty-eighth day (5/18/2009) of sampling. During this time the CPUE ranged from 0.0006/hr/ft^2 to 0.0033/hr/ft^2 with an average of 0.0017/hr/ft^2.

Discussion

American shad harvest in numbers sufficient to yield egg shipments was variable on the Potomac River. The season began with several shipments being at the minimum amount of eggs to make the shipment justifiable. The greatest numbers of ripe/running male and female American shad were caught between surface water temperatures of 17.6

– 20.3 C^o as opposed to last years sampling where the greatest numbers of ripe/running male and female American shad were collected when water temperatures were between 14.9-17.1 C^o. Overall the ratio of ripe male to running female was about 1:1; however this year the males were caught continuously throughout the spawning season (Table 2). Catching males throughout the entire sampling season can be directly attributed to using a smaller mesh gill net during the 2009 season. In the Potomac River males are substantially smaller than females. To collect a higher number of males, we set one smaller mesh gill net (11.75 cm) per boat along with up to three of the larger mesh gill net (14 cm stretch mesh) "female" nets. The smaller mesh nets were attempted in an effort to keep the sex ratio consistent with one male to two females through the entire season. Constant availability of sperm was expected to increase overall egg viability resulting in more fry to be stocked into the Susquehanna River watershed. However, we did not see an increase in viability in 2009 with increased availability of male shad throughout the season due to using smaller mesh nets.

The 2009 Potomac River American shad collection provided Pennsylvania with 132.2 L of eggs, with an overall viability of 30% (1,885,500 viable eggs) (Table 3 M. Hendricks, pers. comm.). By comparison, in 2008 the USFWS provided Pennsylvania 194.4 L of eggs, with an overall viability of 41% (3,491,069 viable eggs). In 2007 the USFWS provided Pennsylvania with 183.9 L with an overall viability of 42% (2,875,455 viable eggs). In 2006, our first year of providing eggs to Pennsylvania 99.3 L of eggs were provided, with an overall viability of 44% (2,003,222 viable eggs)(M. Hendricks, pers. comm.).

Conclusion

The Service's fourth attempt to harvest eggs from the Potomac River for delivery to the Van Dyke American shad hatchery, in support of Susquehanna River restoration, was successful. However, this year's sampling was not as successful as in years past. High flows and variable water temperature made collection viable eggs more difficult than in previous years. Collections in 2009 resulted in the lowest number of viable eggs, and overall viability since the Maryland Fishery Resources Office started collecting American shad eggs from the Potomac River in 2006.

Acknowledgements

The Maryland Fishery Resources Office thanks those who participated in this years sampling, Julie Devers, Sheila Eyler, Susan Frey, Geoff Jay, Rich Netro, Josh Newhard, Ashlee Paver, and Sherr Vue. We would also like to thank Matthew Baldwin from MDDNR.

References Cited

Stier, D.J., and J.H. Crance. 1985. Habitat suitability index models and instream flow suitability curves: American shad. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.88). 34 pp.

The Native Fish Conservancy Home Page. 2005. Migratory fish restoration and passage on the Susquehanna River. <http://www.nativefish.org/ articles/Migratory_Fish_ Restoration.php>. January 9, 2006.

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.

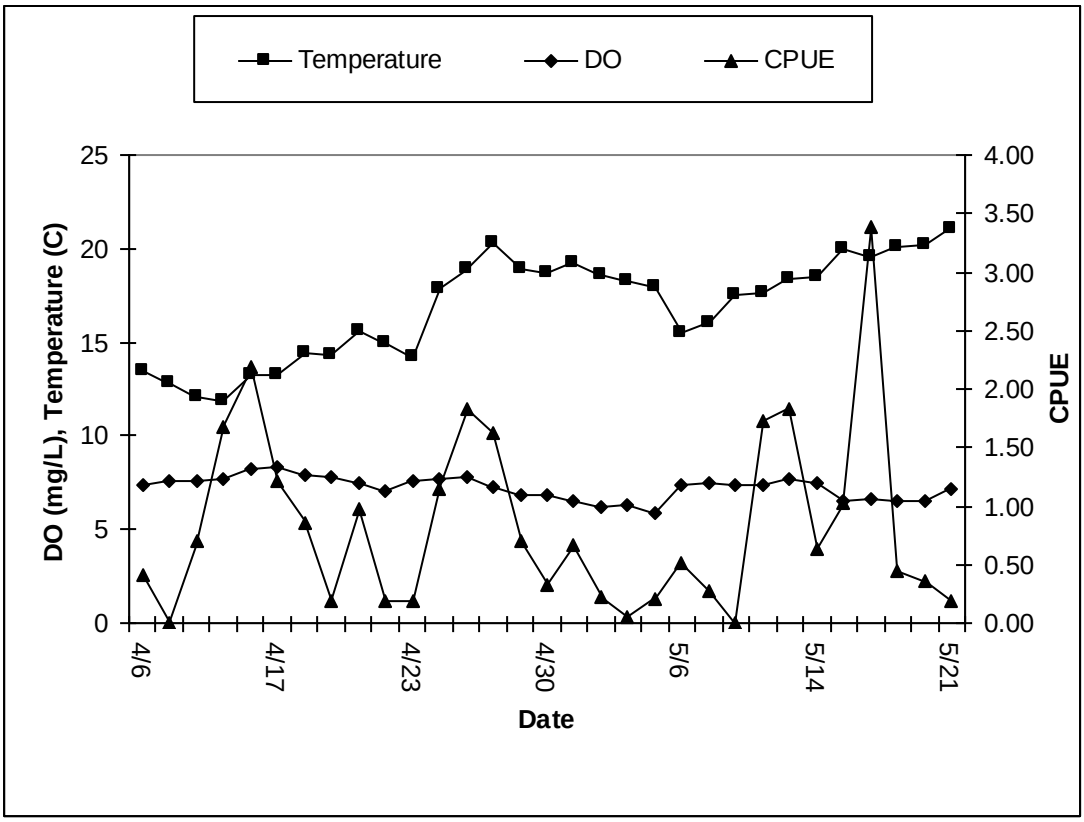

Figure 1. Spring 2009 American shad catch per unit effort, surface dissolved oxygen, and surface temperature, by sample date, for the Potomac River at Marshall Hall, MD. Surface salinity (not depicted) was always ≤ 0.10 ppt.

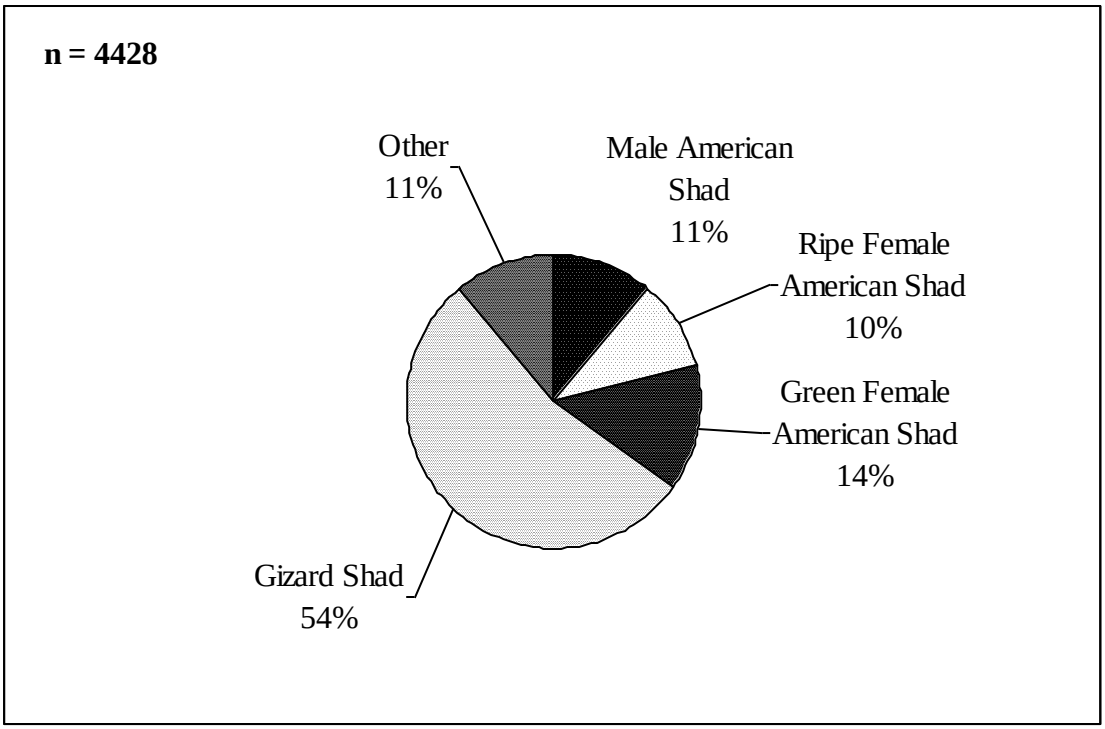

Figure 2. Spring 2009 species composition from Potomac River gill net sampling at Marshall Hall, MD. Other species and number caught listed in Table 1.

Table 1. List of species and number collected in gill nets from the Potomac River during spring, 2009.

Family	Scientific Name	Common Name	Number Captured
Catostomidae	*Carpiodes cyprinus*	quilback sucker	2
	Catostomus commersonii	white sucker	1
Centrarchidae	*Micropterus salmoides*	largemouth bass	1
Clupeidae	*Alosa sapidissima*	American shad	1559
	Dorosoma cepedianum	gizzard shad	2392
Cyprinidae	*Cyprinus carpio*	common carp	7
Ictaluridae	*Ictalurus furcatus*	blue catfish	200
	Ictalurus punctatus	channel catfish	9
Lepisosteidae	*Lepisosteus osseus*	longnose gar	32
Moronidae	*Morone saxatilis*	striped bass	226

Table 2. American shad catch totals with respect to male and female ratio and the associated viability and liters of eggs produced during spring, 2009.

Date	Ripe Male	Running Female	Ratio Male:Female	Viability %	Liters
4/6/2009	4	0	0	0	0
4/13/2009	0	0	0	23	5.2
4/14/2009	7	22	1:3.1	34	5.9
4/15/2009	40	13	3.1:1	9	7.5
4/16/2009	65	13	5:1	6	6.2
4/17/2009	28	10	2.8:1	0	0
4/19/2009	16	11	1.5:1	0	0
4/20/2009	4	3	1.3:1	0	0
4/21/2009	15	20	1:1.3	17	6.7
4/22/2009	2	5	1:2.5	21	3.7
4/23/2009	4	3	1.3:1	0	0
4/26/2009	13	23	1:1.8	0	6.5
4/27/2009	33	55	1.6:1	0.002	19.5
4/28/2009	34	50	1:1.5	7	12
4/29/2009	8	20	1:2.5	42	8.5
4/30/2009	5	9	1:1.8	0	0
5/1/2009	7	5	1.4:1	0	0
5/3/2009	7	1	7:1	0	0
5/4/2009	2	0	0	0	0
5/5/2009	7	3	2.3:1	0	0
5/6/2009	7	9	1:1.28	0	0
5/7/2009	4	1	1:0.2	0	0
5/11/2009	0	0	0	0	0
5/12/2009	40	43	1:1	61	15
5/13/2009	18	48	1:2.6	61	17.25
5/14/2009	7	18	1:2.6	52	9.4
5/17/2009	21	16	1.3:1	44	5
5/18/2009	81	41	2:1	42	9.9
5/19/2009	14	2	7:1	0	0
5/20/2009	16	1	16:1	0	0
5/21/2009	1	6	1:6	0	0

Table 3. 2009 Shipment and viability summary for American shad eggs, delivered to the Van Dyke Hatchery from various collection sites(Hendricks 2009, unpublished).

Site	Shipments (N)	Volume (L)	Eggs (N)	Viable Eggs (N)	Viability (%)
Potomac R.	15	138	6,380,784	1,885,500	30%
Delaware R.	12	47	2,960,122	587,466	20%
Susquehanna R.	10	97	5,885,504	1,366,478	23%
Total	37	282	15,226,409	3,839,443	25%