U.S. Fish & Wildlife Service Susquehanna River American Shad (*Alosa sapidissima*) Restoration: Potomac River Egg Collection, 2008

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 2008

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

Abstract

During April and May, 2008 we used monofilament gill nets to collect 785 viable American shad from the Potomac River (rkm 150). The purpose of sampling was to supply viable 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 21 days and supplied a total of 194.4 L of American shad eggs (8.5 million) with a 41% fertilization rate resulting in 3.5 million viable eggs. The U.S. Fish and Wildlife Service's third attempt to deliver eggs for Susquehanna River American shad restoration resulted in a greater number of viable eggs despite poor sampling conditions. The American shad egg collections from the Potomac River provided a greater number of viable eggs than the combined effort from the Delaware and Susquehanna Rivers (2.1 million 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^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

We used two different types of net in 2008 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 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). American shad otolith samples, total length (nearest mm) and weight (nearest 0.1 gram) were taken from 5% (n=35) of American shad captured. The samples were taken as a permit requirement of the Potomac River Fisheries Commission.

Results

During spring 2008 we sampled the Potomac River a total of 21 days over a 37 day timeframe. During the 21 days of fishing we collected ≥ 5.0 L of eggs 12 times (57%). We shipped a total of 194.4 L (Range = 4.0 – 32.6 L, $\bar{x}$ = 16.2 L/shipment) of eggs from the Potomac River (M. Hendricks, pers. comm.). The egg viability averaged 41% with a daily range of 4.6 – 51.9% (M. Hendricks, pers. comm.).

Gill net sampling produced 2,716 fish from the Potomac River, eight fish species from six families were represented (Table 1). In 2008, green females were more common

than ripe females with a 3:2 ratio (28.7 % green, 18.5 % ripe), but ripe females were proportionally almost twice that of males (10.5%) (Figure 2).

From early April to mid-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 21st – May 4th). 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 11.6 to 19.8 C^{o} ($\bar{x}$ = 15.7 C^{o}) while dissolved oxygen ranged from 7.1 to 9.0 ($\bar{x}$ = 8.3 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 ninth day (4/16/08) of sampling (0.003/hr/ft^2) and the lowest on the fourteenth day (4/29/08) of sampling (0.000/hr/ft^2). Generally speaking the highest value of CPUE was between the 9th (4/16/08) and 12th (4/22/08) day of sampling. During this time the CPUE ranged from 0.0018/hr/ft^2 to 0.0035/hr/ft^2 with an average of 0.0028/hr/ft^2.

Discussion

American shad harvest in numbers sufficient to yield egg shipments was variable on the Potomac River. The season began with some of our largest shipments to date. The greatest numbers of ripe/running male and female American shad were caught between surface water temperatures of 14.9-17.1 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 16.2-18.8 C^{o}. Overall the ratio of ripe male to running female was 2:1; however this year the males were caught continuously

throughout the spawning season (Table 2) as opposed to last year where most of the ripe males were caught early in the sampling period when few ripe females were present. Catching males throughout the entire sampling season can be directly attributed to using a smaller mesh gill net during the 2008 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 we 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 2008 when using the smaller mesh to collect male shad.

The 2008 Potomac River American shad collection provided Pennsylvania with 194.4 L of eggs, with an overall viability of 41% (3,491,069 viable eggs) (Table 3 M. Hendricks, pers. comm.). By comparison, in 2007 the USFWS provided Pennsylvania with 183.9 L with an overall viability of 42% (2,875,455 viable eggs). In 2006 and 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 third 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. This year's sampling began with the first several nights resulting in some our largest catches to date, however shortly thereafter our sampling was hindered by the

spring rain events and the high flows on the Potomac. Collections in 2008 provided the greatest number of viable eggs to date from the Potomac River and provided more viable eggs than the Delaware and the Susquehanna River combined.

Acknowledgements

The Maryland Fishery Resources Office thanks those who participated in this years sampling, Matthew Breece, Julie Devers, Sheila Eyler, Susan Frey, John Gill, Lexie Maple, Emily Miller, Luke Roberson, and Micah Ryder. 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.

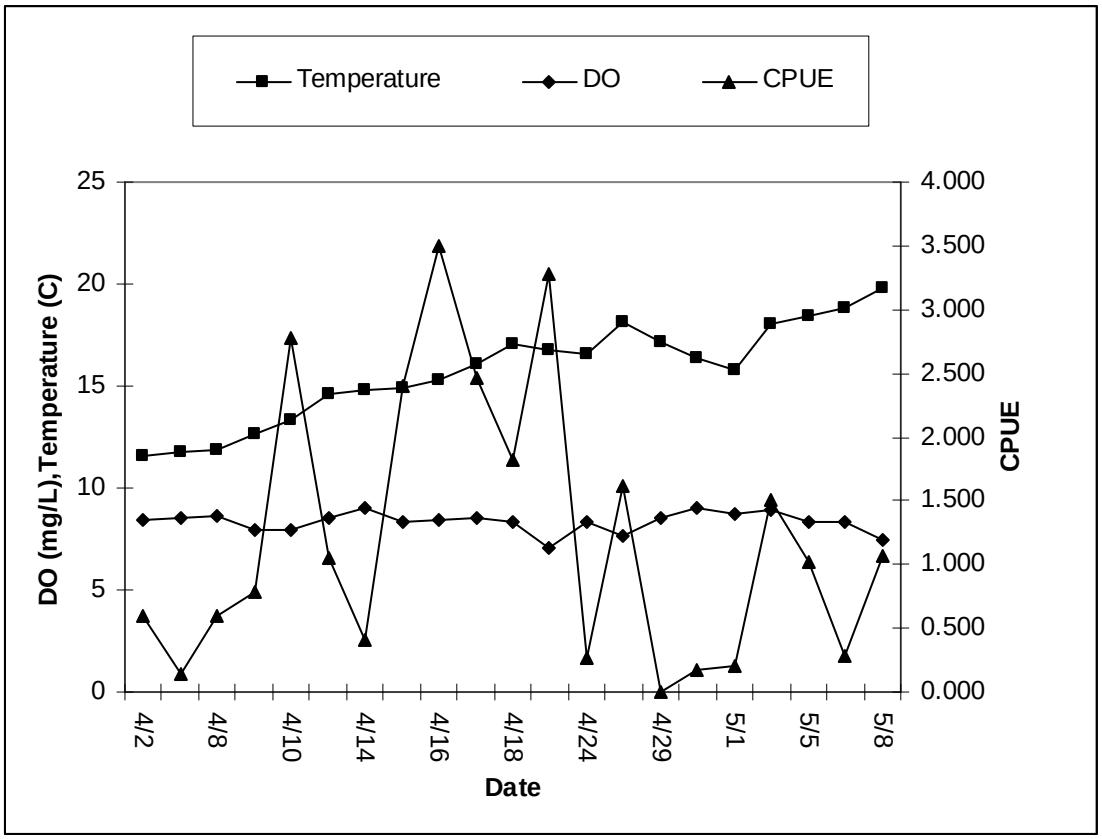

Figure 1. Spring 2008 American shad catch per unit effort, surface dissolved oxygen, and surface temperature, by sample date, for the Potomac River at Marshall Hall, MD. Surface salinity (not depicted) was always ≤ 0.10 ppt.

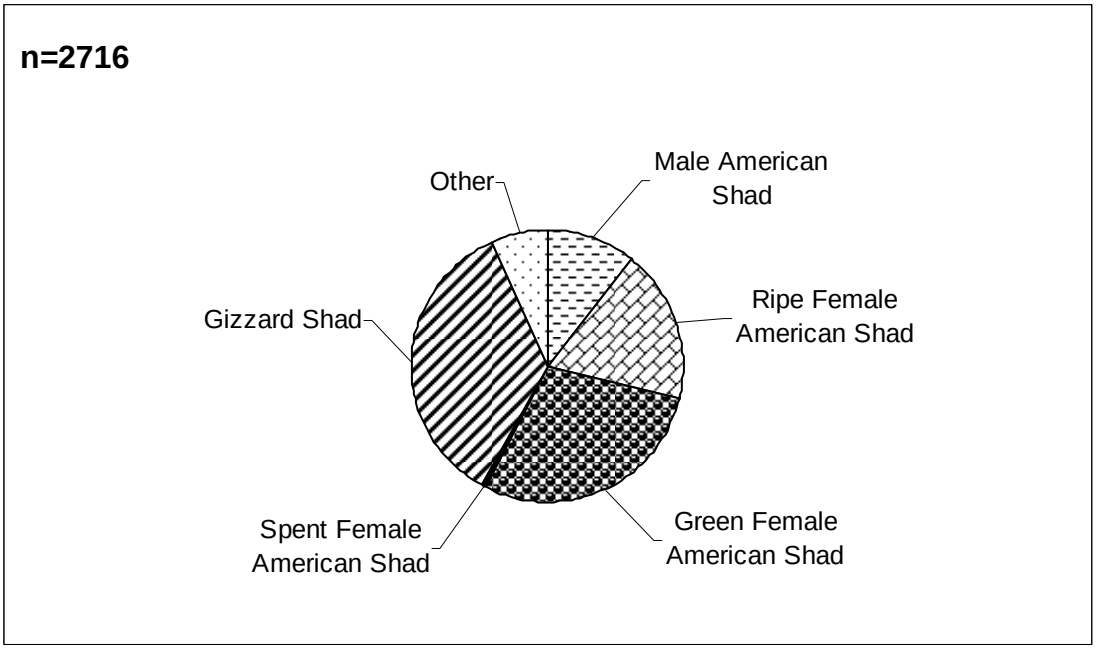

Figure 2. Spring 2008 species composition from Potomac River gill net sampling at Marshall Hall, MD. Other species and number caught listed in Table 1.

Table 1. List of species and number collected in gill nets from the Potomac River during spring, 2008.

Family	**Scientific Name**	**Common Name**	**Number Captured**
Catostomidae	*Carpiodes cyprinus*	quilback sucker	6
Clupeidae	*Alosa sapidissima*	American shad	1565
	Dorosoma cepedianum	gizzard shad	959
Cyprinidae	*Cyprinus carpio*	common carp	4
	Lepisosteus osseus	longnose gar	3
Ictaluridae	*Ictalurus punctatus*	channel catfish	4
Lepisosteidae	*Morone saxatilis*	striped bass	108
Moronidae	*Ictalurus furcatus*	blue catfish	57

Table 2. American shad catch totals with respect to male and female ratio and the associated viability and liters of eggs produced during spring, 2008.

Date	Ripe Male	Running Female	Ratio Male:Female	Viability	Liters
4/2/2008	6	2	3:1	0	0
4/7/2008	0	2	0:2	0	0
4/8/2008	4	4	1:1	0	0
4/9/2008	7	21	1:3	32.9	12.4
4/10/2008	13	62	1:5	42.7	32.6
4/11/2008	6	29	1:5	44	12.5
4/14/2008	1	11	1:11	10.7	5.65
4/15/2008	48	63	1:1	43.4	28
4/16/2008	52	69	1:1	38.2	26.1
4/17/2008	28	77	1:3	42	30.7
4/18/2008	21	42	1:2	51.9	14.2
4/22/2008	22	6	4:1	0	0
4/24/2008	1	6	1:6	0	0
4/27/2008	21	12	2:1	38.2	4
4/29/2008	0	0	0	0	0
4/30/2008	2	4	1:2	0	0
5/1/2008	5	2	2:1	0	0
5/4/2008	2	33	1:16	35.3	9.5
5/5/2008	17	30	1:2	48	11.4
5/6/2008	10	3	3:1	0	0
5/8/2008	18	23	1:1	4.6	7.3

Table 3. 2008 Shipment and viability summary for American shad eggs, delivered to the Van Dyke Hatchery from various collection sites(Hendricks 2008, unpublished).

Site	Shipments (N)	Volume (L)	Eggs (N)	Viable Eggs (N)	Viability (%)
Potomac R.	12	194.4	8,503,709	3,491,069	41.1%
Delaware R.	17	148.2	5,867,652	1,670,744	28.5%
Susquehanna R.	11	98.4	5,749,466	526,816	9.8%
Total	40	440.9	20,120,827	5,688,628	28.3%