Final Report

Push-net survey for young-of-the-year American shad, American eel elver trapping in Rock Creek, and production of yolk-sac fry American shad

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OBJECTIVES

Part 1

The push-net survey was designed to help determine the abundance of young-of-the-year American shad in the District. While our sampling techniques have not been successful at finding adult American shad, we know they are present because of angler reports. This part of this study was designed to help determine the population of young-of-year (YOY) American shad present in the District. The Interstate Commission on the Potomac River Basin, in conjunction with the US Fish and Wildlife Service, stocked larval American shad into the Potomac just below Great Falls over the years 1995 through 2002. While the yearly goal in the stocking was one million larval fish, there were almost 16 million larvae stocked over this period. This stocking has been successful with documented adult returns to the Great Falls area. The US Fish and Wildlife Service also documented increasing numbers of YOY in the Potomac in the District and just downstream of Woodrow Wilson Bridge through their push-net survey. Since 2002 was the final year of the USFWS push-net survey, our survey was designed to document any changes in the population now that the stocking near Great Falls has ended.

Part 2

The second survey was designed to document the existence and abundance of young eels in Rock Creek, a tributary to the Potomac. To date, no targeted studies have looked at eel abundance anywhere in the District, and since we regularly see eel elvers in our electrofishing surveys we are now trying to document their actual abundance.

Part 3

The third element to this project is the production of yolk-sac fry American shad for stocking in the District. While occasional adult American shad are collected during our regular sampling surveys in the District, populations are still far below their historic levels. To supplement the existing population we are going to use capture and artificially spawn wild fish and use the fry produced to stock into District waters.

Part I

Push Net Survey for Young-of -the-Year American Shad

Introduction

A push net survey was implemented in the 2003 sampling regime for the District of Columbia. The purpose of the survey is to 1) improve knowledge of alosids stock dynamics to develop more accurate databases in District waters and to 2) continue programs to restock alosids into historical spawning waters and expand the stock for restoration programs. These objectives are inline with the Chesapeake Bay Alosid Management Plan (FMP). The plan was approved and implemented in 1989 by states of Pennsylvania, Maryland, and Virginia, the District of Columbia, and the Potomac River Fisheries Commission.

American and hickory Shad are anadromous species and members of the Clupeid (herring) family. Spawning for both species come about as a result of increasing water temperatures and increasing photoperiods. Hickory shad start their freshwater migration spawn before American Shad. They arrive in District waters early to late March. American shad then follow them. American shad arrive in the late March to early April. In the District, spawning for both species generally takes place through the month of May. Both species are broadcast spawners. Females migrate first followed by males that fertilize the eggs.

Relatively smaller than American and hickory shads, alewife and blueback herring are also spring spawners. They are less specific to critical spawning habitat. They make use of a variety of habitats including rivers; and creeks with gravel, sand, detritus or SAV substrates. Both males and females broadcast milt and eggs, respectively and simultaneously, over a particular substrate. The adults then migrate back to sea. Juveniles remain in the area waters until the fall. As water temperature drop, they migrate to the Chesapeake Bay and eventually the Atlantic Ocean. However, the Maryland Department of Natural Resources has noted that some juveniles over winter their first year in deeper waters of the bay.

Methods

The District conducts push net sampling during August and September at five locations on the Potomac River. The sites are P5PN (Fletchers Boathouse), P4PN (upstream of Key bridge/adjacent to three sisters island), P3PN (adjacent to Theodore Island), P2PN (adjacent to National Airport), P1PN (upstream from the Woodrow Wilson Bridge), and A1PN (downstream of Pennsylvania Ave. Bridge) was added in 2005 to the sampling regime. This site is located on the Anacostia River.

Samplings are done at dusk and performed eleven times a year. A 50”x 38” x8” (width x depth x length) mesh net is hung on a pivoting tubular metal frame and fished from the bow of the boat for a ten minute period. A 0.83 mile transect in length is covered at each

station. Fishing is performed starting from an upstream position then moving downstream, all sites are fished in this manner except P1PN which is done in the opposite way. Transects are performed at a constant speed of 5 mph. All alosid are collected, enumerated, measured and saved for otolith extraction.

The data collected is used to determine relative abundance of young-of-year American shad and to estimate the spawning success of American shad within the District. The USFWS has been stocking American shad fry upstream of Little Falls Dam on the Potomac River, since 1995 and also collects American shad otoliths to determine the success of their stocking program.

Results

The break down of alosids collected per 1000 cubic meters of water sampled by site from the years 2004 to 2006 is shown in Table 1. In 2004 more America shad were collected than any alosid, but that has not hold true for the following years, when blueback herring have been more numerous (Figure 1-3). In 2004 American shad were numerous throughout the Potomac River compared to 2005 where they were mostly in the lower and middle Potomac River (Figure 4). In 2006 total numbers of American shad where down across the board. Even with these low numbers the heaviest concentration of American shad were still found the lower Potomac and Anacostia. Much like the American shad, the blueback herring and alewife numbers were also lower across the board when compared to 2005 (Figure 5 and 6). In 2006 thirteen sampling dates were done from May 16 to October 26 with the August being the month of most intense sampling. The Anacostia River (A1PN) sampling site was added in 2005 and has shown to be one of the most productive sites, comparing surprisingly well to the middle and lower reaches of the Potomac River. Last year the Anacostia River site (A1) had a greater abundance of alewife, and blueback herring than any of the other Potomac River sites (P1 – P5).

Conclusion

The survey was started slightly earlier than normal in 2006 in an attempt to catch more hickory shad that were suspected to be leaving District water before the bulk of the sampling. This effort proved to be futile, with only one hickory shad caught in 2006 on July the 19 at the Anacostia site (A1). With only three years of data it is difficult to determine spawning success of alosids. American shad numbers appear to be declining since the initiation of this survey. Blueback herring that were very numerous in 2005 dropped in 2006 but not nearly as low as there were in 2004. Alewife like the blueback herring were abundant in 2005 but declined in 2006 to less numbers that were collected in 2004 (Table 1). Now that baseline data is being established, over the next several years the Districts fisheries research branch will be able to more accurately determine spawning success (trends) and relative abundance from year to year.

Part II

American eel elver trapping in Rock Creek

Introduction

The Atlantic States Marine Fisheries Commission's (ASMFC) stock assessment of American eels, *Anguilla rostada* is incomplete. However, current trend data hints to a declining population. In response to the lack of adequate data, the ASMFC developed a regional American Eel Fisheries Management Plan. The plan provides means to fill essential data gaps so that sufficient trend analysis can be developed for American eel populations.

The development of a comprehensive regional stock assessment on American eels will equip fisheries managers with a better understanding of species dynamics, so that effective measures can be developed and implemented to protect, restore and enhance American eels along the east coast. The District of Columbia as well as other coastal members of the ASMFC is engaged in elver surveys.

The purpose of the elver surveys is to assess young of year (YOY) relative abundance. American eels are a catadromous species of fish with a complex life cycle. The fish begins life in the Sargasso Sea where mature adults spawn and die. The eggs hatch, larval eels (leptocephalus stage) drift in the ocean currents towards coastal waters. As the larvae mature at sea, they enter a second phase (glass eels) in which they are transparent. As they further mature, they reach their third phase known as the elver stage. The elvers begin ascending into brackish and/or freshwater systems where they will reach full maturity. Elvers less than 85 mm in length are considered YOY and represent the first year class of migratory eels. Current ASMFC elver surveys conducted by the District of Columbia target YOY eels. Eels mature to a yellow phase which they spend the majority of their lives. Finally, when eels reach full maturity they metamorphosize to a silver phase, then begin their journey back to the Sargasso Sea

Study Area

Rock Creek is a primary freshwater tributary to the Potomac River and a secondary tributary to the Chesapeake Bay. The freshwater stream is approximately 33 miles in length in which 9.3 miles flow within the District of Columbia. The entire 9.3 miles stretch lies within federal land regulated by the National Park Service. The Rock Creek watershed has a surface area of 77 square miles. The park consists of 1754 acres making it one of the largest U.S. National Parks within an urban area.

The single greatest threat to the creek is development within the watershed. Development surrounds the park on most sides. Numerous storm sewers and a dam adversely impact the creek. It is suspected that storm sewers are the major source of pollution (Rock Creek Watershed Study, 1979). Another known source of pollution is combined sanitary-storm sewers that flush raw sewage and rainwater into the creek and the Potomac River during major rainstorms.

Methods

The elver survey was carried out by following a protocol provided by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC protocol requires, minimally sampling one site four days per week for six weeks. The sampling gear consists of an Irish elver ramp trap. The trap is approximately 61 cm wide x 122 cm long. It is made of wood and consists of a ramp that's covered with enkmat, a plastic erosion control material inside a narrow box. The ramp runs three-fourth the length of the trap and ends in a small well at the top of the ramp. Water is fed into the trap from a freshwater source through a tube next to the well. The water fills the well and trickles down the ramp, attracting elvers. Elvers climb the ramp, fall into the well, and are carried into a mesh bag that is attached to the well. Elvers are then collected from the bag counted measured and weighed. All traps are tied to trees with padlocks in case of floods and to deter theft.

Traps are set from early March and are fished until the end of May. Traps are set on Mondays and checked everyday throughout the week and removed on Fridays. All traps are accessible by wading.

As an additional method to capturing elvers backpack electrofishing was done. At each site a 50 m stretch of Rock Creek was shocked for duration of time. A typical crew consists of at least two biologists and sometimes three. Ideally, one person is responsible for shocking with two people trailing behind on each side of the shocker netting the eels. Netters used a fine mesh (1/32) dip net to capture the eels. The backpack shocker is started at its lowest setting (voltage, pulse rate and pulse width) and gradually increased to the point where the eels become immobilized and are netted. Settings vary according to water conditions. As with the Irish elver trap basic biological information was taken, eels where measured weighed and pigment stage was recorded. This method was repeated for a twelve week sampling period.

Results

No glass eels or elvers were caught this sampling season using the Irish elver trap. As mentioned earlier backpack electrofishing was performed this year as an additional sampling method. Shocking started on May 5, 2006 and ended October 5, 2006. The month of June was completely missed due to record rainfall overflowing the banks of Rock Creek. During this span, twelve independent samplings netted a total of 969 eels; within the total sixty two were young-of-year (YOY). for this time frame July was the highest month with forty seven YOY (Figure 7). The total length range for yoy was 57 to 85 mm. The first young of year were seen July 13 when water temperatures were 25 degree Celsius.

Conclusion

Though no elvers have been landed using the Irish elver trap, we will continue to use this method for comparative studies with other states since it is the ASMFC approved protocol. In addition to the Irish elver trap, the poacher trap will be utilized this year as another method to try to gain baseline data and backpack electrofishing will continue since it has been the sole source for data obtained so far. The ASMFC committee has suggested sampling earlier in the year to better determine the peak migration run.

Backpack electrofishing will be done on a weekly basis till elvers are found then the Irish and poacher traps will be set and checked on a daily basis. Though no glass eels were caught and elvers were only caught using backpack shocking the fisheries research branch remains optimistic. In the future, the possibility of experimentation with different traps and methods might be employed to obtain better and more accurate baseline elver data. Perhaps prolonging the survey several weeks will help catch effort. Hopefully with some modifications to equipment or adjustments to sampling time improvements will be seen in the coming years.

Part III

Gill Net Survey for Adult American Shad and Fry Production

Introduction

A gillnet survey was implemented in the 2004 sampling regime for the District of Columbia. The purpose of this survey is to improve knowledge of American shad stock dynamics, as well as provide brood stock for larval shad production. A more accurate assessment of the stock will allow for the development of a dependable database to develop and implement an American shad restocking program. (Develop a program to restock American shad into historical spawning waters of the Potomac and expand the stock for restoration programs.)

This survey's primary target is American shad (*Alsoa sapidissima*). American shad are anadromous fish that spend the majority of their life at sea and only enter freshwater in the spring to spawn. Their spawning runs on the Potomac River usually occur from early April to mid May, depending on water temperature. They are broadcast spawners that release thousand of eggs into the water. Fertilized eggs hatch within several days, and remain in area waters until fall before migrating out of the Potomac. This (migration) coincides with the District of Columbia's Push Net Survey that is done in late summer/early fall to target YOY (young of year) American shad.

Methods

Adult American shad typically begin to arrive in District waters in early April as part of their annual spring spawning run. The run usually last from early April to mid May when water temperature ranges from 12 to 20 degrees C. The Fisheries Research Branch does evening and night sampling in an effort to capture pre-spawn adults through the use of gill nets and electro fishing. The ripe fish are strip spawned immediately after being captured. The shad are then measured and returned to the river. The fertilized eggs are then allowed to water harden and transported to our hatchery. The eggs remain in incubators where a fertility estimate, as well as an enumeration of viable eggs is made. The fry generally hatch after 5 to 10 days in the incubator. The fry are kept for 3 to 5 days and then released.

Gill Netting

Gillnetting consists of fishing one to three nets that are approximately 300ft in length and 8ft to 16ft in depth with 5 ½ " stretch mesh. The nets are fished for roughly an hour each. To get a better understanding of how to fish these nets and to maximize our catch per unit effort different methods were employed. Some nets are left free floating with the currents, while others drifted attached to a boat. After an hour the nets are retrieved and all fish are identified, counted and released. American shad are sexed, measured and the eggs of ripe females are stripped for incubation at the hatchery.

Gillnetting in the upper reaches of the river is difficult because the water is shallow and boulders are more pronounced. At times the current is extremely strong in the upper reaches, so an alternate method was utilized. Electro fishing was attempted on several occasions.

Strip Spawning

As the gill nets are fished the American Shad are sexed, measured, weighed, and scales are taken. The males and females are separated into 2 different live wells; once all the nets have been fished the female shad are closely inspected for ripeness. The green and spent females are then returned to the river. The eggs from 3-5 ripe females are stripped into a large mixing bowl; the milt of 6-10 males will then be put on the eggs. Ideally we would like to have a 2 to 1 male to female ratio, but that rarely works out. After the males and females are stripped they are returned to the river. A small amount of river water is added to the bowl with the eggs and sperm (enough to cover the eggs completely) to activate the sperm. The mixture is then gently mixed by hand in order to thoroughly mix the eggs and sperm. The mixture is then allowed to sit for 5 to 10 min., after which the eggs are run through a strainer to remove any scales, ovaries, feces, and any other contaminants. The eggs are then rinsed several times with river water in an effort to remove any blood or feces that was not removed in the straining process. The eggs are then allowed to water harden for about an hour in an egg box before being taken to the hatchery.

Incubation and Hatching

When the eggs arrive at the hatchery they are immediately put into hatching jars. The hatching jars are regulated to have a flow of approximately 3 gallons per minute. This allows the eggs to roll very gently. The next morning the eggs are examined and the broken eggshells and other debris are siphoned off the top (due to the rolling action the good eggs stay towards the bottom of the jar). A volumetric estimate is then made to

determine the number of eggs. The estimate is made by having ¼ liter increments marked on the side of the hatching jars. With the flow turned off the eggs are allowed to settle and the level is recorded. Using a straw dropped to the bottom of the hatching jar a cross section of eggs is pulled out. Using this 25ml sample we are able to extrapolate the number of eggs as well as a fertilization percentage. The flow is then turned back on to the jar and the eggs are allowed to incubate. The eggs are examined every day. Any dead eggs are removed and if fungal problems arise, the eggs are treated with a formalin bath. The eggs begin to hatch after 5 to 7 days at a water temp of 65 to 70 degrees F. The larvae instinctively swim up towards the mouth of the hatching jar where they flow out into a 5 ft round tank. The larvae then remain in this tank for three days after which they are collected, bagged, and stocked.

Results

Prior to the 2006 gill netting season some work was done around the hatchery in order to up the production. A pallet style filtration system was set up on the tanks where the eggs would be hatched. This system was complete with biological filtration as well as UV light sterilization. With this system we were able to hatch larval American Shad using clean recirculated water.

Gill Netting

Fisheries biologist chose to focus all gill netting efforts on one site in the Potomac River. The site was just south of the confluence of the Anacostia and Potomac Rivers off of Geisboro Pt. This site was chosen because the contours of the channel are very similar to that of the sight where other agencies capture brood stock down river. This site was fished a total of 6 times during the season yielding a total of 39 American Shad captured. Due to insufficient male to female ratios as well as poor egg quality, we were unable to get any good fertilized eggs from these fish. This site was difficult to fish in that the channel is narrow and there is a considerable amount of ship traffic in that area. On several occasions we were forced to move the nets as they were soaking. April 20th gill nets were set in the channel off of Alexandria VA. in an effort to find another site to set gill nets in the District. No American shad were caught at that site. Starting May 2nd efforts were shifted from the District to Marshall Hall in MD. Marshall Hall is about 15 miles down river from the District where several other state and federal agencies go to collect brood stock for strip spawning. Once moving down to Marshall Hall we were able to capture a total of 32 American Shad, over 4 nights.

The break down of American shad captured while gill netting is as follows

Date	Site	net length (ft)	Soak time (Min)	Am. Shad female **ripe**	Am. Shad female **green**	Am. Shad female **spent**	Am. Shad **male**
4/11/2006	Geisboro	600	60	2	5		5
4/12/2006	Geisboro	600	60	5	7		
4/18/2006	Geisboro	600	60	1	3		2

4/20/2006	Alexandria	600	60				
4/20/2006	Geisboro	600	60	2			
5/1/2006	Geisboro	600	60	1	4	1	1
5/2/2006	Marshall Hall	600	60	1	2	2	
5/2/2006	Marshall Hall	300	60	2	1	1	
5/3/2006	Marshall Hall	900	60	7			
5/4/2006	Marshall Hall	600	60	2	2		
5/4/2006	Marshall Hall	900	60	6	2	1	1
5/9/2006	Marshall Hall	900	60	1	1		

Strip Spawning

American shad strip spawning began on April 11th. The first batch of eggs came from two semi-ripe females which produced 1.5 liters of eggs. Milt from five males was introduced to the eggs, the eggs were then allowed to fertilize. After eggs were fertilized we realized that there was a considerable amount of broken and immature eggs. There was not enough good eggs to bring back to the hatchery and those eggs were returned to the river. The second batch of eggs that was collected was on April 20th, two females produced 1.8 liters of eggs. The milt of only one male, which was caught electro fishing, was put on the eggs. After letting the eggs water harden we realized that the results were similar to that of the first batch. On May 3rd we got our first batch of eggs from Marshall Hall, 2.3 liters of good eggs were brought back to the hatchery. We were unable to capture any males that night but did receive some males from other biologists with Maryland DNR, and US Fish &Wildlife service. The second batch of eggs collected from Marshal Hall was on May 4th which consisted of 2 liters. Eggs were collected from eight females; the milt from 5 males was put on the eggs. We were able to get 4 males from MDDNR and USF&WS.

The following table shows the amount of eggs collected during 2006 gill net survey

Date	Site	Number Females	Number Males	Liters of Eggs
4/11/2006	Geisboro	2	5	1.5
4/20/2006	Geisboro	2	1	1.8
5/3/2006	Marshall Hall	7	4	2.3
5/4/2006	Marshall Hall	8	5	2

Incubation and Hatching

The first batch of American shad eggs arrived at the hatchery on May 3rd, a total of 2.3 liters of eggs were placed in hatching jars. The following day a sample of eggs were taken from the hatching jar and analyzed to determine the percentage of fertilized eggs. Once the broken eggs and other debris was removed from the hatching jar we were able

to determine that the fertility was 65%. Over the next 3 days unfertilized and broken eggs were siphoned off the top, leaving us with 2.3 liters of good fertilized eggs. At this time a volumetric estimate of the number of eggs was made and it was determined that we had 50,830 viable eggs. On day 4 the eggs began to hatch, and by day 5 all the larvae had hatched out of the hatching jars. On May 4th a second batch of eggs arrived at the hatchery, and the same procedure was followed. It was determined that the 2.0 liters of eggs had a fertility of 95% and an estimated 63,920 viable eggs. On May 9th the American shad larvae from both batches were combined and stocked at the Anacostia river boat ramp, for a total of 114,750.

The following table shows the American shad production for the 2005and 2006 seasons.

Year	Date	Site of Stocking	# American Shad Stocked
2005	12-May	Beaver Dam Creek, Anacostia River	60,000
2006	9-May	Anacostia River boat ramp	114,750

Conclusion

The 2006 sampling season got off to a slow start. We were unable to collect the numbers of American shad at the Geisboro Pt. site that we needed. This was in part due to two factors, high ship traffic in the channel, and the nets we were using were too shallow. The channel is narrow in that portion of the river and the times that we needed to fish the nets coincided with the time that several large dinner cruise ships would run up and down the river. This traffic made it very difficult to set the nets exactly where we wanted to. We also ran into the problem of having to move the nets before we were ready to fish them. The nets that were used were 16 ft deep, after consulting with officials from other agencies it was determined that 20 ft deep nets would probably help increase the catch. Due to these two factors it was decided to get a permit to go down river to Marshall Hall. Once moving down to Marshall Hall our catches increased dramatically. One other benefit to moving down river was the ability to share fish with other agencies. On several occasions we were unable to capture enough male American shad to fertilize the eggs we had, by having other agencies around we were able get extra males from them. The larval shad production went well for 2006; with the new filtration system we had no problems with fungi or iron. Some issues that did arise were with the hardness of the well water, because the water was so hard we were unable to mark the larval shad with oxytetracycline. We found that with the relativity small batches of eggs being hatched, it was very difficult to get the larval shad out of the 6ft round tank that they hatched into.

Several improvements in this program are in order for next year in an effort to increase the overall production. We plan to focus all gill netting efforts at the Marshall Hall site, and 20ft deep gill nets have been purchased to be used. Water softener systems have been installed to condition the well water for marking the larval shad with

oxytetracycline. Smaller hatching tanks have been installed and will be on line in the event of small batch sizes. With all of our advancements in the brood stock collection as well as the fry production we hope to see a marked improvement for the 2007-spawning season.

Tables and Figures

	P5	P4	P3	P2	P1	A1	Total
American shad **06**	1.54	1.50	6.54	14.43	10.76	10.13	7.48
American shad **05**	26.58	11.77	29.93	113.44	33.79	32.45	41.33
American shad **04**	133.42	157.45	264.91	167.77	72.91	nst	159.29
Alewife **06**	0.00	0.05	0.15	2.99	2.85	18.93	4.16
Alewife **05**	0.56	2.01	10.62	13.96	21.27	104.12	25.42
Alewife **04**	2.96	7.10	12.93	5.62	6.51	nst	7.03
blueback herring **06**	2.06	16.22	4.70	94.18	68.44	596.30	130.32
blueback herring **05**	4.46	3.98	23.57	349.97	243.61	779.84	234.24
blueback herring **04**	4.32	11.76	41.14	62.83	35.62	nst	31.13

Table 1 – Number of Alosids collected per 1000 cubic meters of water sampled by site during push-netting from 2004 to 2006.

* nst – no sample taken

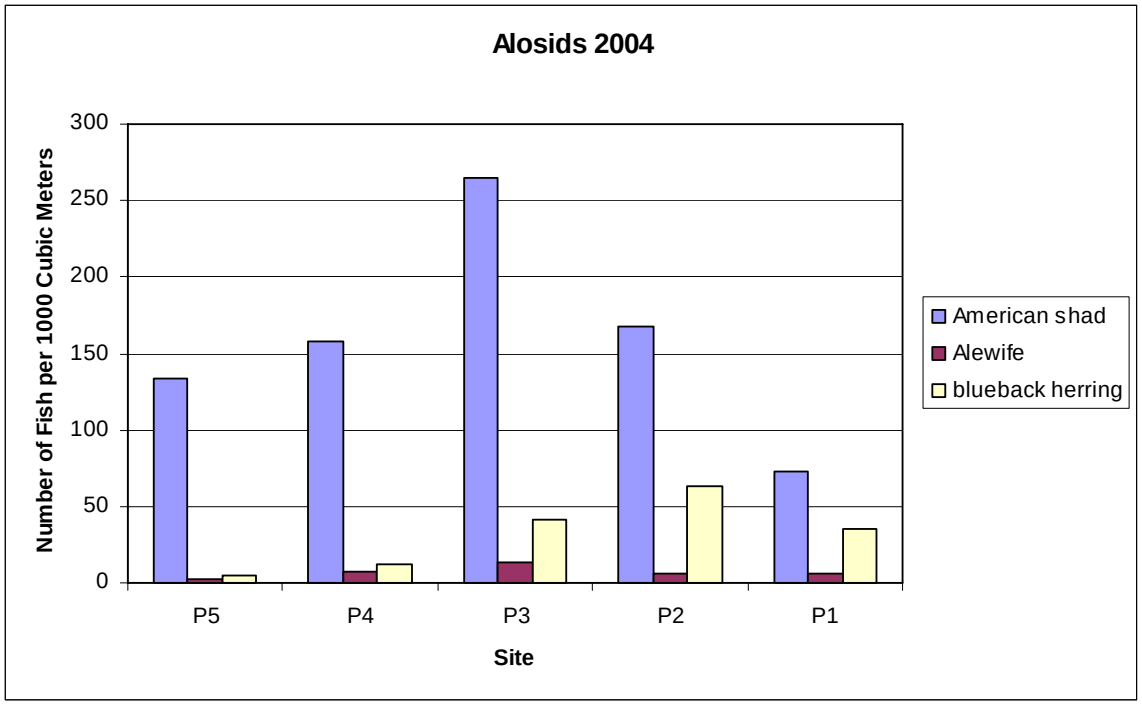

Figure 1 – Comparison of Alosids collected per 1000 cubic meters of water sampled during push-netting in 2004.

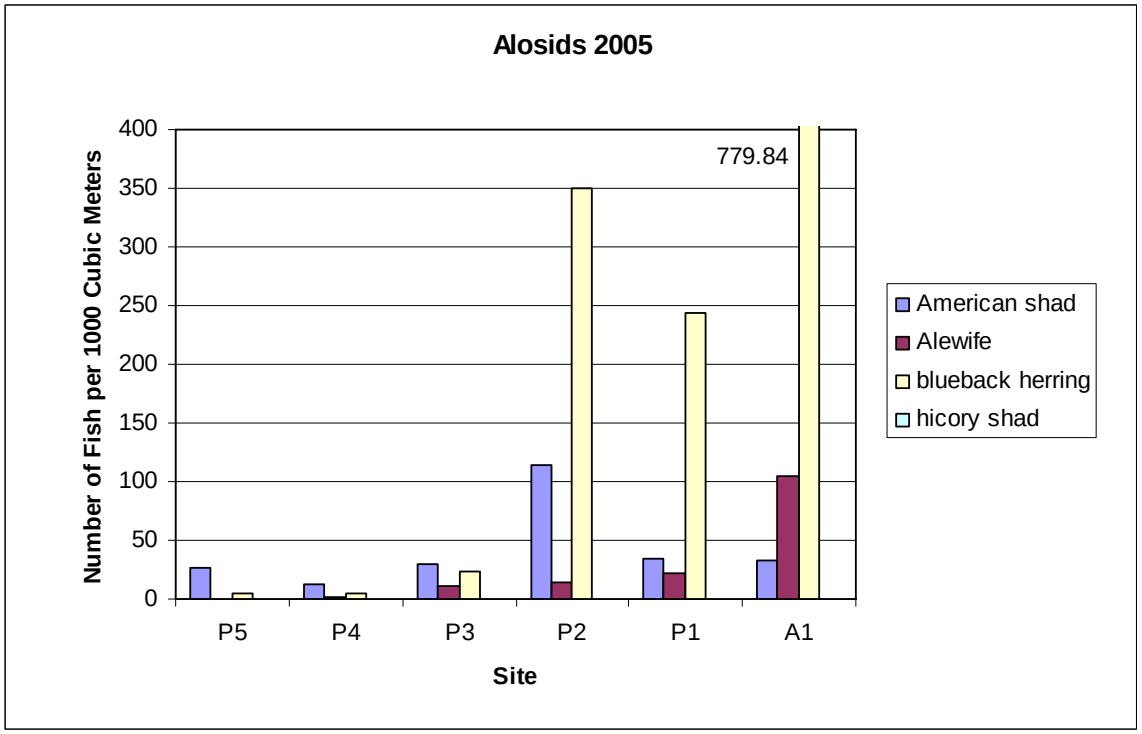

Figure 2 – Comparison of Alosids collected per 1000 cubic meters of water sampled during push-netting in 2006.

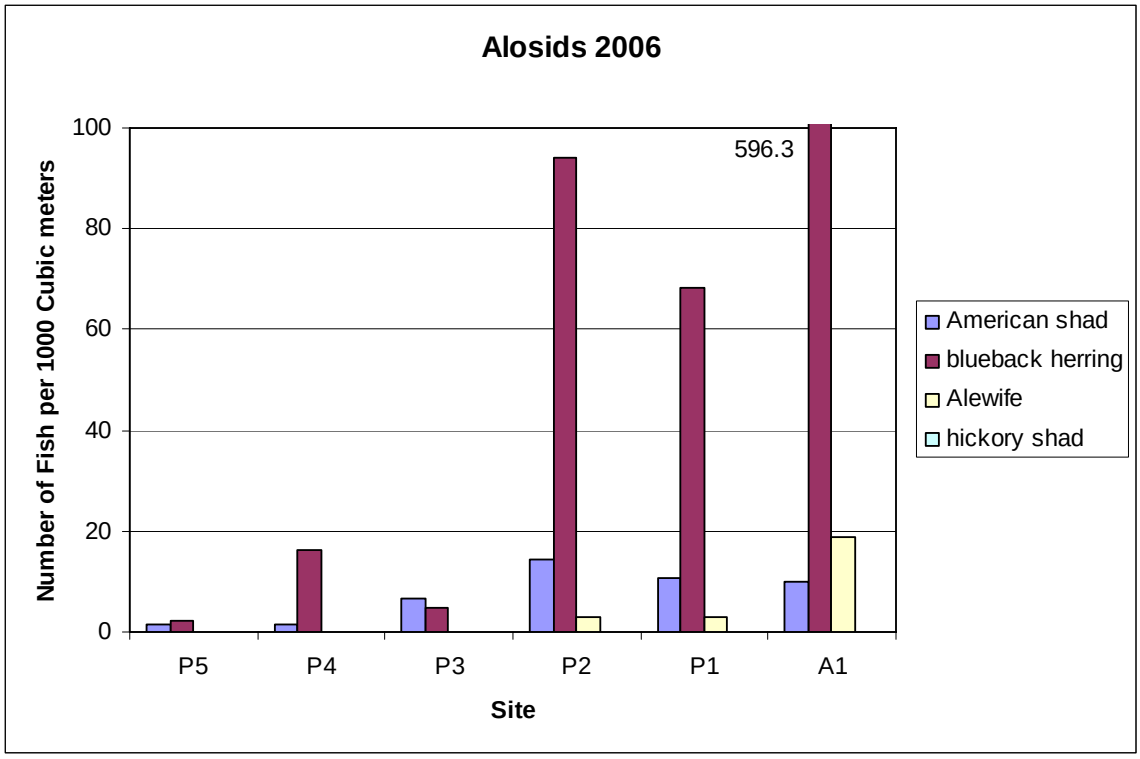

Figure 3 – Comparison of Alosids collected per 1000 cubic meters of water sampled during push-netting in 2006.

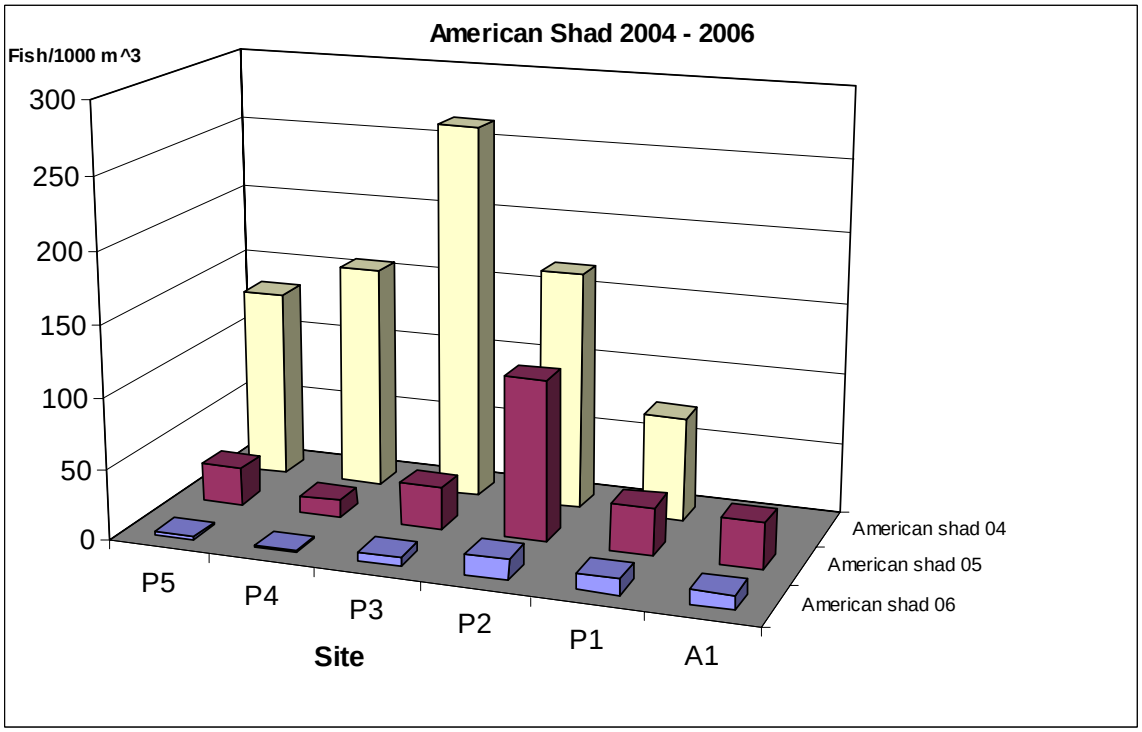

Figure 4 – American shad collected per 1000 cubic meters of water sampled during push-netting form 2004 to 2006.

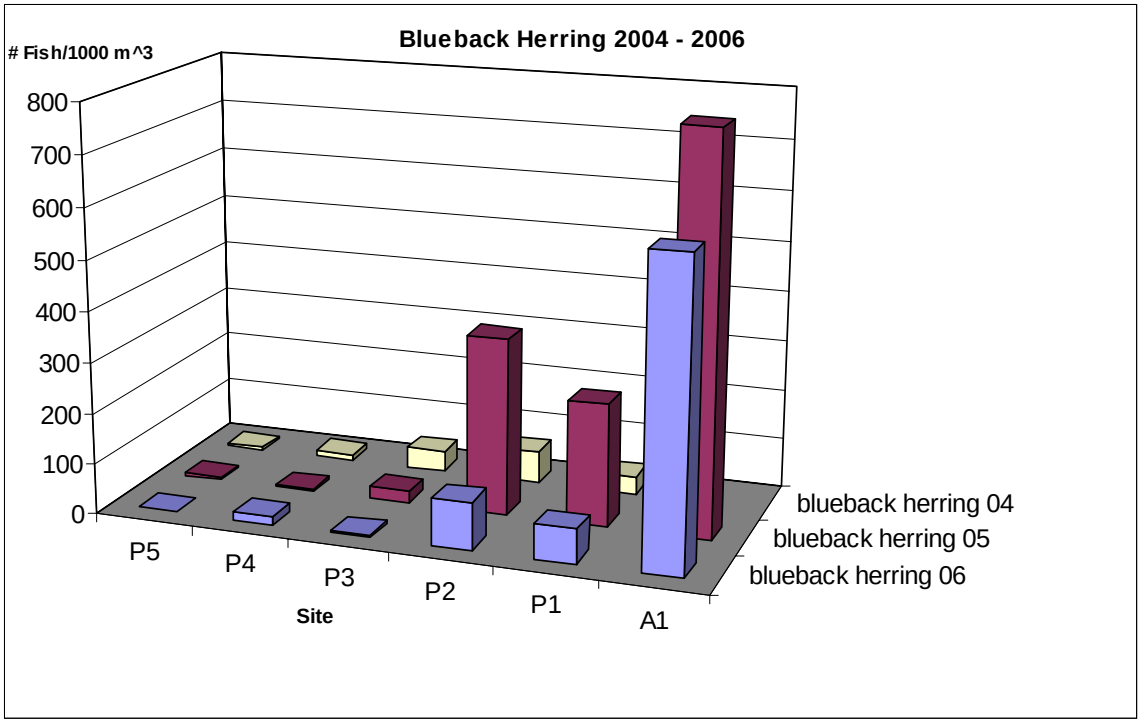

Figure 5 – Blueback herring collected per 1000 cubic meters of water sampled during push-netting form 2004 to 2006.

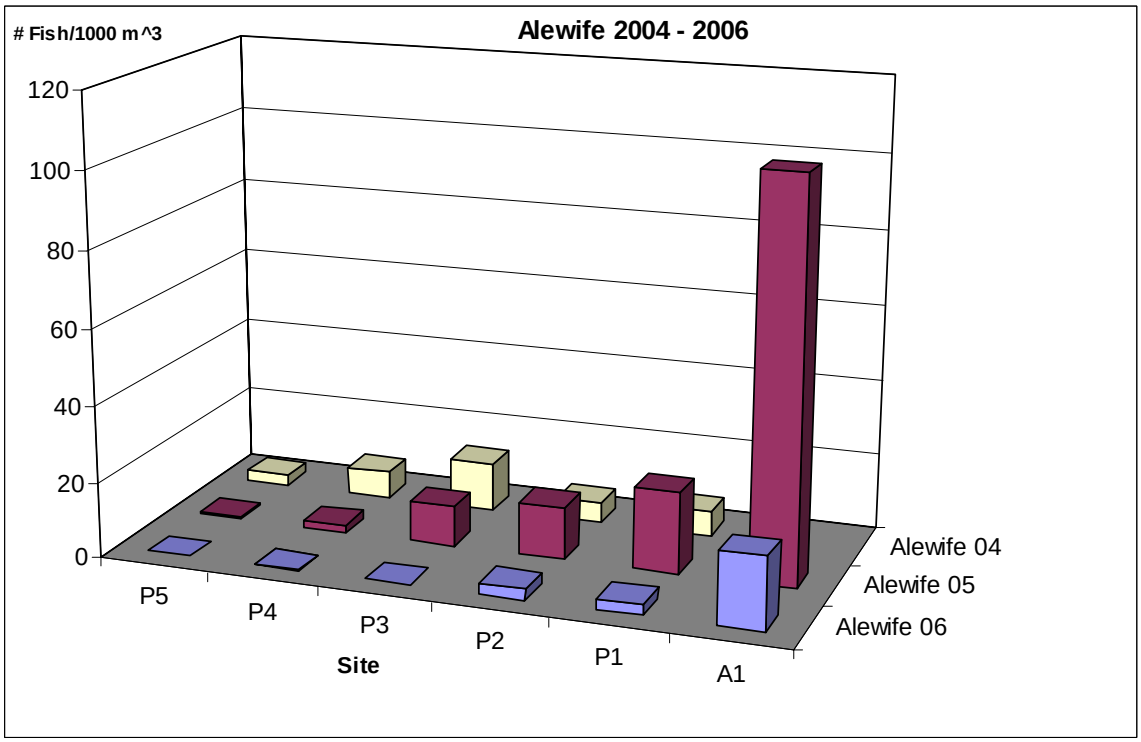

Figure 6 – Alewife collected per 1000 cubic meters of water sampled during push-netting form 2004 to 2006.

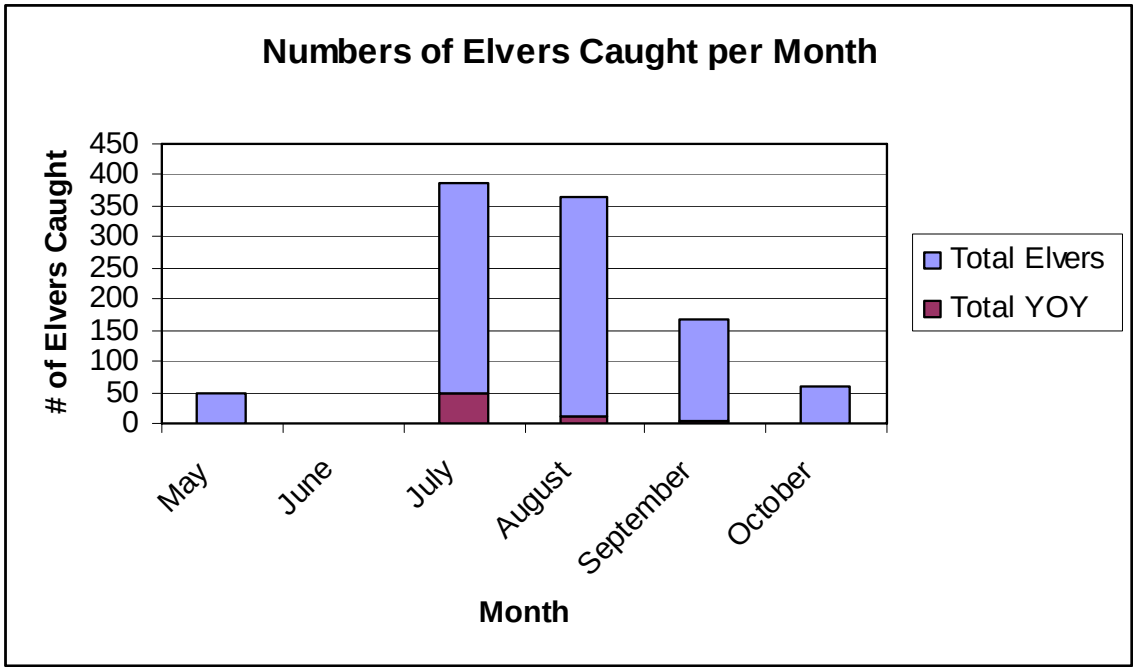

Figure 7 – Number of elver caught per month in Rock Creek using backpack shocker in 2006.

* Record rainfall in June interrupted sampling.