

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 (1/8 inch mesh) 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 2007 is shown in Table 1. In 2004 more American shad were collected than any alosid, but that has not held true for the following years, when blueback herring have been more numerous (Figure 1-4). 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 5). 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. In 2006, total numbers of American shad were 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 6 and 7). In 2007, eleven sampling dates were done from July 17 to September 25 on a weekly basis. Abundance of alosids in 2007 was much higher than what was seen in 2006 for all species. While blueback herring and Alewife were more abundant than the pervious three years (Figure 6 and 7), American shad did not quite reach the levels that were seen in 2004 or 2005 (Figure 5).

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). In 2007 the sampling dates were concentrated during the time when alosids were show from pervious years to be most abundant.

The catch of hickory shad does not appear to be affected by the timing of the survey. In 2007 only two hickory shad were captured, one on August 14 at site P2 and the other on August 21 at site A1. The hickory shad are not remaining in District waters as juveniles in significant numbers.

American shad numbers were up in 2007 compared to 2006 (Figure 5). The fish are most abundant at the southern end of District waters and taper off towards the north where they are the least abundant (Table 1). The Anacostia site (A1) has a surprisingly low

abundance of American shad because it is by far the most productive site for all other species.

Blueback herring and Alewife (collectively referred to as river herring) numbers were the highest seen since the initiation of the survey in 2003 (Table 1). Both species follow nearly identical distribution patterns to American shad with the exception of the Anacostia site. The river herring in the Potomac River are most abundant at the southern end of District waters and decrease towards the northern boundary where they are the least abundant. The Anacostia site, like in previous years, produced more river herring than any of the other sites. More consistent spring time temperatures made for a longer spawning season than the previous year that saw temperatures quickly rise and plummet creating a narrow window for spawning.

Part II

American eel elver trapping in Rock Creek

Introduction

The status of American eels *Anguilla rostrata* stocks are inadequately understood and current information suggests that populations have declined significantly; in response to the evidence the Atlantic States Marine Fisheries Commission has established an American Eel Fishery Management Plan. The purpose of the plan is to restore, protect and enhance the abundance of the American eels along the east coast.

For the last four years the District of Columbia Fisheries Management Branch, along with other coastal states, has participated in the ASMFC elver surveys. The surveys are conducted to assess American Eel young-of-year (YOY) abundance. Elvers less than 85 mm are considered young-of-year. Eels of this size represent the first year class of eels migrating back from the ocean.

American eels are a catadromous species whose life cycle starts in the Sargasso Sea and matures in brackish and/or freshwater then returns to the ocean to spawn and die. American eels are widely distributed along the east coast from northern South America to Greenland. The eels go through several phases during their life cycle beginning with the leptocephalus stage to glass eel, to elver, to a yellow phase in which it spends most of its life, then to their final metamorphosis, the silver phase, where they begin their migration 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. It is approximately 33 miles in length in which 9.3 miles flow within the District of Columbia. This 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 1,754 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 dimension of the wood constructed trap is approximately 61 cm wide x 122 cm long. Each trap consists of a narrow interior ramp that is covered with enkmat, a plastic erosion control material. 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. 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. The traps are set on Mondays and checked everyday throughout the week and removed on Fridays. All traps are set in Rock Creek and are accessible by wading.

As an alternate method to capturing elvers backpack electrofishing was done. At each site a 50 m stretch of Rock Creek was shocked at 200 to 300 volts depending on water conditions for duration of just over 500 seconds. A typical crew consists of at least two biologists. A three person crew is ideal with one person responsible for shocking with two people trailing behind on each side of the shocker netting the eels. A fine mesh (1/32) dip net is used 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. Biologist document basic biological information and eels are measured, weighed and pigment stage recorded. This method was repeated for a twenty week sampling period.

Results

No glass eels or elvers were caught this sampling season using the Irish elver trap. As suggested by the ASMFC committee last year the Fisheries Management branch started sampling earlier in the year with little success as water temperatures ranged from 3.2 to 10.4 degrees Celsius.

As mentioned earlier backpack electrofishing was again performed this year as an alternative method for capturing elvers. Shocking started on March 9, 2007 and ended

July 31, 2007. During this span, sixteen samplings were completed yielding a total of 1,073 eels being caught. Unlike last year very few YOY were captured, a total of eleven YOY were caught in 2007 compare to sixty two in 2006. No glass eels were caught using the electrofishing method. This years peak month occurred in May with only eleven YOY opposed to last year when in July forty seven YOY were caught. (Figure 8). The month of May also had the highest cpue (Figure 9). The total length ranges for YOY were 79 to 85 mm.

As water temperature increased seasonally over the sampling period so did productivity. Salinity was not a factor as it ranged from 0.14 to 0.28 ppt. The average length of elvers varied over the sampling period, with no recognizable trend.

Conclusion

Though no elvers have been landed using the Irish elver trap, we will continue to use this trap to coincide along with other states and the ASMFC approved sampling methods. Backpack electrofishing will continue as it has been the sole source for data obtained thus far. The Fisheries Management Branch is in the process of trying to determine the age of elvers caught at different times of the year to verify whether they are young of year. Otoliths obtained from elvers will be removed this winter to determine their age. The Maryland Department of Natural Resource staff will instruct and assist District biologist in the proper method for aging elvers. Hopefully this will give us a better time frame of when YOY are present. As mentioned earlier sampling in March yielded little data, it seems that sampling should begin at the earliest in April when water temperature is more suitable. Backpack electrofishing will be done on a weekly basis until elvers are found then the Irish 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 Management Branch remains optimistic. In the future, the possibility of experimentation with different traps and methods might be employed to obtain better more accurate baseline elver data. Over the last several years the DC Fisheries staff has performed this project for a twenty week period instead of the required six weeks. In 2008 it will be narrowed down to twelve weeks, in lieu of other projects. Hopefully with some modifications to equipment or adjustments to sampling time improvements will be seen in the coming years. Next year this project will be expanded to include adult eels within the Potomac and Anacostia Rivers.

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 (*Alosa 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.

Study 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

In order to maximize our catch of ripe American shad the gill netting has been primarily moved down river to Marshall Hall. This section of river is outside District jurisdiction so a collection permit is acquired through Potomac River Fisheries Commission. It is well known that gillnetting in this section of river for spawning American shad is very productive. Typically gillnetting consists of fishing three nets that are approximately 300ft in length and 20ft in depth with 5 ½ " stretch mesh. The nets are fished for roughly an hour each. The nets are set during the evening slack tide in an effort to prevent the nets from drifting to far during the soak. The nets are set parallel to the shore line along sharp edges on the river bottom, this is done in an effort to catch spawning fish as they come up from the deeper channel at night to spawn. 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. In compliance with the conditions of the collection permit from Potomac River Fisheries Commission 5 % of the adults American shad captured were kept, scale and otoliths were taken, for age analysis.

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 milt (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 $\frac{1}{4}$ 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

Gill Netting

During the 2007 gill netting season fisheries biologist focused most gill netting efforts on one site in the Potomac River South of the District near Marshall Hall. Marshall Hall is located about 15 miles down river from the District where several other state and federal agencies go to collect brood stock for strip spawning. During the first month of gill netting biologist were able to capture a total of 495 American shad with a ratio of males to females was sufficient enough to keep the fertilities of the eggs in a favorable range. During the month of May male shad were hard to come by at the Marshall Hall site. In an effort to capture more male shad for strip spawning a team of biologists tried fishing in a different location. On May 8th & 9th three gill nets 300ft long X 8 ft deep were set along a 10 ft deep channel just off National airport. The nets were fished using the same protocol as the nets down river at the Marshall Hall site. The results of these experimental sets was mixed, although the ratio of males to females was better the over

all number of American shad was much lower. Biologist also determined that it was not feasible to use the milt collected from the male American shad captured off the airport to fertilize the eggs collected at the Marshall Hall site.

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

Date	Site	Net length (ft)	Am. Shad female ripe	Am. Shad female green	Am. Shad female spent	Am. Shad male	Total Am. Shad
4/19/2007	Marshall Hall	900	2	3	0	3	8
4/23/2007	Marshall Hall	900	12	82	8	10	112
4/24/2007	Marshall Hall	900	49	48	2	10	109
4/25/2007	Marshall Hall	900	24	100	27	11	162
4/26/2007	Marshall Hall	1800	34	56	10	4	104
5/1/2007	Marshall Hall	900	0	24	2	1	27
5/2/2007	Marshall Hall	900	2	21	0	1	24
5/3/2007	Marshall Hall	900	4	5	4	2	15
5/8/2007	Marshall Hall	900	17	0	0	0	17
5/8/2007	National Airport	900*	3	1	5	5	14
5/9/2007	Marshall Hall	900	4	9	2	1	16
5/9/2007	National Airport	900*	1	1	4	1	7

Catch per unit effort per 300 ft² gill net

Date	Site	Net length (ft)	CPUE Am. Shad female ripe	CPUE Am. Shad female green	CPUE Am. Shad female spent	CPUE Am. Shad male	CPUE Am. Shad Total
4/19/2007	Marshall Hall	900	0.03	0.05	0.00	0.05	0.13
4/23/2007	Marshall Hall	900	0.20	1.37	0.13	0.17	1.87
4/24/2007	Marshall Hall	900	0.82	0.80	0.03	0.17	1.82
4/25/2007	Marshall Hall	900	0.40	1.67	0.45	0.18	2.70
4/26/2007	Marshall Hall	1800	0.28	0.47	0.08	0.03	0.87
5/1/2007	Marshall Hall	900	0.00	0.40	0.03	0.02	0.45
5/2/2007	Marshall Hall	900	0.03	0.35	0.00	0.02	0.40
5/3/2007	Marshall Hall	900	0.07	0.08	0.07	0.03	0.25
5/8/2007	Marshall Hall	900	0.28	0.00	0.00	0.00	0.28
5/8/2007	National Airport	900*	0.13	0.04	0.21	0.21	0.58
5/9/2007	Marshall Hall	900	0.07	0.15	0.03	0.02	0.27
5/9/2007	National Airport	900*	0.04	0.04	0.17	0.04	0.29

Strip Spawning

American shad strip spawning began on April 19 and ran until May 9. The first measurable amount of ripe females was captured on April 23. The ripe eggs from 12 females were stripped and the milt of 10 males was introduced to the eggs, after allowing

the eggs to water harden a total of 6.5 liters of eggs were collected. The volume of eggs collected peaked on the night of April 24 with 31 liters of eggs, from a total of 49 ripe females; the milt from 10 males was introduced to these eggs. In the evenings following April 24 there was a gradual decline in the number of ripe females collected and in turn the number of eggs. During the month of May the numbers of male shad declined drastically on the 8th we were unable to capture any males. Biologists were able to obtain male shad that were captured by other agencies working in the same area in order to fertilize the eggs collected. On May 9th strip spawning was halted due to increasing water temps and a decreased number of ripe females.

The following table shows the amount of eggs collected during 2007 gill net survey

	Site	Number Ripe Females	Number Males	Liters of Eggs	24 Hr Fertility %
4/23/2007	Marshall Hall	12	10	6.5	90
4/24/2007	Marshall Hall	49	10	31	70
4/25/2007	Marshall Hall	24	11	12.5	66
5/8/2007	Marshall Hall	17	0	10	70
5/8/2007	National Airport	1	1	1.75	70
5/9/2007	Marshall Hall	4	1	2.25	78
5/9/2007	National Airport	1	1	0.75	78

Incubation and Hatching

The first batch of American shad eggs arrived at the hatchery on April 23, a total of 6.5 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 were removed from the hatching jar we were able to determine that the fertility was 90%. Over the next 3 days unfertilized and broken eggs were siphoned off the top, leaving us with 4.5 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 135,000 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 April 24 a second batch of eggs arrived at the hatchery, and the same procedure was followed. It was determined that the 31 liters of eggs had a fertility of 70% and an estimated 517,500 viable eggs. Biologist noticed some fungus began to develop on the eggs collected from April 23rd & 24th a formalin treatment was applied to the eggs to clear up the problem. On May 1st the larvae from 4/23-4/25 were combined and stocked in the Anacostia for a total of 652,500. The hatchery received more eggs on 5/8 the eggs collected from Marshall Hall were combined with the eggs from the airport site for a combined total of 11.75 eggs. After calculations were made it was determined that the fertility was 70% and total of 246,750 larvae were hatched. On May 9th the final batch of eggs arrived at the hatchery, the 2.25 liters of eggs from Marshall Hall were combined with the 0.75 liters collected from the airport site for a total of 3 liters. The fertility for these eggs was calculated at 78% and a

total of 64,350 larvae were hatched. The larvae from eggs collected in April were combined and stocked in the Anacostia River on May 1st for a total of 652,500 larvae. The resulting larvae from eggs collected in May were stocked in the Anacostia on May 15 & 16 for a total of 311,100 larvae. A total of 963,600 larvae were stocked in the Anacostia River in 2007, 200,000 of which were stocked to meet the conditions of the collection permit issued by Potomac River Fisheries Commission.

The following table shows the American shad production for the 2007 season.

	Date	Site	# Am. Shad larvae stocked
	5/1/2007	Anacostia River	652,500
	5/15/2007	Anacostia River	246,750
	5/16/2007	Anacostia River	64,350
Total			963,600

Conclusion

For the 2007 season fisheries biologist chose to focus most of the gill netting effort at the Marshall Hall site. In order to fish in this area of the river first a collection permit was obtained from Potomac River Fisheries Commission. Biologists were very successful at capturing and collecting eggs from this site, partly due to the deeper nets that were purchased during the off season. In addition to increased number of fish, another 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 2007; with the new filtration system we had very few problems with fungi or iron. We found that with the relativity small batches of eggs being hatched, it was much easier getting the larval shad out of the 3ft round hatching tanks, which were installed prior to the 2007 season. 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 2008-spawning season.

Tables and Figures

	P5	P4	P3	P2	P1	A1	Total
American shad 07	1.01	4.13	30.92	45.16	51.59	20.50	25.73
American shad 06	1.54	1.50	6.54	14.43	10.76	10.13	6.92
American shad 05	26.58	11.77	29.93	113.44	33.79	32.45	42.77
American shad 04	133.42	157.45	264.91	167.77	72.91		156.39
Alewife 07	0.06	1.06	14.02	50.73	83.81	117.63	42.05
Alewife 06	0.00	0.05	0.15	2.99	2.85	18.93	4.11
Alewife 05	0.56	2.01	10.62	13.96	21.27	104.12	27.26
Alewife 04	2.96	7.10	12.93	5.62	6.51		7.00
blueback herring 07	10.72	61.76	352.84	899.09	1481.34	2894.62	883.64
blueback herring 06	2.06	16.22	4.70	94.18	68.44	596.30	126.01
blueback herring 05	4.46	3.98	23.57	349.97	243.61	779.84	251.81
blueback herring 04	4.32	11.76	41.14	62.83	35.62		33.18

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

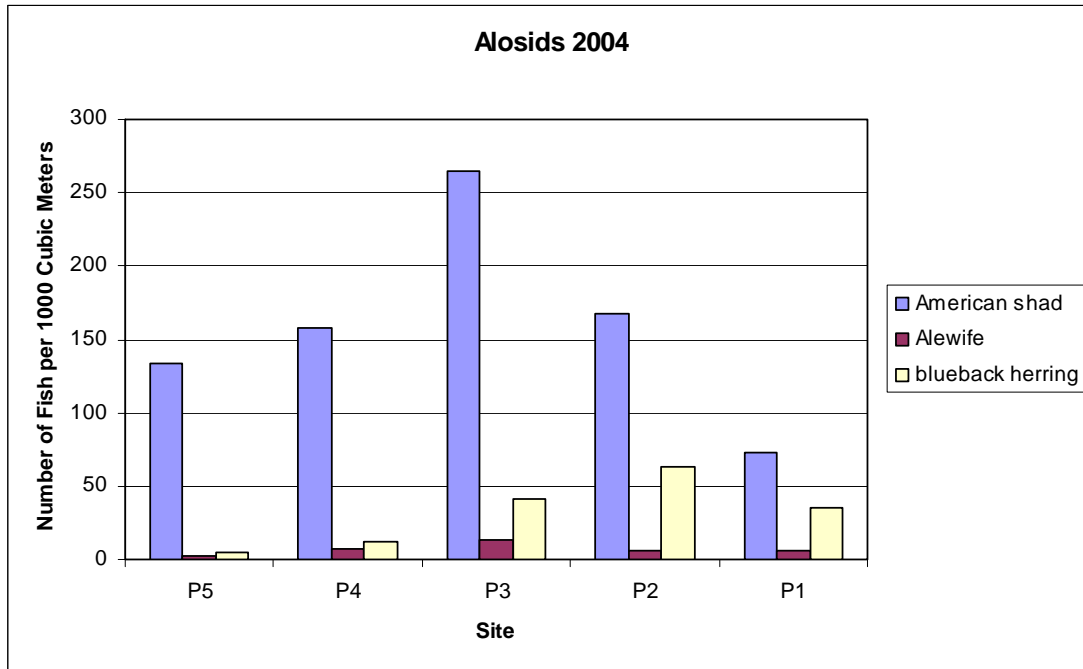


Figure 1 – Comparison of Alosids collected per 1000 cubic meters of water sampled during push-netting in 2004.

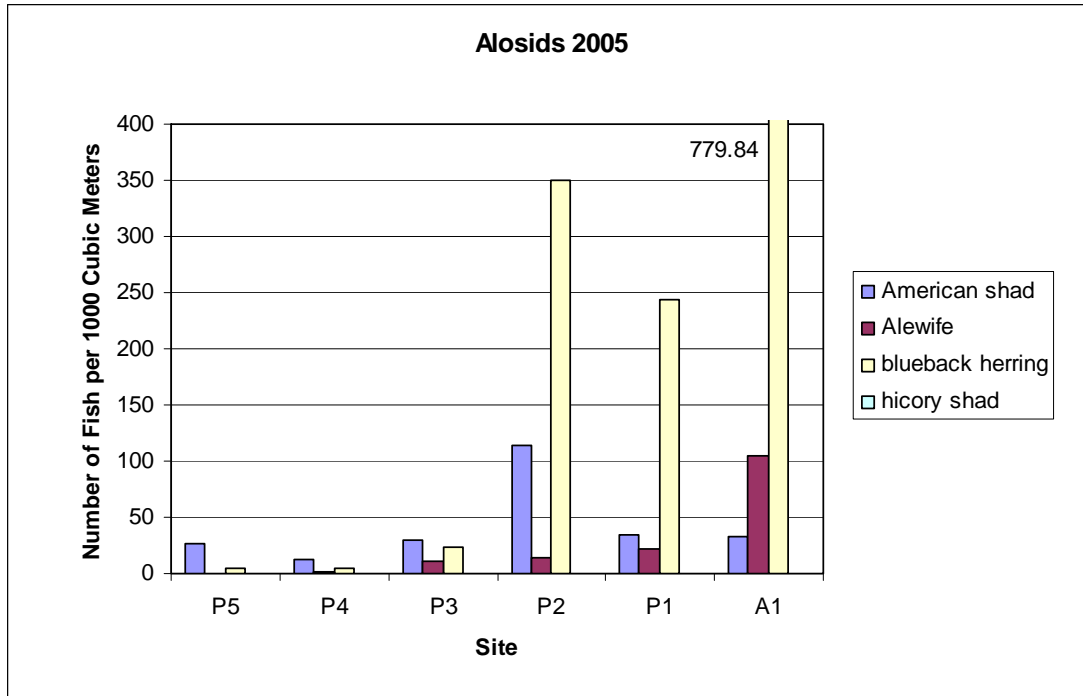


Figure 2 – Comparison of Alosids collected per 1000 cubic meters of water sampled during push-netting in 2006.

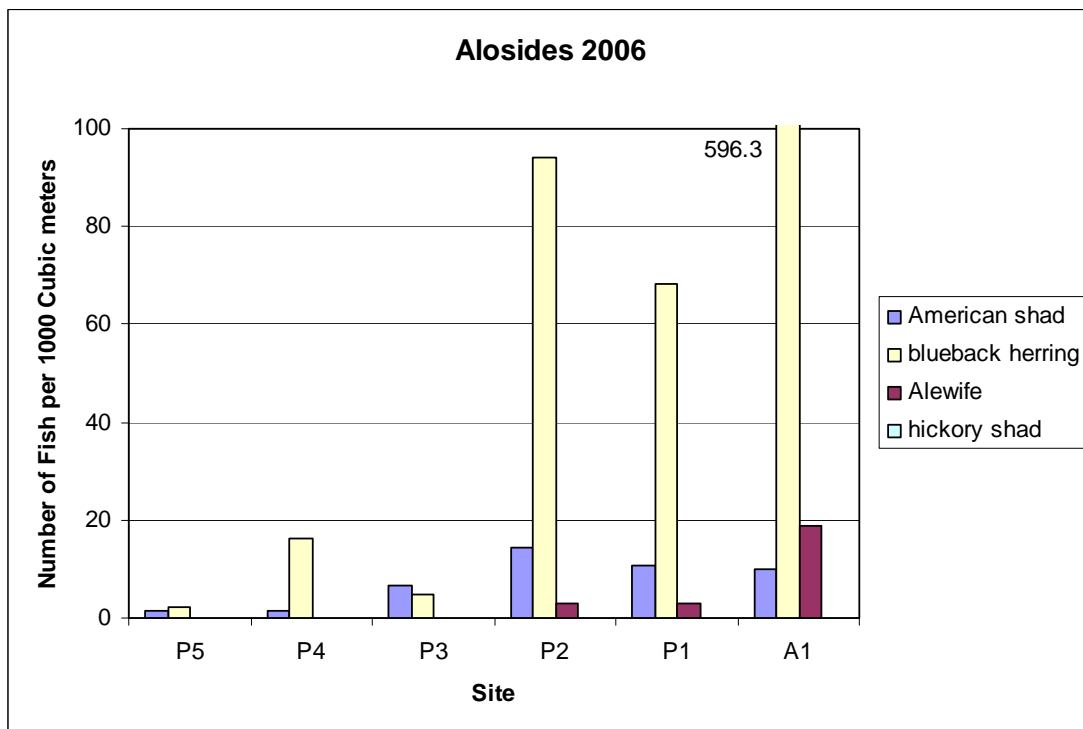


Figure 3 – Comparison of Alosids collected per 1000 cubic meters of water sampled during push-netting in 2006.

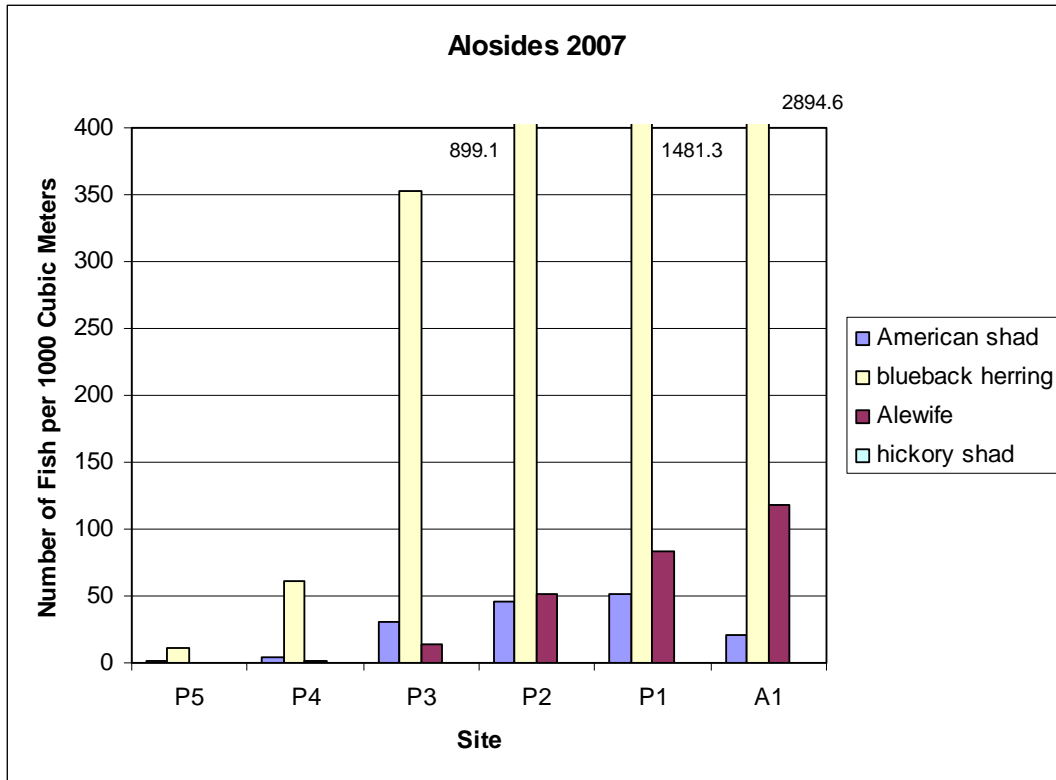


Figure 4 – Comparison of Alosids collected per 1000 cubic meters of water sampled during push-netting in 2007.

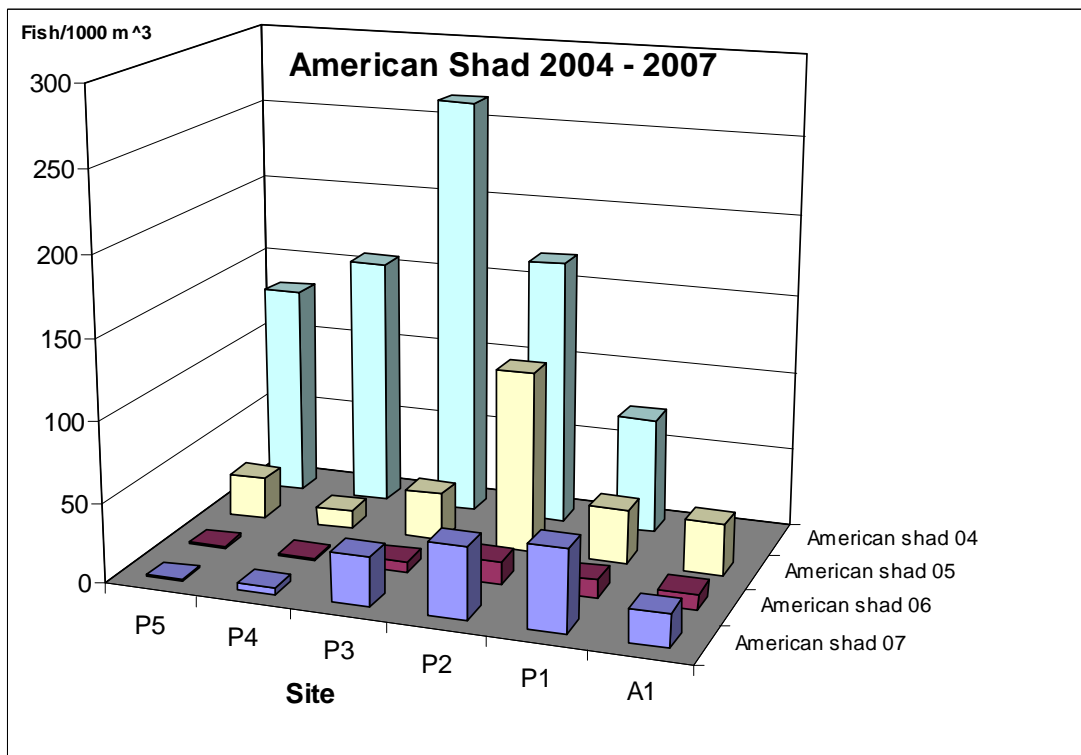


Figure 5 – American shad collected per 1000 cubic meters of water sampled during push-netting from 2004 to 2007.

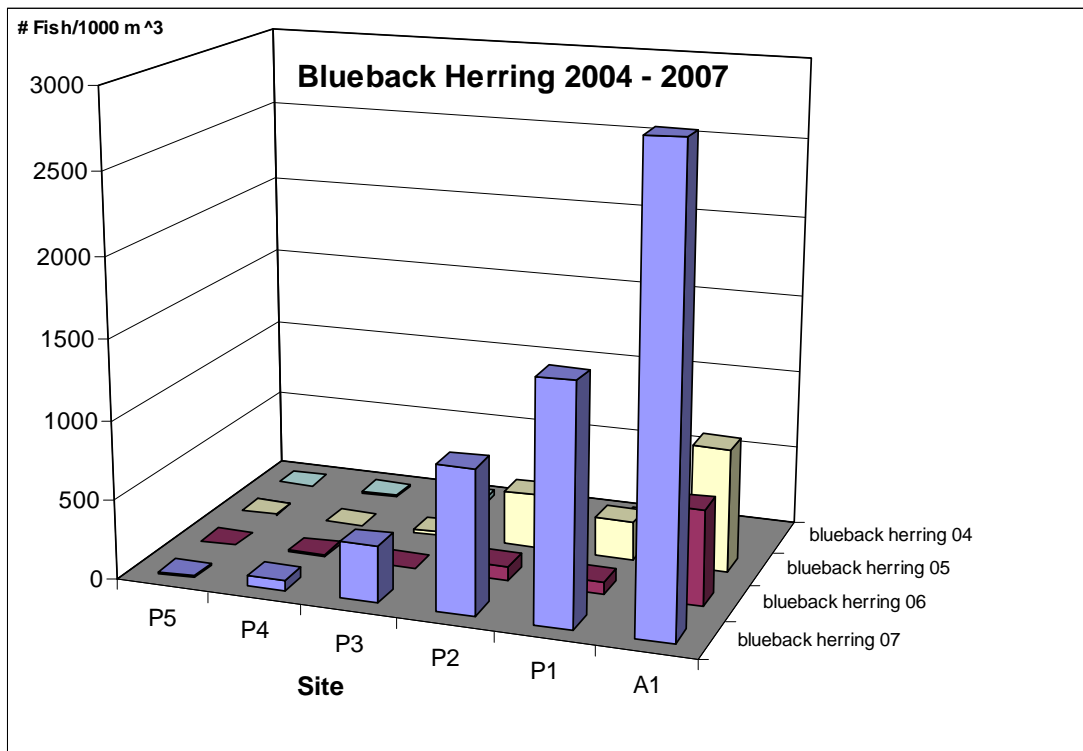


Figure 6 – Blueback herring collected per 1000 cubic meters of water sampled during push-netting from 2004 to 2007.

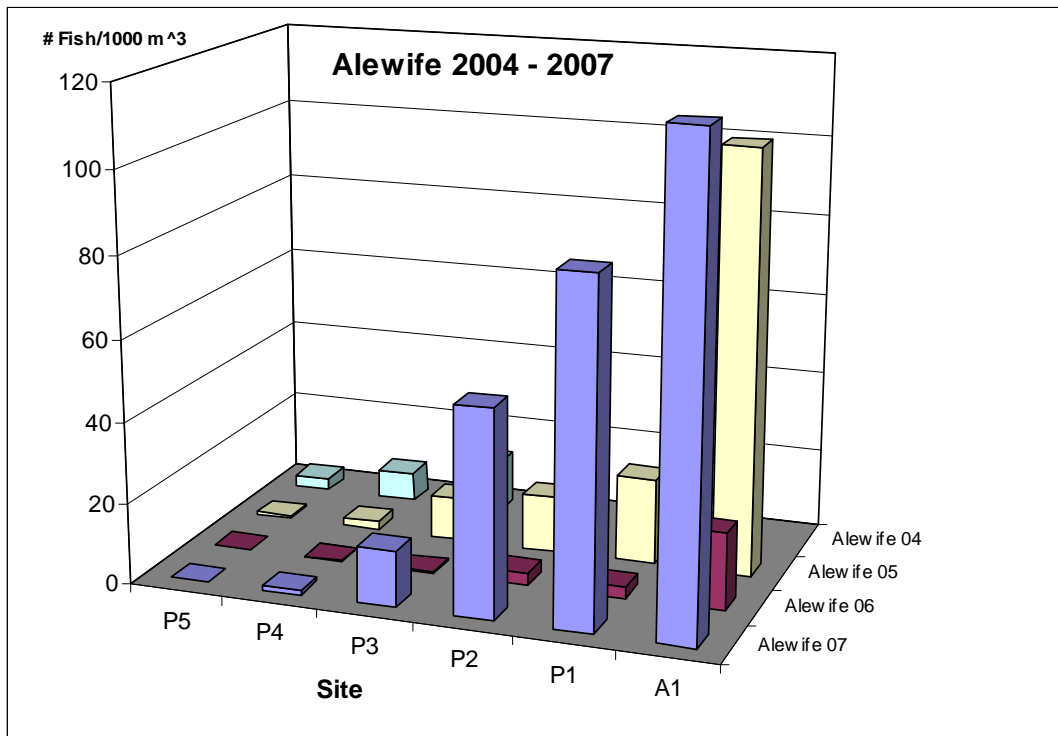


Figure 7 – Alewife collected per 1000 cubic meters of water sampled during push-netting from 2004 to 2007.

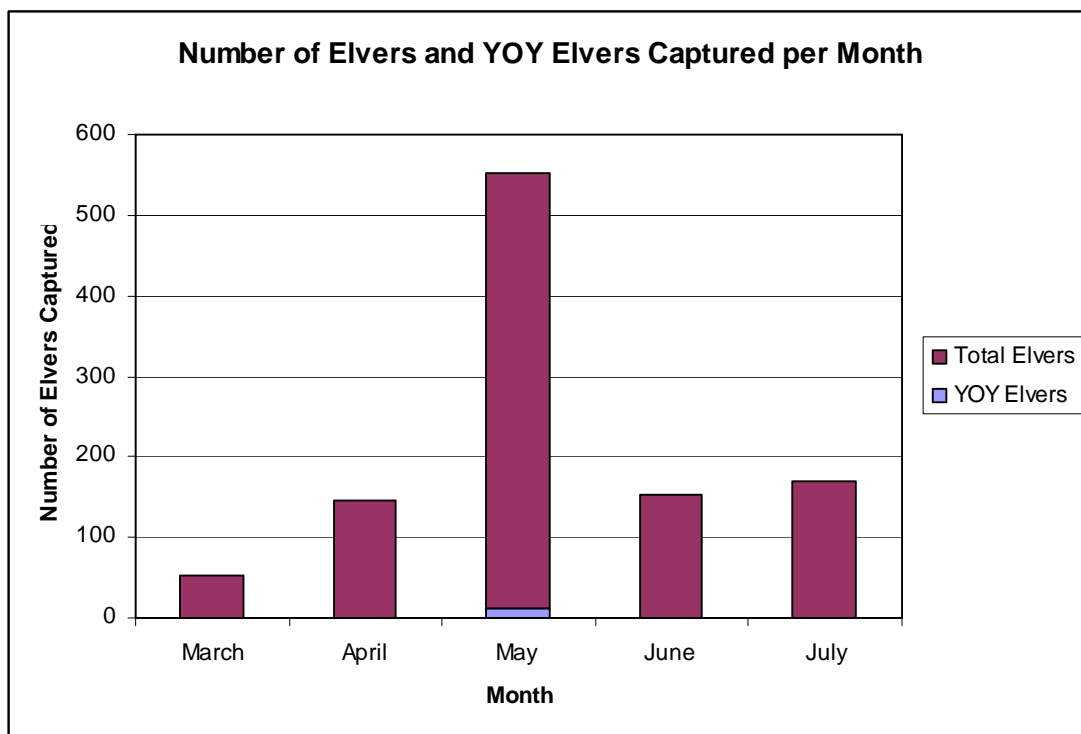


Figure 8 – Number of Elvers and YOY (young-of-year) elvers captured per month in Rock Creek 2007.

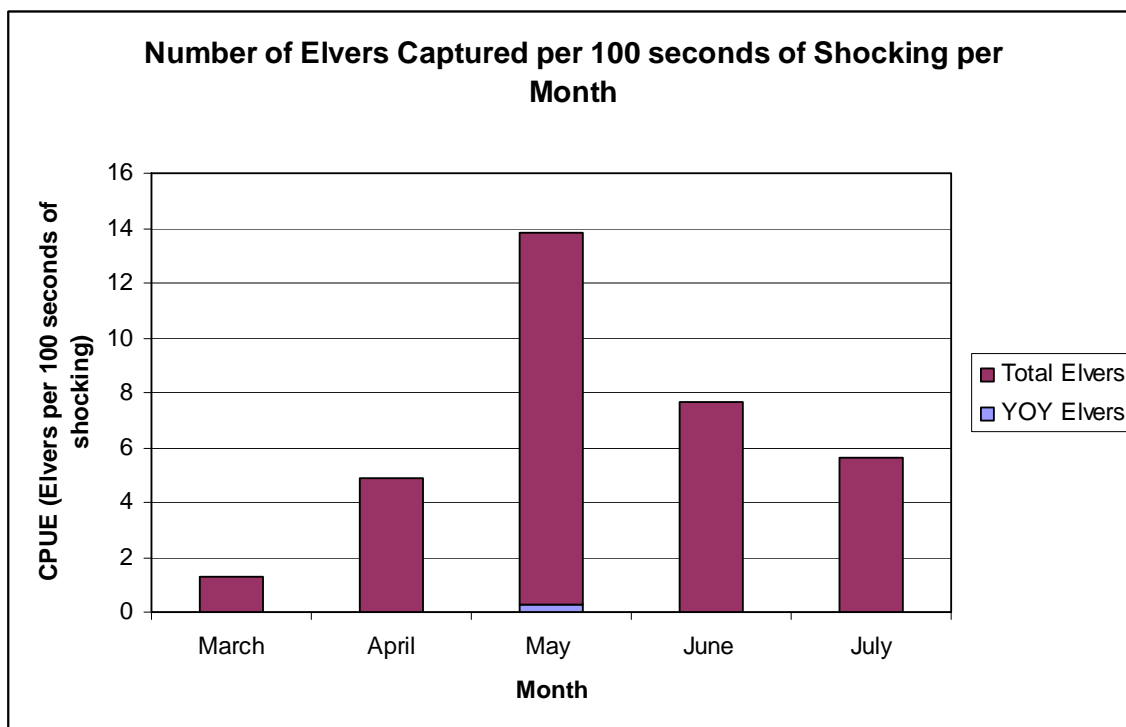


Figure 9 – Catch per unit effort (CPUE) of elvers captured in Rock Creek in 2007.