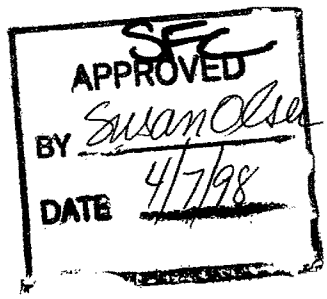

UNITED STATES
DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
State, Federal & Constituent Programs Office

COMPLETION REPORT

Grantee: **VIRGINIA DEPARTMENT OF GAME & INLAND FISHERIES**

Project No: **N/A**

Grant No: **NA66FU0316**

Project Title: **ANADROMOUS FISH RESTORATION**

Period Covered: **07/01/96 - 10/31/97**

Prepared by: **L. ALAN WEAVER**

Approved by:

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Statutory Funding Authority:
___Anadromous Fish Conservation Act (P.L. 89-304)
_X_ Chesapeake Bay Studies
___Endangered Species Act
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___Magnuson Act
___Oyster Disease Research
___Saltonstall-Kennedy
___Unallied Industry Projects
___Unallied Science Projects

Ref. No. NA66FU0316

Final Report for the period August 1, 1996 to October 31, 1997
for the project:

Anadromous Fish Restoration - State of Virginia

Prepared and submitted by:

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January 29, 1998

Objectives

The main objectives of the study "Anadromous Fish Restoration" are to supplement existing state, federal, and local efforts to restore anadromous fish populations throughout Virginia. Direct components of this study are:

1. To provide funding for a Virginia Fish Passage Coordinator position with the Virginia Department of Game and Inland Fisheries to direct the Fish Passage Program (e.g. fish passage projects) and directly aid in supporting all other anadromous fisheries initiatives in Virginia (e.g. monitoring, trap and transport of river herring, American shad fry stocking).

2. To provide funding for Fish Passage Technicians to assist the Fish Passage Coordinator in accomplishing fish passage and restoration goals in Virginia.

Job I: Fish Passage Coordination

During this grant period the Virginia Fish Passage Coordinator continued to coordinate ongoing projects funded by a variety of sources (i.e. federal grants, state funds, local funds, private funds, etc.). The following is a brief update on several Virginia fish passage projects.

Ashland Mill Dam, South Anna River, Hanover County:

This 13' dam blocks 9 miles of spawning habitat on the South Anna River up to the Ashland water supply dam (3') which blocks another 28 miles. Negotiations with the owner, Ashland Milling Company (Linwood Attkisson), have temporarily been terminated due to problems over personal financing of the project. The VDGIF offered federal grant money (#NA36FU0326) but could not cannot guarantee that the owner would not be required to spend any personal funds or time on the fishway. The VDGIF plans to reopen negotiations with the owner in the future. However, Chesapeake Bay Program funds originally granted for the Ashland project were first extended and transferred to the Ruffins Pond Dam project and then again extended and transferred to the Bosher Dam fishway project. Further details on this project will be provided in the final report for Grant #NA36FU0326 which was extended until September 30, 1998.

Ruffins Pond Dam, Massaponax Creek, Spotsylvania County:

This 16' dam is owned by Tarmac, Inc. and a fishway is needed to reopen 8 miles of spawning habitat above the dam. This includes 3.5 miles on Massaponax Creek (including 122 acres of Ruffins Pond), and 4.5 miles on a permanent tributary of Massaponax Creek. The final design was completed by J.K. Timmons and Associates in December 1996 and was accepted by Tarmac, the USFWS and the VDGIF. Two construction bids were received in January 1997. Unfortunately, both bids were approximately $275K over the available grant amount ($208K for construction). Tarmac considered donating $40K worth of materials but was not able to supply the remaining funds (about $125K). This project was postponed indefinitely and the remaining grant funds were transferred to the Bosher Dam fishway project

which was in need of additional funding. Details on this project will be provided in the final report for grant #NA36FUO326 which was extended until September 30, 1998.

Bosher Dam, James River, Henrico County:

This 10' dam is the last blockage to migratory fishes on the James River in Richmond, and a vertical slot fishway will reopen 137.6 mainstem miles of anadromous fish spawning habitat up to Lynchburg. Approximately 200 miles of additional spawning habitat will also become accessible on major tributaries (e.g., 36.3 miles on the Rivanna River). The final design and construction bidding was completed in 1996 by J.K. Timmons and Associates. After receiving high bids (twice the original budget), additional funds had to be raised and construction was finally begun on a vertical slot fishway on June 23, 1997 by English Construction, Inc. Numerous delays resulted because of the contractor's difficulty in controlling water in the work area. Progress is several months behind schedule and the project may not be completed in time for the complete 1998 spawning run. Fund raising for this project was a multi-faceted, public-private venture spearheaded by the James River Association. The fishway will be operated and monitored by the VDGIF and the City of Richmond will maintain the structure (CSX Railroad is transferring ownership to the City of Richmond). Details on this project will be provided in the final reports for Grant #NA46FU0284 (design - ended December 31, 1997) and Grant #NA36FUO326 (portion of construction - ends September 30, 1998).

Harvell Dam, Appomattox River, City of Petersburg:

The owner, Joshua Greenwood, is constructing a Denil fishway for this 9' dam in accordance with FERC orders (license #8657). The fishway will have one entrance channel on the new hydro siphon unit side and one on the spillway side. The lower portions of the fishway and the sections that interface with the dam crest were made of concrete. The main baffle run sections were fabricated out of steel and wooden baffles will be inserted. During construction of the steel section of the exit channel, the owner discovered that there is room for a viewing window. The fishway is scheduled to be operational in time for the 1998 spawning run and will reopen 5.6 miles of spawning habitat up to the Abutment Dam (Battersea Dam is passable and is also a FERC project owned by Greenwood).

Abutment Dam, Appomattox River, City of Petersburg:

The Abutment Dam is an old Virginia Electric and Power Company facility that currently serves only as a water source for an historic canal. This dam is located 1.4 miles below Brasfield Dam (Lake Chesdin) and 5.1 miles upstream of Battersea Dam (Greenwood; FERC license). The Abutment Dam zigzags across the river and is connected to an island in the middle. An old, non-functional, pool and weir fishway exists near the north shore. A natural breach has formed near the old fishway, but the dam is too high for the breach to be passable. We are uncertain as to how the City of Petersburg plans to deal with the issue of fish passage at this dam. A Denil fishway will be completed at Harvell Dam (FERC) in time for the 1998 spawning run so migratory fishes will soon be reaching the Abutment Dam. The USFWS is preparing conceptual plans for a series of notches to pass fish over the Abutment Dam. No formal plans have yet been made.

Embrey Dam, Rappahannock River, Spotsylvania County:

This 22' dam on the Rappahannock River in Fredericksburg is the only mainstem migration impediment and is located about one mile upstream of the head of tide in the fall line. Passage here would reopen 70.6 miles of the mainstem and several miles on significant tributaries (e.g., 41.6 miles on the Rapidan River). In 1994 a sediment study done by the VDGIF and DEQ showed the sediments to be non-toxic. These results allowed for consideration of removing all or part of the dam. In 1996, the City of Fredericksburg and Spotsylvania County made the decision to build a joint water plant at Mott's Run Reservoir which is on a tributary to the Rappahannock a few miles upstream of Embrey. This will make Embrey obsolete as a potable water supply by early 1999. In January 1997, the VDGIF was instructed by Virginia Senate Joint Resolution No. 296 to conduct a feasibility study on providing fish passage at Embrey Dam. J.K. Timmons & Associates was hired in June 1997 to complete this study which included a synthesis of all previous studies, development of technical and local decision matrices, recommendations, and cost estimates for various scenarios. GKY & Associates was sub-contracted by Timmons to evaluate the sediment load entrapped by the dam and to conduct a sediment fate and transport study (HEC-6 model). Throughout the study all interested parties and agencies were included in discussions and their comments were incorporated into the decision making process. The report, which was funded by the state, was submitted to the General Assembly in December 1997 for review in the 1998 session. The study is now available for use in the decision making process.

Additional Fish Passage Program Efforts

The Fish Passage Coordinator is also involved in the ongoing process of pursuing additional fish passage projects as they are needed, and as they fit into the long range planning for restoration in Virginia. Public and professional meeting speaking engagements and written communication are also an integral part of the process of promoting and advancing the Fish Passage Program. Opportunities for anadromous fish restoration education are an additional, and very important, part of the overall program. The educational aspect of the program will be expanded in the future.

Job II: Anadromous Fish Restoration

Trap and Transport

In April 1997, the VDGIF and the U.S. Fish & Wildlife Service (USFWS) combined their efforts to trap and transport 5,092 pre-spawn blueback herring in an effort to restore the migratory run of herring to areas of the James River that have not had spawning runs since the construction of dams in the Richmond area. This was the fourth consecutive year for trap and transport operations. Blueback herring were collected by electrofishing at the base of Walker's Dam on the Chickahominy River (a lower James tributary). The fish were then counted and placed into circular hauling tanks equipped with oxygen for aeration and a water recirculation system to provide directional flow for orientation. The VDGIF operated a 450 gallon tank and the USFWS operated a 900 gallon tank. Tank hauling density was approximately one fish per gallon and hauling mortality was less than 6% for all stocking

locations. Most of the herring were transported to Columbia on the James which is approximately 45 river miles upstream of Bosher Dam. Byrd Creek is about 39 miles upstream of Bosher Dam and Harrison Lake is on Herring Creek which is a lower James tributary (Table 1). There is a Denil fishway at the Harrison Lake dam which is operated by the USFWS staff at Harrison Lake National Fish Hatchery.

American Shad Restoration

American shad fry stocking was begun in Virginia in 1992 in a cooperative effort between the VDGIF and Virginia Commonwealth University (VCU). In 1992 and 1993 the fry were reared at the Pennsylvania Fish and Boat Commission's Van Dyke hatchery and then transported in oxygenated containers back to the James for stocking. In 1994, the VDGIF opened the King and Queen shad hatchery addition in Stevensville, Virginia and began full project operations. A harvest moratorium, that is still in effect, was placed on American shad in 1994 for Virginia Bay and Bay tributary waters.

In April and May 1997, 1,444 spawning American shad were collected on the Pamunkey River by Commercial Watermen funded by the Virginia Marine Resources Commission. VDGIF biologists and technicians extracted eggs, stripped males to fertilize the eggs in the field, and transported the eggs to either the King and Queen State Fish Hatchery or the Harrison Lake National Fish Hatchery. A total of 15.3 million fertilized eggs were produced. The fry were hatched in McDonald jars and reared in 200 gallon circular tanks. Shad fry were fed salmon starter and brine shrimp. Oxytetracycline treatments were applied to tag otoliths in order to identify stocked fish during out migration and return spawning runs to determine the contribution of the hatchery fish to the overall restoration effort.

At about 10 days old, American shad fry were stocked in the middle James above Bosher Dam to reintroduce the species to that river section in anticipation of fish passage at Bosher Dam and in the Pamunkey River to supplement natural recruitment. The circular tanks were loaded onto distribution trucks, hauled to the river, tempered, and the fry were quick released into the water. Using this procedure eliminated handling stress on the fry. The James River received 4,988,205 fry from King and Queen and 977,615 fry from Harrison Lake. The Pamunkey River received 1,065,377 fry from King and Queen and 215,589 from Harrison Lake.

Complete details on American shad restoration will soon be available in the 1997 report titled "Virginia's American Shad Restoration Project: 1997." This report covers all aspects of the project including stocking and hatchery product evaluation (juvenile monitoring).

Job III: Anadromous Fish Monitoring

The purpose for this monitoring is to describe the temporal and spatial distribution of anadromous fishes (adults and juveniles) targeted for restoration through fish passage implementation and stocking efforts.

Spawning Run Monitoring

Documenting the migratory run at, and downstream of, impediments validates the need for fish passage and directly aids in setting fish passage priorities. Also, migratory species information is necessary to design appropriate fishways and to design future fishway monitoring protocols. Boat electrofishing was conducted at several locations using either a 16' Smith-Root boat with a 7500 watt generator or a 14' jon boat with a 3500 watt generator. Pulsed DC current was employed and output power was generally 2700 watts (5.0 A x 540V; 120hz). Species presence/absence was determined and relative abundance information (Catch Per Unit Effort, or CPUE, in fish/hr) was collected. Basic information such as sex, spawning condition, fork and total length, and in some cases, weight, was collected. Data were entered into a spreadsheet to be analyzed for site specific and regional trends. A summary of the CPUE results from all locations sampled in 1997 are presented in Table 2. The following are some individual site highlights from the 1997 spring sampling season.

Hickory shad (*Alosa mediocris*) was confirmed on the South Anna River just below Ashland Mill Dam where American shad (*A. sapidissima)* and blueback herring (*A. aestivalis*) continued to show up in electrofishing samples (Fig. 1). Interestingly, a late "wave" of spawning American shad showed up toward the end of the season. Although we did not sample after June 5, low water allowed for negative visual observations.

Three of the four targeted *Alosa* species were again collected in the Appomattox River just below Harvell Dam (Fig. 2). To date, we have not collected American shad but there is anecdotal information that American shad are occasionally caught by anglers at the dam. A Denil fishway should be completed and operational in time for the 1998 spawning migration.

Blueback herring were slow to ascend the fall line up to Embrey Dam on the Rappahannock River. Herring relative abundance did not peak until May 9 at Embrey Dam and then it quickly decreased (Fig. 3). A much stronger peak in the run was recorded at Embrey Dam on April 20, 1995 when the CPUE was roughly 500 fish/hr. Three of the four targeted *Alosa* species for passage at Embrey Dam were found about 1 mile downstream at Route 1 (Fig. 4). American shad have been caught by anglers in the past, but recent electrofishing efforts have produced negative results.

Otoliths collected from adult shad captured in the Pamunkey and James rivers in 1997 were examined for the presence of OTC tags on the otoliths. Results from the Pamunkey showed that of the 330 otoliths collected, 50 were from three year old fish. Of the three year old otoliths examined, two (4.0%) carried a four day tag that was used to mark shad stocked into the Pamunkey in 1994. Of the nine adults collected on the James, five were three year old fish. Three (60.0%) of these fish carried the OTC tag used to mark James River fish stocked in 1994. The remaining adult fish collected in the Pamunkey and James were adults of varying ages, none of which carried an OTC tag.

Juvenile Monitoring

General descriptions of the sites sampled during the 1997 juvenile alosid monitoring effort are provided in Table 3.

The first method employed in late May and June of 1997 was an ichthyoplankton net (mesh size 560 microns; mouth opening 38 cm). The net was mounted to a metal frame on a jon boat (15 hp) and pushed in front of the boat just below the water surface. A flow meter was used to calculate the volume of water sampled during a 10 minute run. Juvenile American shad ranging from 25 mm to 52 mm TL were collected in the pool above Bosher Dam which is at rm 113 (Fig. 5).

In cooperation with the USFWS, push net sampling with a 3' x 4' net with a mesh size of ¼" was begun in June 1997 to collect juvenile alosids above and below Bosher Dam on the James River. In August, the VDGIF finished construction of a new push net frame for their 40hp jon-boat. The USFWS provided assistance in preparing the actual net for mounting to the boat frame. The VDGIF boat is equipped with a 2500 pound winch to automatically lift the net at the end of a sample run. A flow meter was also used during push net sampling to quantify the volume of water sampled during a 10 minute run. The eight mile pool immediately above Bosher Dam was divided into 16 half-mile transects and four to six transects were picked from a random number program (Lotus) for each sample night. Sampling was done weekly in the Watkin's Pool and at one of three river sections below Richmond in tidal water (also divided into half-mile transects). A few attempts were made to boat electrofish in the Watkin's Pool using randomly selected sites but major equipment problems limited this effort.

American shad

American shad juveniles ranging from 30 to 100 mm were collected from June through early November. Average density (fish/100m^3) was calculated for the four to six pushes per night (Fig. 5). Previously, push net CPUE of juveniles was reported using time sampled as the unit of effort. In 1997, the number of fish per 100 cubic meters of water sampled was used as the unit of effort. In June, the ichthyoplankton net was more efficient than the ¼" mesh push net because most of the juvenile alosids had not yet "recruited" to the push net gear. The maximum density for a single ichthyoplankton sample was 3.6 fish/100m^3 which occurred on 16 June. The maximum density for a single push net sample was 2.17 fish/100m^3 which occurred on 25 June. River flows were relatively low and temperatures were consistent through the middle of the summer, however, no American shad juveniles were collected with the push net from 21 July through 11 August. Interestingly, though, American shad juveniles were being collected during that same time frame several miles upstream in shallower habitat. USFWS and VDGIF shad project personnel were collecting juvenile shad in shallow, vegetated habitat near Columbia and Cartersville (see Table 3). Fish were located by site and then a pre-positioned area shocking (PPAS) technique was used to collect the fish in shallow, near shore water (Michael Odom, USFWS, pers. comm.).

A total of 208 juvenile shad were collected in the James River above Bosher Dam (push net and PPAS). Otoliths from 202 of these fish were processed for oxytetracycline (OTC) tag verification. All but two carried a one day tag that distinguished fish stocked in the James. This is an unusual result given the fact that no spawning adult shad should have been able to pass Bosher Dam in the spring. Therefore, it is believed the two otoliths not carrying a tag were from fish other than American shad and were misidentified. Other alosid species are in the James above Bosher Dam as a result of herring trap and transport efforts (blueback herring) and out-migrants (mostly alewives) from Lake Moomaw (Jackson River).

Juvenile shad were also collected at three locations on the James below Bosher Dam mostly by electrofishing and a few by push netting (see Table 3). A total of 183 fish were collected and processed for OTC verification. Of those examined, 147 (80.3%) carried the OTC mark distinguishing fish stocked into the James in 1997.

On the Pamunkey River, 90 shad juveniles were collected at three tidal locations by boat electrofishing (see Table 3). Otoliths from these fish were also processed and examined which resulted in the identification of 8 (8.9%) hatchery fish. The tags observed were a four day tag which was used to distinguish fish stocked in 1997.

The full report on Virginia shad restoration will soon be available in "Virginia's American Shad Restoration Project: 1997."

Blueback herring

On 28 July, blueback herring juveniles (30 - 51 mm) were also collected with the push net above Bosher Dam in the Watkin's Pool (see Table 3). The average density of juvenile herring for four push net runs was 0.55 fish/100m^3. The herring showed up in the push closest to the dam (rm 114) and upstream at rm 121. Finding blueback herring juveniles distributed in the pool is evidence that the herring that were translocated in the spring successfully spawned and the fry were able to grow to at least the juvenile phase. However, herring were found on only one night. More data will be needed in future years to better evaluate the contribution of Trap and Transport to the restoration effort.

Push net collections at sites downstream of Bosher Dam (rm 113) in the tidal James River (see Table 3) were done in a similar fashion to those above the dam. Four to six half-mile transects were selected randomly for a given night from three different 10 mile sections. The sampling sites ranged from as far downstream as rm 74 (Hopewell) up to rm 103 (just below Richmond). Most of the sampling was conducted between rm 83 and rm 103. The collections consisted almost entirely of river herring and gizzard shad juveniles. One American shad juvenile was collected at rm 99 on 24 July and one was collected at rm 96 on 3 September. Figure 6 shows average juvenile herring density (fish/100m^3 of water sampled) for four to six nighttime pushes. In general, as the water temperature dropped over the season, the CPUE decreased as well. These data were collected to monitor the juvenile population of blueback herring in the tidal section and to compare to the catch above the dam. Higher catch rates below the dam demonstrate the effectiveness of the push net when herring are relatively abundant and found in dense schools.

Collection data for both herring and shad from 1997 add to the baseline database that is being established for future comparison. Overall restoration goals will be evaluated over the next several years as stocking and translocating efforts continue and target fishes are spawning above the fishway at Bosher Dam.

TABLE 1. Blueback herring stocked by site from April 21,1997 to May 2, 1997 during the Trap and Transport Project (VDGIF and USFWS combined). The fish were collected at Walker's Dam on the Chickahominy River (lower, major tributary of the James).

Stream	Stocking Site	No. of Bluebacks Stocked	No. of Stockings	Percent Mortality
James River	Columbia	3,576	4	1.6
Byrd Creek (James trib.)	Rt. 603	956	2	5.3
Herring Creek (James trib.)	Harrison Lake	560	1	0
	TOTAL	5,092	7	2.1

TABLE 2. Maximal CPUE (fish/hr) for alosid species collected during spring 1997 electrofishing sampling at several locations on Virginia Chesapeake Bay tributaries from March to June.

River	Site	Blueback herring (fish/hr)	American shad (fish/hr)	Hickory shad (fish/hr)	Alewife (fish/hr)
Appomattox	Harvell Dam (Denil construction)	90.2	0.0	37.0	3.7
Swift Creek	White Bank	97.8	3.1	0.0	17.4
James	*Bosher Dam (vert. slot const.)	0.0	64.8	0.0	0.0
Chickahominy	Walkers Dam (existing Denil)	11,255.6	**	**	**
S. Anna	Ashland Mill Dam (future Denil)	6.5	132.3	10.8	0.0
Rappahannock	Route 1 (fall line)	113.9	0.0	20.0	264.9
Rappahannock	Embrey Dam (future passage)	287.3	0.0	0.0	0.0
Mattaponi	Aylett (future passage on tribs?)	36.0	78.0	0.0	0.0

* VCU is conducting this sampling for the City of Richmond to fulfill an ACOE condition on a new water withdrawal permit.

** Not targeted during blueback herring collection for trap and transport.

TABLE 3. - Description of James River and Pamunkey River sites sampled during the 1997 juvenile alosid monitoring effort. All push net and ichthyoplankton sampling was conducted at night. PPAS sampling and most boat electrofishing was conducted during the day.

Site	River	Gear Used*	Site Characteristics
Columbia	James	PPAS, P, I	45 miles above Bosher Dam, relatively shallow pool between landing and upstream riffle, site contains Rivanna River confluence
Cartersville	James	PPAS	37 miles above Bosher Dam; shallow pool habitat and some riffle habitat
Watkins	James	P, I	site begins at Bosher Dam (rm 113; 10' in height) and extends 8 miles upstream to the landing; large pool with suburban and agricultural land use and includes Tuckahoe Creek confluence
Osborne	James	P, E	20 miles downstream of Bosher Dam, site extends 10 miles upstream to rm 103 and 10 miles downstream to rm 83; large pool habitat with some industrial outfalls and several tidal flats; upper end is near the head of tidal influence below the fall line
Hopewell	James	P	31 miles downstream of Bosher Dam, site starts near the confluence of the James and Appomattox rivers and extends 5 miles upstream to Turkey Island; large pool habitat with occasional tidal flats
Lafferty's	Pamunkey	E	34 miles above mouth (West Point), tidal, main channel and flats
Rockahock	Pamunkey	E	29 miles above mouth (West Point), tidal, main channel and flats; broodstock site
Cumberland	Pamunkey	E	22 miles above mouth (West Point), tidal, main channel and flats

* E = boat electrofishing
PPAS = pre-positioned area shocking
P = push net
I = ichthyoplankton net

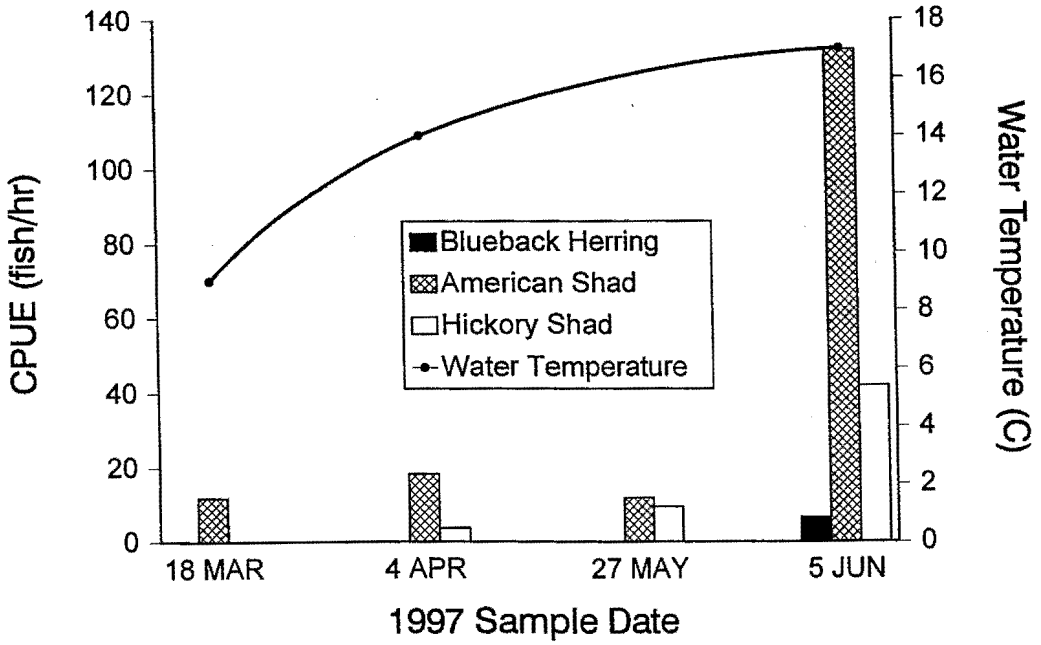

FIGURE 1.-Spring 1997 adult alosid electrofishing results below Ashland Mill Dam on the South Anna River in Ashland, Virginia.

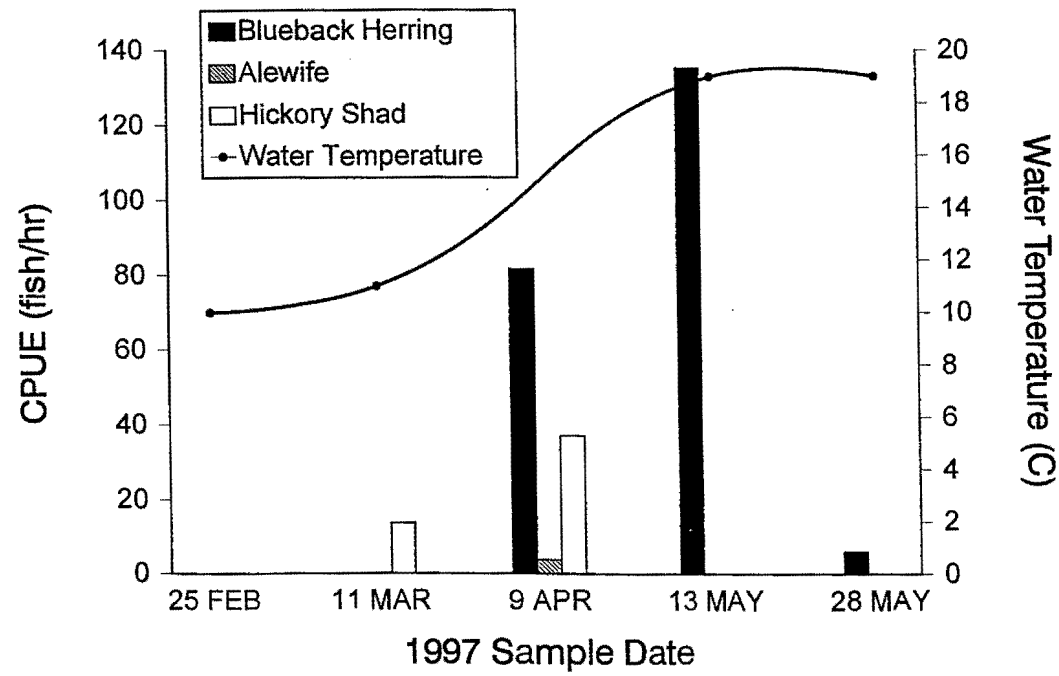

FIGURE 2.-Spring 1997 adult alosid electrofishing results below Harvell Dam on the Appomattox River in Petersburg, Virginia.

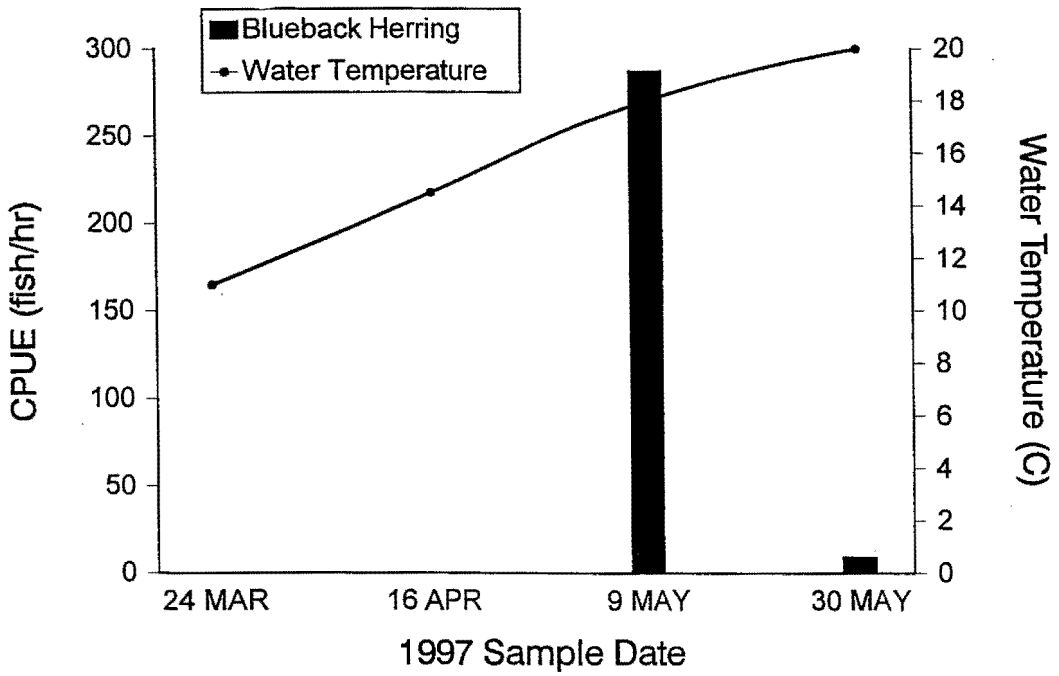

FIGURE 3.-Spring 1997 adult alosid electrofishing results below Embrey Dam on the Rappahannock River in Fredericksburg, Virginia.

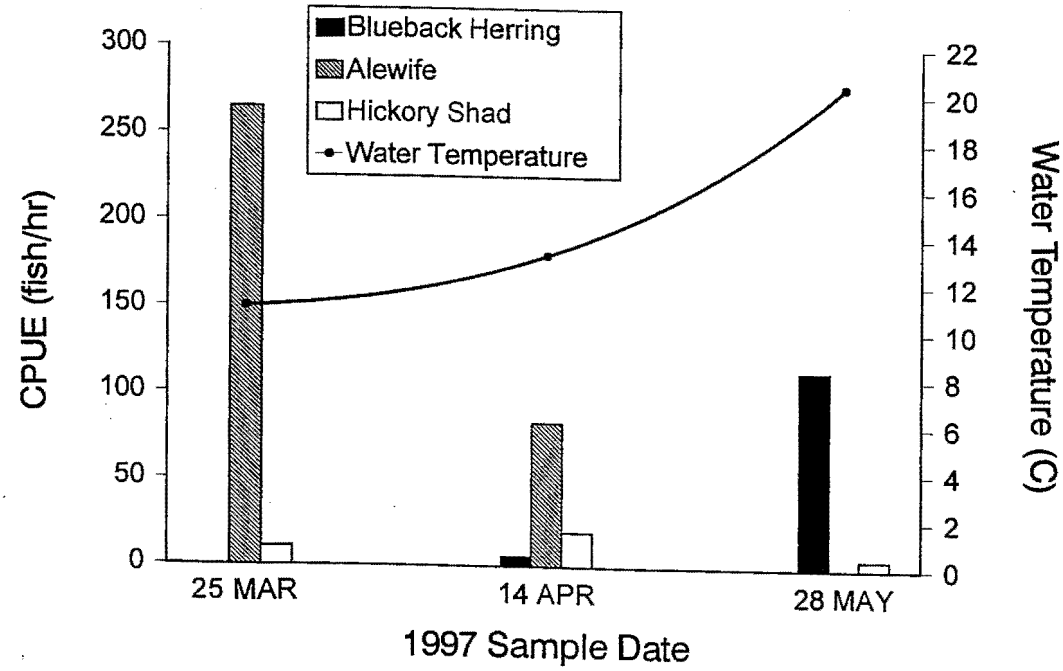

FIGURE 4.-Spring 1997 adult alosid electrofishing results below Route 1 on the Rappahannock River in Fredericksburg, Virginia. Route 1 is approximately 3 miles downstream of Embrey Dam.

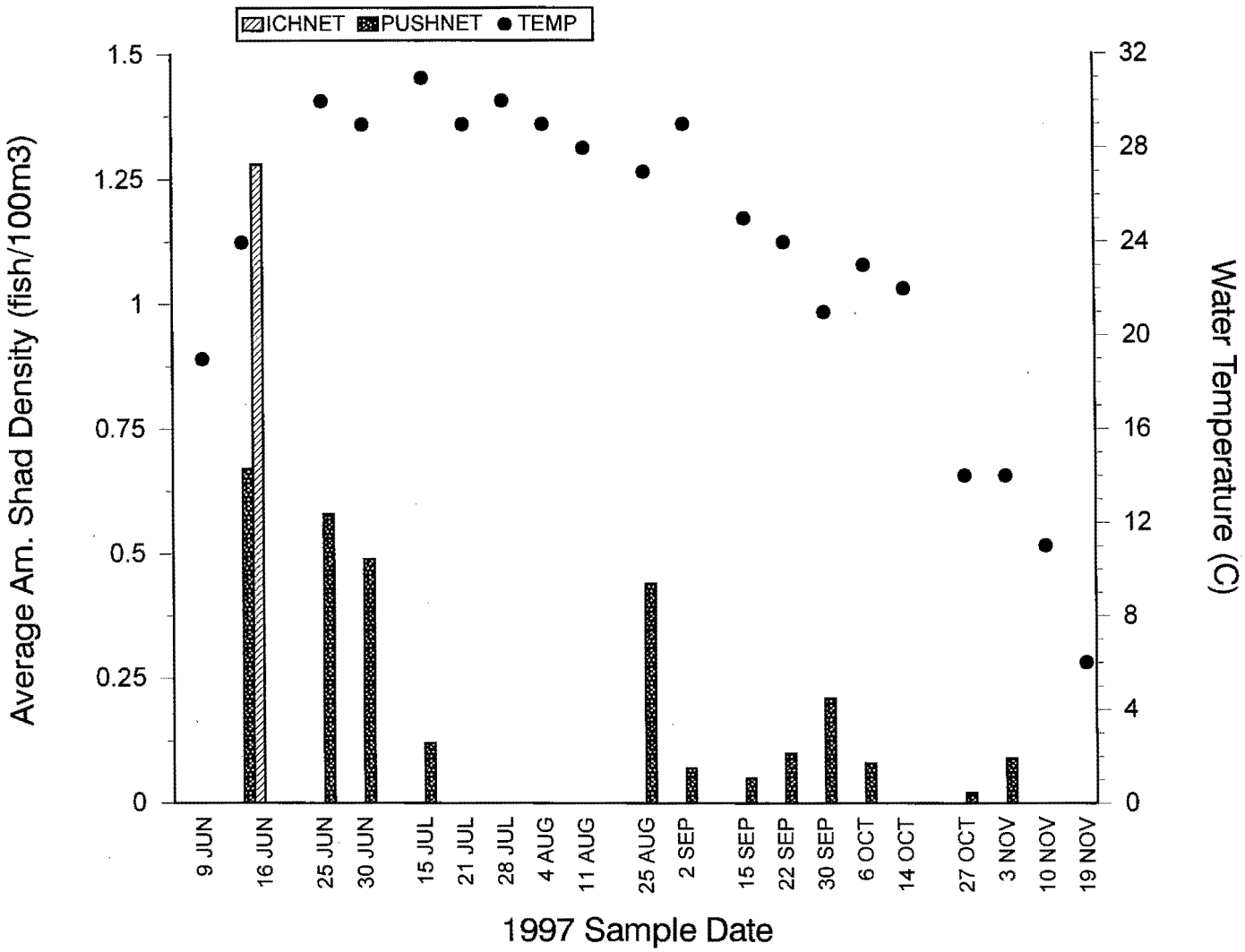

FIGURE 5. - CPUE shown as American shad juvenile density (fish/100m3) from 1997 ichthyoplankton and push net samples in the 8 mile pool above Bosher Dam (rm 113; Watkin's Pool). Four to six half-mile transects were randomly selected per sample night from rm 114 up to rm 121. Ichthyoplankton sampling ended on 16 June. There were no flood events on the James River during this sample period.

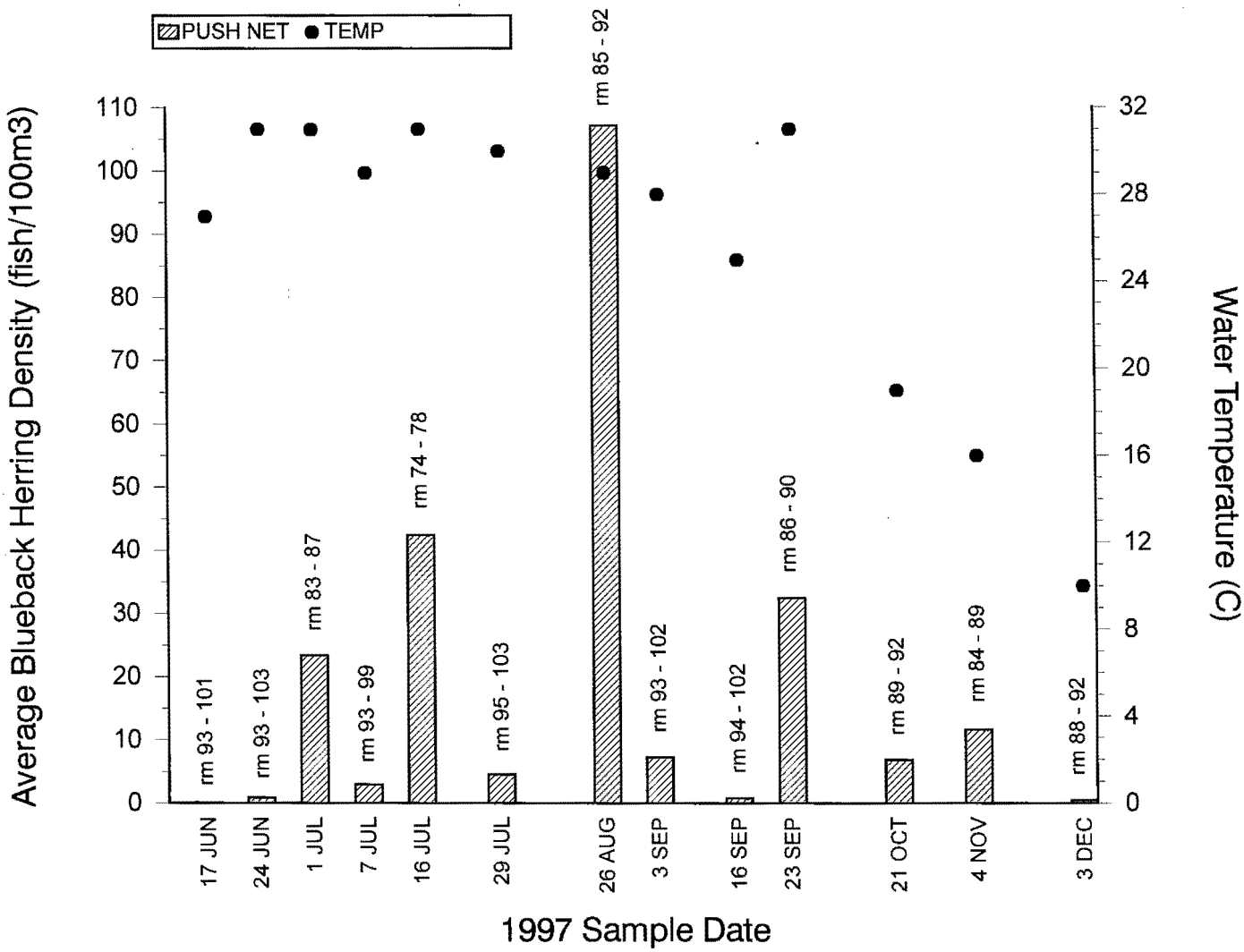

FIGURE 6. - CPUE shown as blueback herring juvenile density (fish/100m3) from 1997 push net samples from rm 74 up to rm 103 downstream of Bosher Dam (rm 113). Four to six half-mile transects were randomly selected per sample night from three 10 mile sections. There were no flood events on the James River during this sample period.