

Ichthyofaunal Survey of Tributaries of the Appomattox River System, Virginia, 1986-87

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ABSTRACT

An extensive survey of the fish fauna of tributaries of the Appomattox River system, Virginia was conducted during 1986-87. A total of 81 collections was made, including two in the mainstem of the system. We collected 17,210 fish representing 11 families, 35 genera, and 55 species. Two species (*Notropis volucellus*, Mimic Shiner; and *Moxostoma cervinum*, Blacktip Jumprock) were new records for the Appomattox system. Three species (*Notropis bifrenatus*, Bridle Shiner; *Anguilla rostrata*, American Eel; and *Acantharchus pomotis*, Mud Sunfish) are listed as Species of Greatest Conservation Need. A limited sport fishery was determined for 13 species.

Key words: Appomattox River, fish survey, habitat.

INTRODUCTION

We conducted an extensive survey of the fish fauna in tributaries of Virginia's Appomattox River system during 1986-87 to ascertain species composition and relative abundance for the purpose of inventorying species present and assessing the sport fishery. The objective of this survey was to target the tributary streams (generally first and second order). All but two of the collections were on tributary streams. Relatively little was known about the fish fauna in the Appomattox system prior to this survey. The Fish and Wildlife Information System (FWIS) of the Virginia Department of Game and Inland Fisheries (VDGIF) shows 12 fish collection series for the Appomattox system prior to 1986. These collections were made from 1935-1983. Apparently the results of most of the collections were not published.

STUDY AREA

The Appomattox River is a major tributary of the James River in central Virginia. From its source in

northeastern Appomattox County, the Appomattox River flows generally southeastward to Farmville where it makes a large arc northeastwardly and then southeastwardly passing through Petersburg to Hopewell, where it merges with the James River. The Appomattox River originates in the Piedmont Foothill Zone subprovince, passes through the Piedmont Lowlands subprovince, and merges with the James River in the Coastal Plain. Jenkins & Burkhead (1994) reviewed in detail the characteristics of these physiographic regions with discussion including topography, soil types, and stream hydrology. The Appomattox River is about 258 rkm in length (Jenkins & Burkhead, 1994), dropping in elevation from 115.8 m at its source to 1 m at its confluence with the James River (Fry et. al., 2011). The watershed area is about 3,481 km². Discharge at the Matoaca U.S.G.S. gaging station, situated in Chesterfield County about 4.8 km downstream of the Brasfield Dam, averages 38.66 m³/s. The Appomattox River watershed is 42.4% deciduous forest, 18.1% evergreen forest, 4.1% mixed forest, 16.8% pasture hay, and 1.8% cultivated crop (Fry et. al., 2011).

Four dams of greatly varied age, height, and condition are present on the lower Appomattox River. History and structural characteristics of these dams are reviewed by EA Engineering, Science, and Technology, Inc., 2012. The farthest downstream is Harvell Dam, located at the Great Falls of the Appomattox about 100 m upstream of the head of tide and situated between VA Rt. 36 and US Rt. 1. The dam was reportedly built about 1856. It is about 3 m high, effectively preventing upstream fish passage. To satisfy a requirement of the Federal Energy Regulatory Commission, a Denil fishway was built in 1998 which allowed some fish passage until the hydropower facility ceased operation in 2004. About 1 km upstream of Harvell Dam is Battersea Dam, which is about 3.1 m high but sufficiently breached for fish passage. The Abutment Dam (2-3 m high) is about 8.2 km upstream of Battersea Dam. A Denil fishway was built on the Abutment Dam in 2003, and in 2009, a middle section of the dam (approximately 33 m wide) collapsed, eliminating this barrier to fish passage. About 2.1 km

upstream of the Abutment Dam is Brasfield Dam (22 m high) constructed in 1966-67, which impounds Lake Chesdin (1,254 ha), the only major reservoir in the system. A fish lift was completed on Brasfield Dam in 2004 in mitigation for the installation of a hydropower unit in 1993. Brasfield Dam is the farthest upstream obstacle to fish passage on the Appomattox River. Approximately 192 km of the river is available for anadromous fish spawning above this point.

The section of the Appomattox River from Brasfield to Harvell Dam was designated in 1977 as a Virginia Scenic River by the Virginia Department of Conservation and Recreation.

MATERIALS AND METHODS

We made 79 collections between April and August, 1986, all but 15 of these in April and May. Two additional collections were made on 28 July 1987, for a survey total of 81 collections. The locations of collection sites are presented in Figure 1 and Table 1.

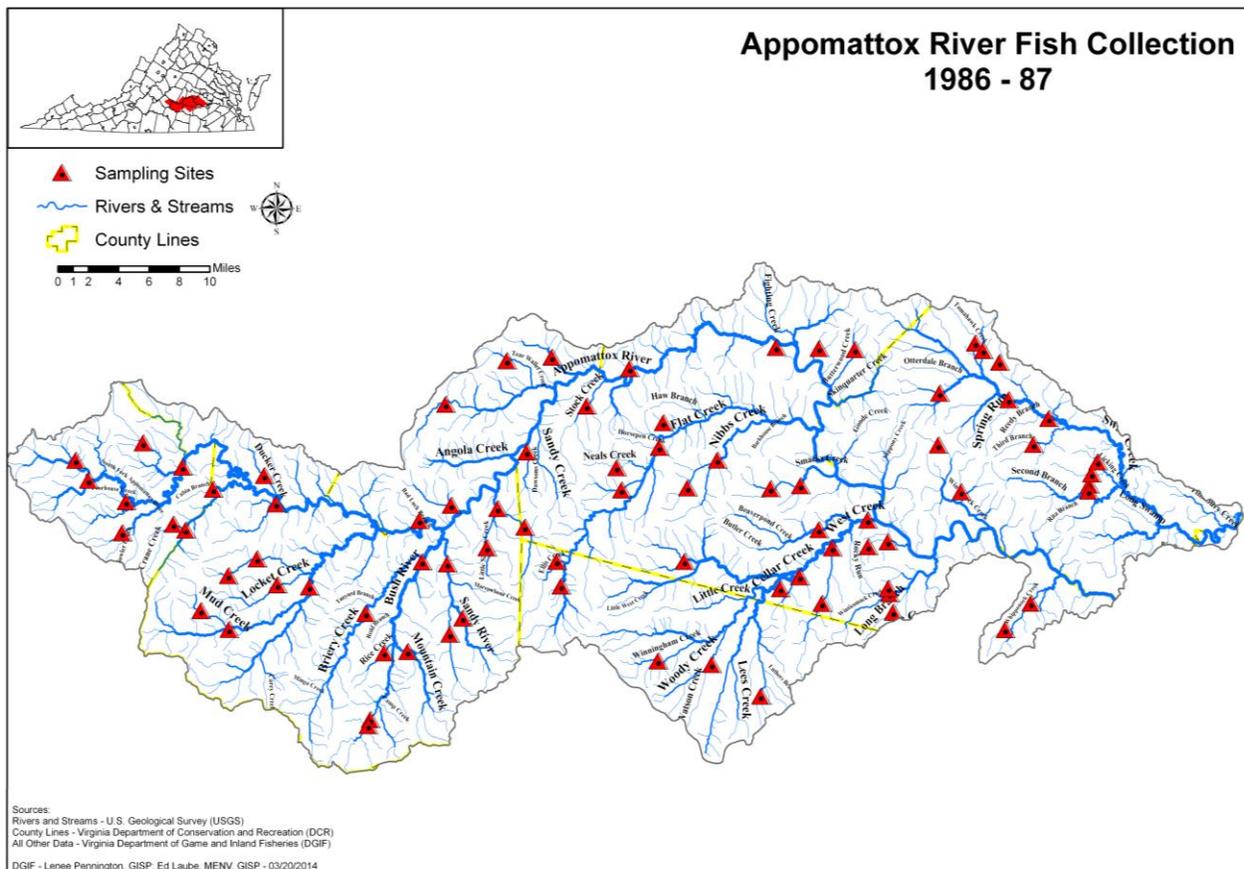


Fig. 1. Map of fish collection sites in the Appomattox River system, Virginia, 1986-87.

Table 1. Appomattox River fishes survey, 1986-87.

<u>Site</u>	<u>County</u>	<u>Stream</u>	<u>Route</u>	<u>USGS Topo Map</u>	<u>Date</u>	<u># species collected</u>	<u># fish collected</u>
183	Dinwiddie	Whippemock Cr.	708	Church Road	3/04/86	16	67
184	Dinwiddie	Whippemock Cr.	627	Church Road	3/04/86	6	8
185	Chesterfield	Rita Br.	636	Beach	3/04/86	1	1
186	Chesterfield	Second Br.	636	Beach	3/04/86	8	80
187	Chesterfield	First Br.	636	Beach	3/04/86	9	29
188	Chesterfield	Licking Cr.	636	Beach	3/04/86	12	26
189	Chesterfield	Swift Cr.	653	Chesterfield	3/04/86	9	13
190	Chesterfield	Rocky Run	653	Beach	3/04/86	3	8
191	Chesterfield	Tomahawk Cr.	652	Hallsboro	4/04/86	6	12
192	Chesterfield	Little Tomahawk Cr.	652	Hallsboro	4/04/86	4	18
193	Chesterfield	Nuttree Br.	652	Hallsboro	4/04/86	12	202
194	Chesterfield	Swift Cr.	360	Hallsboro	4/04/86	9	88
195	Chesterfield	Horsepen Cr.	667	Hallsboro	4/04/86	2	2
196	Chesterfield	Winterpock Cr.	655	Winterpock	4/04/86	3	9
197	Chesterfield	unnam. trib. Surline Br.	602	Winterpock	4/04/86	11	91
198	Amelia	Namozine Cr.	622	Hebron	8/04/86	8	19
199	Amelia	Long Br.	600	Hebron	8/04/86	8	92
200	Amelia	Winticomack Cr.	600	Hallsboro	8/04/86	6	12
201	Amelia	unnam. trib. Winticomack Cr.	600	Mannboro	8/04/86	7	17
202	Amelia	Sweathouse Cr.	682	Wellville	8/04/86	8	24
203	Amelia	Spindler's Cr.	615	Wellville	8/04/86	17	55
204	Amelia	Deep Cr.	615	Wellville	8/04/86	8	18
205	Amelia	South Buckskin Cr.	640	Jetersville	8/04/86	7	25
206	Amelia	N. B. Nibbs Cr.	687	Jetersville	8/04/86	14	112
207	Amelia	Little Cr.	642	Jetersville	9/04/86	9	43
208	Amelia	Neal's Cr.	642	Jetersville	9/04/86	21	547
209	Amelia	Flat Cr.	644	Ballsville	9/04/86	6	13
210	Amelia	unnam. trib. Flat Cr.	667	Ballsville	9/04/86	10	88
211	Amelia	Nibb's Cr.	681	Amelia Courthouse	9/04/86	12	61
212	Amelia	Puckett's Br.	685	Church Road	22/04/86	9	57
213	Amelia	Horsepen Br.	622	Mannboro	22/04/86	5	12
214	Amelia	Beaverpond Cr.	153	Amelia Courthouse	22/04/86	17	103
215	Amelia	Sweathouse Cr.	708	Mannboro	22/04/86	2	3
216	Amelia	Smack's Cr.	627	Amelia Courthouse	22/04/86	2	5
217	Amelia	Smack's Cr.	628	Amelia Courthouse	22/04/86	14	166
218	Amelia	Stock Cr.	644	Cumberland	22/04/86	14	51
219	Amelia	Dawson's Cr.	619	Cumberland	22/04/86	16	95
220	Amelia	Sayler's Cr.	617	Deatonville	22/04/86	15	148
221	Prince Edward	Buffalo Cr.	658	Farmville	23/04/86	10	20
222	Prince Edward	Locket Cr.	650	Prospect	23/04/86	14	197
223	Prince Edward	Falling Cr.	626	Prospect	23/04/86	7	104
224	Prince Edward	Falling Cr.	657	Prospect	23/04/86	7	290
225	Prince Edward	Vaughn's Cr.	627	Prospect	23/04/86	13	244
226	Prince Edward	Mud Cr.	639	Abilene	23/04/86	10	60
227	Prince Edward	S. F. Spring Cr.	664	Abilene	23/04/86	19	130
228	Prince Edward	Rice Cr.	647	Hampden Sydney	24/04/86	22	216
229	Prince Edward	Evans Cr.	632	Hampden Sydney	24/04/86	21	110
230	Prince Edward	Bush R.	633	Keysville	24/04/86	13	95
231	Prince Edward	Briery Cr.	665	Hampden Sydney	24/04/86	15	79
232	Prince Edward	Little Sandy R.	612	Green Bay	24/04/86	23	263
233	Nottoway	Bland Cr.	605	Wellville	19/05/86	15	106
234	Nottoway	Woody Cr.	607	Crewe East	19/05/86	10	169
235	Nottoway	Winningham Cr.	617	Crewe East	19/05/86	15	221
236	Nottoway	Flat Cr.	629	Deatonville	19/05/86	21	405
237	Nottoway	Ellis Cr.	628	Deatonville	19/05/86	17	581
238	Prince Edward	Bush R.	460	Rice	20/05/86	11	56
239	Prince Edward	Sandy R.	460	Rice	20/05/86	13	60
240	Prince Edward	Sayler's Cr.	600	Rice	20/05/86	16	477
241	Prince Edward	Sandy R.	606	Green Bay	20/05/86	15	115
242	Prince Edward	Mountain Cr.	628	Green Bay	20/05/86	19	221
243	Cumberland	Bad Luck Br.	600	Rice	20/05/86	17	165
244	Buckingham	Ducker Cr.	725	Prospect	20/05/86	7	242
245	Cumberland	Green Cr.	600	Rice	21/05/86	11	87
246	Cumberland	Tear Wallet Cr.	641	Cumberland	21/05/86	18	178
247	Cumberland	Little Guinea Cr.	654	Cumberland	21/05/86	16	43
248	Powhatan	unnam. trib. Appomattox R.	681	Ballsville	21/05/86	15	90
249	Powhatan	Butterwood Cr.	604	Clayville	8/07/86	14	288
250	Powhatan	Skipper's Cr.	603	Clayville	8/07/86	8	66
251	Cumberland	Little Guinea Cr.	640	Hillcrest	8/07/86	22	658
252	Appomattox	S. F. Appomattox R.	627	Pamplin	9/07/86	23	736
253	Appomattox	Rocky Run	631	Vera	9/07/86	22	1273
254	Appomattox	Fish Pond Cr.	614	Holiday Lake	9/07/86	13	274
255	Appomattox	Appomattox R.	626	Pamplin	9/07/86	7	228
257	Appomattox	Crane Cr.	600	Pamplin	13/08/86	19	475
258	Appomattox	Poorhouse Cr.	627	Pamplin	13/08/86	24	958
259	Appomattox	Suanee Cr.	619	Pamplin	13/08/86	19	132
260	Prince Edward	Harris Cr.	651	Prospect	14/08/86	33	793
261	Prince Edward	Vaughn's Cr.	609	Prospect	14/08/86	26	595
262	Prince Edward	Sayler's Cr.	619	Rice	14/08/86	26	478
269	Amelia	Deep Cr.	612	Mannboro	28/07/87	31	993
270	Amelia	Appomattox R.	682	Chula	28/07/87	11	51

Most of our sampling was by electrofishing using a portable 230 volt DC generator with probes and 30 m cable. Rotenone was used at 21 sites. Seining (15.2 m minnow seine) was our exclusive sampling method at one site, and we used both trap nets and seining at another site. For rotenone sampling, a block net (minnow seine) was set at the downstream point of the sample site to prevent fish from escaping and to assist in fish capture. Sampling effort was intensive. Sample length at the rotenone sites ranged from 45.7-219.5 m. Sample length at the electrofishing sites ranged from 24.4-137.2 m.

We made a conscious attempt to collect all fishes observed in the sampling, with the exception of American Eels (*Anguilla rostrata*) which were sometimes simply enumerated in passing. Individual fish were identified to species with the exception of Johnny and Tessellated Darters (*Etheostoma nigrum* and *E. olmstedii*; see species account). For these two sibling and problematic species, all specimens were considered Johnny Darter because this species is generally found above the Fall Line whereas the Tessellated Darter is generally found in the Coastal Plain of the James River drainage.

Some fish were identified and enumerated in the field. However, most specimens were preserved in formalin (10%) and then stored in ethanol (70%) for identification in the lab. All fish were measured for total length (TL) by inch group. Many of the preserved specimens were taken to Roanoke College where Dr. Robert E. Jenkins either identified or confirmed the species identification made by us. A few such specimen lots were retained at Roanoke College. Almost all of the collections were stored by VDGIF. Due to storage space limitation, many of the VDGIF specimens were later discarded, with the notable exception of the darters and a few other special interest fishes, which were deposited with the North Carolina State Museum of Natural Sciences in Raleigh, NC.

Channel width and stream depth were measured (in feet) and recorded as averages. Other physical habitat characteristics were described and subjectively rated as follows: stream flow – slow, moderate, or swift; fish cover – poor, fair, good, or excellent (with notations on type such as macrophytes, undercut banks, brush, boulders, etc.); aquatic macrophytes – none, sparse, common, or abundant (with notations on type); substrate – silt, sand, gravel, cobble, boulders, bedrock, or mud; water clarity – clear, slightly turbid, or very turbid; and riparian zone – forest canopy, pasture, agricultural field, etc. Water temperature was determined with a YSI meter and recorded in degrees Celsius.

Chemical habitat parameters monitored were specific conductance, pH, total hardness, and total alkalinity. Specific conductance was determined with a YSI meter. The other chemical parameters were determined with a Hach Water Quality monitoring kit.

Collection data (with the exception of some habitat notes) were stored in the FWIS database of VDGIF.

RESULTS

Habitat

Most physical habitat characteristics were fairly uniform over the entire drainage. For example, of the 81 collection sites, stream flow was rated slow or moderate at 97.5% (only two sites were rated swift), water clarity was rated clear or slightly turbid at 88.6%, and aquatic macrophyte abundance was rated none or sparse at 96.2%. Fish cover was more diverse: it was rated fair or good at 62.0% and poor at 29.1% of the sites; only seven sites were rated excellent for fish cover. With the exception of the two mainstem sites, stream width ranged from 1.2– 9.1 m but was generally within 2.4-4.6 m. Mean stream depth was generally 0.15-0.46 m. Substrate type ran the gamut from silt to bedrock, with most sites exhibiting several types which were not quantified.

Of the chemical parameters, specific conductance ranged from 25 to 130 $\mu\text{s}/\text{cm}$ (\bar{x} = 73.5 $\mu\text{s}/\text{cm}$, SD = 25.35), total hardness ranged from 17 to 68 ppm (\bar{x} = 37.0 ppm, SD = 12.58); and total alkalinity ranged from 17 to 103 ppm (\bar{x} = 62.8 ppm, SD = 22.55). In general, the higher conductivity (>100 $\mu\text{s}/\text{cm}$) and alkalinity (>100 ppm) sites were in the upper part of the system (notably in Prince Edward, Nottoway, and Buckingham counties). pH ranged from 6-7.4, with the mode (78.7%) falling within 6.7-7.2. In general, the more acidic sites were in the lower part of the drainage.

Water temperature ranged from 11.5° C (24 April 1986, site 230) to 28° C (9 July 1986, site 255). In general, water temperature was below 20° C until mid-May. Of the 49 collections made in April, water temperature was 16° C or less at 31 sites.

Ichthyofauna

Fifty-five species of fish representing 11 families and 35 genera were collected (Table 2). Individual species accounts with habitat notes are presented phylogenetically by family and alphabetically by genus and species.

Table 2. Fish species collected in the Appomattox River system, 1986-1987.

<u>Family</u>	<u>Species</u>	<u>Common Name</u>	<u># sites</u>	<u># specimens</u>	<u>Mean # specimens/site</u>
Anguillidae	<i>Anguilla rostrata</i>	American Eel	9	12	1.33
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	2	32	16.00
Esocidae	<i>Esox niger</i>	Chain Pickerel	23	48	2.09
Umbridae	<i>Umbra pygmaea</i>	Eastern Mudminnow	14	27	1.93
Cyprinidae	<i>Campostoma anomalum</i>	Central Stoneroller	16	465	29.06
Cyprinidae	<i>Chrosomus oreas</i>	Mountain Redbelly Dace	26	556	21.38
Cyprinidae	<i>Clinostomus funduloides</i>	Rosyside Dace	38	681	17.92
Cyprinidae	<i>Cyprinella analostana</i>	Satinfin Shiner	24	332	13.83
Cyprinidae	<i>Exoglossum maxillingua</i>	Cutlip Minnow	5	46	9.20
Cyprinidae	<i>Hybognathus regius</i>	Eastern Silvery Minnow	16	198	12.38
Cyprinidae	<i>Luxilus cerasinus</i>	Crescent Shiner	9	243	27.00
Cyprinidae	<i>Luxilus cornutus</i>	Common Shiner	20	849	42.45
Cyprinidae	<i>Lythrurus ardens</i>	Rosefin Shiner	17	424	24.94
Cyprinidae	<i>Nocomis leptcephalus</i>	Bluehead Chub	65	2877	44.26
Cyprinidae	<i>Nocomis micropogon</i>	River Chub	3	60	20.00
Cyprinidae	<i>Notemigonus crysoleucas</i>	Golden Shiner	16	45	2.81
Cyprinidae	<i>Notropis amoenus</i>	Comely Shiner	3	19	6.33
Cyprinidae	<i>Notropis bifrenatus</i>	Bridle Shiner	2	5	2.50
Cyprinidae	<i>Notropis procne</i>	Swallowtail Shiner	20	298	14.90
Cyprinidae	<i>Notropis volucellus</i>	Mimic Shiner	2	10	5.00
Cyprinidae	<i>Rhinichthys atratulus</i>	Blacknose Dace	29	588	20.28
Cyprinidae	<i>Rhinichthys cataractae</i>	Longnose Dace	5	21	4.20
Cyprinidae	<i>Semotilus atromaculatus</i>	Creek Chub	37	561	15.16
Cyprinidae	<i>Semotilus corporalis</i>	Fallfish	26	582	22.38
Catostomidae	<i>Erimyzon oblongus</i>	Creek Chubsucker	38	257	6.76
Catostomidae	<i>Hypentelium nigricans</i>	Northern Hog Sucker	13	42	3.23
Catostomidae	<i>Moxostoma cervinum</i>	Blacktip Jumprock	1	4	4.00
Catostomidae	<i>Thoburnia rhothoeca</i>	Torrent Sucker	34	713	20.97
Ictaluridae	<i>Ameiurus natalis</i>	Yellow Bullhead	17	37	2.18
Ictaluridae	<i>Ameiurus nebulosus</i>	Brown Bullhead	15	29	1.93
Ictaluridae	<i>Ictalurus punctatus</i>	Channel Catfish	2	4	2.00
Ictaluridae	<i>Noturus insignis</i>	Margined Madtom	43	621	14.44
Aphredoderidae	<i>Aphredoderus sayanus</i>	Pirate Perch	52	273	5.25
Poeciliidae	<i>Gambusia holbrooki</i>	Eastern Mosquitofish	6	19	3.17
Centrarchidae	<i>Acantharchus pomotis</i>	Mud Sunfish	7	11	1.57
Centrarchidae	<i>Centrarchus macropterus</i>	Flier	8	12	1.50
Centrarchidae	<i>Enneacanthus gloriosus</i>	Bluespotted Sunfish	12	53	4.42
Centrarchidae	<i>Lepomis auritus</i>	Redbreast Sunfish	45	684	15.20
Centrarchidae	<i>Lepomis gibbosus</i>	Pumpkinseed	35	127	3.63
Centrarchidae	<i>Lepomis gulosus</i>	Warmouth	17	29	1.71
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill	45	406	9.02
Centrarchidae	<i>Lepomis microlophus</i>	Redear Sunfish	2	3	1.50
Centrarchidae	<i>Micropterus dolomieu</i>	Smallmouth Bass	8	47	5.88
Centrarchidae	<i>Micropterus punctulatus</i>	Spotted Bass	6	52	8.67
Centrarchidae	<i>Micropterus salmoides</i>	Largemouth Bass	9	14	1.56
Centrarchidae	<i>Pomoxis annularis</i>	White Crappie	1	3	3.00
Centrarchidae	<i>Pomoxis nigromaculatus</i>	Black Crappie	3	7	2.33
Percidae	<i>Etheostoma flabellare</i>	Fantail Darter	43	452	10.51
Percidae	<i>Etheostoma fusiforme</i>	Swamp Darter	13	35	2.69
Percidae	<i>Etheostoma longimanum</i>	Longfin Darter	3	59	19.67
Percidae	<i>Etheostoma nigrum</i>	Johnny Darter	64	1653	25.83
Percidae	<i>Etheostoma vitreum</i>	Glassy Darter	13	163	12.54
Percidae	<i>Perca flavescens</i>	Yellow Perch	3	8	2.67
Percidae	<i>Percina notogramma</i>	Stripeback Darter	30	139	4.63
Percidae	<i>Percina peltata</i>	Shield Darter	4	29	7.25

Family Anguillidae – Freshwater Eels

Anguilla rostrata, American Eel: This was the only diadromous species found in the survey. It was not abundant (only 12 specimens collected) and was generally restricted to the lower portion of the system. One outlier was found in Falling Creek (site 223) in Prince Edward County. American Eel is listed as a Species of Greatest Conservation Need (Tier IV) in the Virginia Wildlife Action Plan (VDGIF, 2014).

Family Clupeidae – Herrings

Dorosoma cepedianum, Gizzard Shad: Gizzard Shad was collected at only two sites: Appomattox River mainstem at the Amelia Wildlife Management Area (site 270) and lower Deep Creek (site 269). The streams at both sites were relatively large (mean width about 12.2 m), which is preferred habitat for Gizzard Shad compared with small tributaries. Since the vast majority of sampled sites were small tributaries, the scarcity of Gizzard Shad in the survey was expected. All specimens were adults ranging from 7-11 inches TL.

Family Umbridae – Mudminnows

Umbra pygmaea, Eastern Mudminnow: The Eastern Mudminnow was found at 14 sites, mostly in the central part of the system. The species was never abundant; most sites yielded a single specimen. At sites yielding higher numbers, habitat characteristics in common included: relatively small stream (mean width and depth of 2.4 m and 15 cm); substrate of sand, gravel, and cobble; abundant fish cover; and pH 7.0.

Family Cyprinidae – Minnows

Campostoma anomalum, Central Stoneroller: This species was fairly common but restricted to the upper system. Most stations yielded <15 specimens with the notable exceptions of Crane Creek (site 257), Poorhouse Creek (site 258), and Rocky Run (site 253), which collectively yielded 79.1% of the total specimens. The high count at these sites was undoubtedly influenced by the sampling method (rotenone) and survey length (76-134 m). The substrate at all three sites was very silty, suggesting a high turbidity tolerance by this species. Habitat characteristics common at each site were: riffle/run habitat with pools to 0.8 m depth; fish cover fair to good; and pH slightly alkaline (7.1-7.4). Each site was fully canopied, which had a noticeable influence on water temperature (20.0° C on August 13).

Chrosomus oreas, Mountain Redbelly Dace: This dace was fairly common and widely distributed in the upper and middle system. It was generally associated with Blacknose and Longnose Daces. Habitat characteristics at the five sites with the higher counts (>50 fish/site) included: stream width, 1.5-3 m; water clarity either clear or slightly turbid; substrate of sand/gravel/cobble; flow either slow or moderate; fish cover fair to excellent; and pH 6.9-7.2.

Clinostomus funduloides, Rosyside Dace: This minnow was collected at 38 sites widely dispersed in the system but was more concentrated in the upper portion. Although the total number of specimens collected was relatively high, this species was generally uncommon with usually <10 specimens collected per site. A notable exception was Neal's Creek (site 208) in Amelia County where 199 Rosyside Dace were collected. Habitat characteristics at this site were: mostly riffle/run with pools to 1 m depth; mean stream width and depth, 2.4 m and 15 cm; moderate stream flow; substrate of sand/ gravel/cobble; excellent fish cover (logs, brush, under-cut banks, rocks); slightly turbid water; neutral pH; and complete forest cover with beaver dam upstream. Although this species prefers clear water, it apparently tolerates some turbidity. All three sites where the Rosyside Dace was most abundant had slightly turbid water. Rosyside Dace was always found associated with Blacknose Dace.

Cyprinella analostana, Satinfish Shiner: Another common cyprinid, 332 specimens were collected at 24 widely distributed sites, but usually with fewer than 10 collected at each site. Notable exceptions were Sayler's Creek (site 262) and Deep Creek (site 269), with counts of 65 and 97, respectively. Sampling method (rotenone) and survey length were probably factors in determining the high counts at these two sites.

Exoglossum maxillingua, Cutlip Minnow: The Cutlip Minnow was collected at only five sites, all in the upper system (Appomattox and Prince Edward counties). The species was rare (46 specimens collected) and restricted in distribution. Two sites (#252, S. Fork Appomattox River and #253, Rocky Run) collectively yielded 78.3% of the total specimens. Habitat characteristics at these two sites included: primarily riffle/run with a few pools to depth of 0.8 m; substrate of sand/gravel/cobble with a few boulders; mean stream width and depth 3.6 m and 23 cm; fish cover classified as good or excellent; water clarity rated clear; stream flow rated slow; and slightly alkaline pH.

Hybognathus regius, Eastern Silvery Minnow: This species was found at 16 sites scattered over the upper two-thirds of the system. It was relatively uncommon with usually <10 specimens/site. Two sites (Harris Creek, #260 and Little Guinea Creek, #251) yielded a relatively high number of specimens with counts of 34 and 64, respectively. The substrate at Harris Creek was very silty. Otherwise, there were no distinguishing habitat characteristics for these two streams.

Luxilus cerasinus, Crescent Shiner: This shiner was reported from nine sites, all in the upper system. Previously, it was known from only one site in the Appomattox system (Holiday Creek just below Holiday Lake), where it is believed to have been a bait fish introduction, probably from the Roanoke drainage (Jenkins & Burkhead, 1994).

Of the nine reported collections, only three (Evans Creek, site 229; Bush River, site 230; and Appomattox River, site 255) were confirmed by Jenkins as Crescent Shiner (voucher specimens for sites 229 and 230 are at Roanoke College; that Jenkins identified Crescent Shiner at site 255 is suggested from our notes on the field sheet). An additional collection at Roanoke College (Mud Creek, site 226) has three vouchers that are either *L. cerasinus* and/or *L. cerasinus* x *cornutus* hybrids (R. E. Jenkins, pers. comm.). Also, one specimen from site 229 may be a hybrid *L. cerasinus* x *L. cornutus*; it was taken with eight specimens each of *L. cerasinus* and *L. cornutus*.

Crescent Shiners were reported from five additional collections (using preserved specimens), but the field sheets are not checked to show that identification was made or confirmed by Jenkins (as was our routine practice). Since the specimens were later discarded, identification cannot be verified. These five "questionable" collections are: Vaughn's Creek (Co. Rt. 627), site 225; S. Fork Spring Creek, site 227; Fish Pond Creek, site 254; Crane Creek, site 257; and Vaughn's Creek (Co. Rt. 609), site 261.

The Crescent Shiner was uncommon in this survey, with 243 fish reported. It was most abundant at sites 255 (Appomattox River mainstem) and 261 (Vaughn's Creek), where 67 and 95 specimens, respectively, were taken. Of these two collections, only the Appomattox River specimens may have been identified by Jenkins.

The habitat at the four sites with confirmed Crescent and/or hybrid Common Shiners is as follows. Three sites were either riffle or riffle/run/pool with a few pools to 0.6 m depth; the other site was essentially a run. The substrate varied considerably from very silty/clay to clay/gravel/bedrock to sand/gravel. Mean stream width and depth ranged from 2.4-6.1 m and 15-46 cm, respectively. The stream bottom was non-

vegetated at all four sites. Fish cover was rated fair at three sites and poor at one. Water clarity was rated clear at two sites and slightly turbid at two. Chemical habitat parameters were: pH 7.0-7.2, specific conductance 32-88 $\mu\text{s}/\text{cm}$, total hardness 17-51 ppm, and total alkalinity 51-86 ppm.

Luxilus cornutus, Common Shiner: The Common Shiner was indeed common with 849 fish collected at 20 sites. This was the second most abundant cyprinid in the survey. All sites were in the upper half of the system. Streams with a very high number of Common Shiners in the sample were South Fork Appomattox River (site 252), Rocky Run (site 253), and Poorhouse Creek (site 258), with counts of 93, 186, and 216 fish, respectively. However, these high counts were undoubtedly influenced by the sampling method (rotenone) and survey length (128-152 m). Habitat at these sites was very similar. Rocky Run and Poorhouse Creek had a heavy small-sediment load, suggesting that the watershed disturbance had long duration; by inference, the Common Shiner is turbidity tolerant. Otherwise, the substrate at both sites was the same: sand/gravel/ cobble/bedrock (very rocky).

Lythrurus ardens, Rosefin Shiner: This was another common cyprinid; 424 specimens were collected at 17 sites widely distributed over the system. Generally <10 specimens were taken per site. Exceptions were Harris Creek (site 260), Rocky Run (site 253), and Appomattox River (site 255) which collectively yielded 60.1% of the total specimens. Habitat characteristics at each site included: riffle/run with pools to 0.76 m; substrate of sand/silt/pea gravel; water clarity rated clear; and pH 7.1-7.4. The main difference among the sites was stream width; the Appomattox River (mean width 6.1 m) was about twice that of the others.

Nocomis leptcephalus, Bluehead Chub: With 2,877 specimens collected at 65 sites, the widely distributed Bluehead Chub was the most abundant cyprinid in the survey. It was most abundant in the upper system (Nottoway, Prince Edward, and Appomattox counties) where the streams were slightly alkaline (pH 7.1-7.4) and had higher conductivity (80-102 $\mu\text{s}/\text{cm}$). Bluehead Chubs were 3-6 inches TL.

Nocomis micropogon, River Chub: River Chub was collected at only three sites. Two sites (260, Harris Creek and 261, Vaughn's Creek) are in the upper system (Prince Edward County) where the species was not common (total of seven fish collected). The third site (269, Deep Creek) is in the lower system (Amelia County), where the fish was common (n = 53). The

only apparent habitat difference is stream size: both Prince Edward County sites were relatively small (mean width 3-4.6 m), whereas the Amelia County site was large (mean width, 12.2 m). However, the relatively high count at the Deep Creek site was heavily influenced by a large number of young-of-year (YOY) fish (51 of the 53 specimens were 0-3 inches TL). River Chubs ranged up to 8 inches TL.

Notemigonus crysoleucas, Golden Shiner: Found in low abundance (generally one or two specimens/site) at 16 sites (most in the middle portion of the system), the Golden Shiner was not common or widely distributed. Water turbidity and temperature were high at the sites with the higher counts (due to pasture and/or agricultural fields bordering the sites), showing that this shiner is indeed tolerant of these conditions as reported by Jenkins & Burkhead (1994).

Notropis amoenus, Comely Shiner: The Comely Shiner was a rare cyprinid in this survey. Collectively, only 19 specimens were taken at three sites, all in the middle of the system. Two sites (Flat Creek, #236 and Appomattox River, #270) were each represented by one specimen; the third site (Deep Creek, #269) yielded 17. Habitat characteristics in common among the sites included: slow flow; non-vegetated bottom; substrate mostly of sand/pea gravel but with some cobble; and clear water. Specific conductance was relatively high (112-122 $\mu\text{s}/\text{cm}$).

Notropis bifrenatus, Bridle Shiner: This petite cyprinid was found at only two sites, both in the middle system (Amelia County). Four specimens were collected in South Buckskin Creek (Co. Rt. 640; site 205) and one in North Branch Nibbs Creek (Co. Rt. 687; site 206); both collections were made on April 8. All five specimens were identified by Jenkins as documented by his and/or our notes, but both collections were later discarded. Habitat at the two streams was similar: mean width (3-3.7 m) and depth (15-46 cm); slow stream flow; water turbid; specific conductance, 75-78 $\mu\text{s}/\text{cm}$; pH 6.7-7.1; total hardness, 34-51 ppm; total alkalinity, 51-68 ppm; and water temperature (17.9-18.4° C). The sites differed considerably with respect to cover and substrate. Fish cover at Buckskin Creek was rated fair (brush and abundant macrophytes along the shoreline) whereas that at Nibbs Creek was poor (little brush and no macrophytes – basically a sand bar). The substrate at Buckskin Creek was soft mud; that at Nibbs Creek was mostly sand and silt with mud. Both sites had been impacted by watershed disturbances. There had been some highway construction and forest clearing at Buckskin Creek. The Nibbs Creek site had a pasture

with agricultural field (row crop) along the sample site. Bridle Shiner is listed as a Species of Greatest Conservation Need (Tier I) in the Virginia Wildlife Action Plan (VDGIF, 2014).

Notropis procne, Swallowtail Shiner: This shiner was collected at 20 sites scattered over the drainage. It was uncommon with generally <10 specimens/site. Notable exceptions were Deep Creek (site 269) and Woody Creek (site 234), with counts of 89 and 121, respectively. These high counts are probably attributable to sampling method (rotenone) and survey length. Habitat characteristics in common included: slow stream flow, macrophytes absent, water clear, pH 7.2, and substrate mostly sand with some gravel/cobble/bedrock at one site.

Notropis volucellus, Mimic Shiner: Our records of the Mimic Shiner are the first for the Appomattox system. Our field notes indicate that Mimic Shiner was identified from preserved specimens (and thus, probably identified at Roanoke College), but do not state that the specimens were definitely identified at Roanoke College. Jenkins (pers. comm.) vaguely remembers identifying Mimic Shiner from at least one Appomattox collection. Unfortunately, the specimens were discarded.

Mimic Shiner was rare and limited in distribution; 10 specimens total were collected at two sites, both in the upper portion of the system: South Fork Spring Creek (#227) in Prince Edward County and Flat Creek (#236) in Nottoway County. Habitat differed between sites. Spring Creek was swift-flowing over sand/gravel/cobble and had good cover; it was turbid at the time sampled. Flat Creek was slow-flowing over sand and cover was poor; water was clear. pH was comparable (7.0 and 7.2). Other water quality parameters varied slightly. Each site had a diverse fish fauna: (Spring Creek, 19 species; Flat Creek, 21 species). *Notropis volucellus* probably is native to the Appomattox system. It typically occurs in medium-size streams and at least small rivers north and south of the Appomattox (Jenkins & Burkhead, 1994). Its distributional status in the Appomattox should be reconsidered after the system is well surveyed.

Rhinichthys atratulus, Blacknose Dace: Blacknose Dace was found at 29 sites, almost all of which were in the upper half of the system. It was generally uncommon (<10 collected/site), but there were a few notable exceptions with counts of >50 fish/site (one site produced 240 Blacknose Dace). Habitat characteristics at the four sites with the higher numbers of Blacknose Dace were: relatively small stream (mean width, 1.8-2.4

m; mean depth, 15-46 cm), slow to moderate flow, macrophytes absent, fish cover fair or good, pH 7.0-7.2, and substrate generally sand/gravel (some bedrock at one site). However, there were other sites with these same habitat characteristics which yielded only a few dace.

Rhinichthys cataractae, Longnose Dace: Longnose Dace was found at only five sites, all of which were in the extreme upper portion of the system (Appomattox and Prince Edward counties). The species was rare (21 fish), nine being the maximum number collected at any site. Longnose Dace was always found associated with Blacknose Dace, but the former was generally less abundant. Habitat at these five sites was mostly riffle/run over substrate of sand, gravel, cobble, and bedrock. The pH ranged from 7.1-7.4. There was almost complete forest canopy at each site. Field notes for some sites state that the stream looked like a mountain trout stream! Water clarity was clear at all but one site which was slightly turbid on the date of our sample. Apparently there was some major watershed disturbance upstream which involved destruction of the forest canopy, as inferred from the relatively high water temperature (26.5° C on July 9) compared with the water temperatures at three other sites (20° C on August 13-14).

Semotilus atromaculatus, Creek Chub: Creek Chub was fairly common and widely distributed in the system. It was always associated with Bluehead Chub but was seldom the numerically dominant chub (only 5 of the 37 syntopic sites). Of these five sites, Creek Chub was considerably more abundant at only one, where its dominance can be attributed to a much larger number of small (possibly YOY) fish. Creek Chubs ranged from 3-6 inches TL. The only habitat characteristics in common for the three sites yielding the greatest number of creek chubs were: relatively small stream (mean width, 1.8-3.7 m; mean depth, 15-46 cm), slightly alkaline (pH range, 7.1-7.2), and non-vegetated stream bottom.

Semotilus corporalis, Fallfish: The Fallfish was collected at 26 sites scattered in the upper two-thirds of the system. It was generally not common, with usually <10 specimens collected/site. Notable exceptions were Harris Creek (site 260), Vaughn's Creek (site 261), and Saylor's Creek (site 262), which collectively yielded 53.8% of the total specimens. Habitat characteristics at these three sites were: relatively small stream (mean width, 3-4.6 m; mean depth, 15-46 cm), slow to moderate flow, substrate of silt/sand/pea gravel/boulders, fish cover generally fair, and pH 6.9-7.1. Two

of the sites were very silty, suggesting Fallfish are turbidity-tolerant. Fallfish in the samples ranged from 3-9 inches TL.

Family Catostomidae – Suckers

Erimyzon oblongus, Creek Chubsucker: We collected Creek Chubsuckers at 38 sites widely scattered in the entire system and which varied considerably in habitat characteristics. Where collected, it was relatively uncommon with <10 specimens at almost all sites with the exception of Neal's Creek (site 208) which yielded 98 specimens. An explanation for the high count was the abundance of juveniles including 45 specimens of the 0-3-inch class and 26 of the 4-inch class.

Hypentelium nigricans, Northern Hog Sucker: All but two of 13 collection sites for this species were located in the upper system. Both outliers were in the lower portion of the system (Deep Creek). The species was uncommon; fewer than five specimens were collected at almost all sites. One site (Rocky Run, #253) yielded 12 specimens; habitat there was riffle/run with pools to depth 0.8 m. The specimens were 3-10 inches TL.

Moxostoma cervinum, Blacktip Jumprock: The Blacktip Jumprock was collected at only one site (Neal's Creek, #208), which is in the central portion of the system (Amelia County), and represents the first record for the Appomattox system. Identification of the species was confirmed by Jenkins. Blacktip Jumprock is known in Virginia from the Chowan and Roanoke drainages (where it is native) and the James and New drainages (where it is believed introduced) (Jenkins & Burkhead, 1994). The four specimens that we collected included three of the 0-3-inch class and one of the 4-inch class, indicating natural reproduction. Habitat characteristics at the Neal's Creek site included: relatively small stream (mean width and depth of 2.4 m and 15 cm, respectively) with pools to depth 1 m (beaver pond upstream of the site); slow flow; non-vegetated bottom; substrate of sand/gravel/cobble; excellent cover; water slightly turbid; pH 7.0; and complete forest cover. Water temperature was 13.0° C (April 9).

Thoburnia rhotroeca, Torrent Sucker: Represented by 713 specimens collected at 34 sites, this was the most abundant catostomid, occurring commonly in the upper half of the system, sparsely in the mid-section and not found in the lower. Where encountered, generally <10 specimens were collected/site with the following notable exceptions: 217 fish at Rocky Run (site 253); 65 at Little Guinea Creek (site 251); 56 at Falling Creek (site 224); and 52 at Harris Creek (site 260). Habitat

characteristics at these sites were generally riffle/run with pools to 1 m; relatively small (mean width 1.5-3.7 m) and shallow (mean depth 15-30 cm); slow to moderate flow; substrate of sand/gravel/cobble with considerable silt at some sites; water clear; and pH 6.9-7.4. Two of these four sites were very silty. The suckers were 3-6 inches TL.

Family Ictaluridae – Bullhead Catfishes

Ameiurus natalis, Yellow Bullhead: The Yellow Bullhead was collected at 17 sites widely scattered over the system, but was rare with generally only 1-2 specimens collected/site. Specimens ranged from 3-12 inches TL; most were <9 inches TL. The yellow bullhead was found with brown bullhead at five of the 17 sites. Habitat characteristics varied considerably among the sites.

Ameiurus nebulosus, Brown Bullhead: The Brown Bullhead was also found widely scattered over the system and rare, with generally only one specimen collected/site. Specimens ranged from 3-9 inches TL, with most <6 inches. As with Yellow Bullhead, habitat characteristics varied considerably among the sites.

Ictalurus punctatus, Channel Catfish: This introduced species was represented by four fish found at two sites, including the Appomattox mainstem (#270) and Deep Creek (#269), a major tributary. Channel Catfish have been extensively stocked in Lake Chesdin, where the species is now common. The paucity of records in this survey is undoubtedly due to the species' habitat preference for lakes and medium and large rivers. Most of the streams surveyed in this study are small tributaries. Since the Channel Catfish stockings in Lake Chesdin began in the 1970s, it is apparent that the species will not move into small tributaries. Two adults (15 and 16 inches TL) were found; the other two were YOY, showing some natural reproduction in the mainstem and major tributaries.

Noturus insignis, Margined Madtom: This was the most abundant ictularid and one of the most abundant species in the collection. A total of 621 specimens was taken from 43 sites, which were widely scattered over the system. Generally <10 specimens were collected at each site but frequently 20-30 specimens were found. Streams which yielded the highest number of Margined Madtoms were Little Guinea Creek (site 251) and Deep Creek (site 269) with counts of 89 and 193, respectively. These had riffle/run habitat and pools to 1 m deep. Sampling method (rotenone) and survey length undoubtedly influenced the high counts, and presence

of a forested riparian zone at each site may have contributed also by improving the insect forage base upon which madtoms depend.

Family Esocidae – Pikes

Esox niger, Chain Pickerel: This was the only esocid collected. It was widely distributed in the system but never common. Specimens ranged from 3-12 inches TL, showing some recruitment as well as the presence of a limited sport fishery.

Interestingly, and contrary to most literature (e.g., Scott & Crossman, 1973; Hastings, 1984; Jenkins & Burkhead, 1994), the abundance of Chain Pickerel was not directly related to aquatic macrophytes. Of the four sites where pickerel were most common, aquatic macrophytes were absent at two, fairly common at one and abundant at one. At another site with abundant macrophytes, only one pickerel was collected. However, the presence of Chain Pickerel does seem to be related to the amount of fish cover. Of the 23 sites where pickerel were found, fish cover was rated fair to excellent at 18, but poor at only five. Other habitat characteristics which seem to be favored by Chain Pickerel include a moderate stream flow and slightly acidic to neutral pH (6.5-7.0).

Chain Pickerel is the only esocid native to the Appomattox system. The apparent absence of its close relative (Redfin Pickerel, *E. americanus*) in the lower Appomattox is enigmatic considering its distribution in drainages north and south of the James drainage (Jenkins & Burkhead, 1994).

Family Aphredoderidae – Pirate Perches

Aphredoderus sayanus, Pirate Perch: This species was collected at 52 sites widely scattered over the system, but it was relatively uncommon with <5 specimens collected at most sites. Habitat varied considerably.

Family Poeciliidae – Livebearers

Gambusia holbrooki, Eastern Mosquitofish: This livebearer was very rare, with only 19 fish collected at six sites. It was most common at sites with abundant aquatic macrophytes (preferred habitat) but was also found at sites lacking such vegetation, the latter captures probably representing waifs from vegetated areas.

Family Centrarchidae – Sunfishes

Acantharchus pomotis, Mud Sunfish: Another rare species in the survey, 11 Mud Sunfish were found at

seven sites, all clustered in the lower third of the system (Amelia County) excepting one site (Rice Creek, #228) in the upper portion (Nottoway County). Habitat characteristics were fairly consistent across sites: stream size (mean width typically <2.4 m); stream flow (generally slow); fish cover (fair to excellent); water clarity (clear); and pH (acidic, 6.0–6.7). Most of the Mud Sunfish were of the 0–3-inch class, with a few specimens up to 6 inches TL, indicating a limited sport fishery potential. Mud Sunfish is listed as a Species of Greatest Conservation Need (Tier IV) in the Virginia Wildlife Action Plan (VDGIF, 2014)

Centrarchus macropterus, Flier: Flier was another very uncommon centrarchid, with 12 specimens collected from eight sites scattered across the lower two-thirds of the system. Habitat characteristics in common included: stream size (mean width was generally 1.8 m); stream flow (slow); and aquatic vegetation (absent or very sparse). The pH was acidic to slightly alkaline (range, 6.2–7.2). Specimens ranged from 3–7 inches TL, indicating a limited sport fishery potential.

Enneacanthus gloriosus, Bluespotted Sunfish: Bluespotted Sunfish was relatively uncommon; it was found at 12 sites, generally with <5 fish at each site. The species was found only in the lower two-thirds of the drainage, suggesting restriction to that area. Habitat characteristics varied considerably for most parameters. Fish cover including aquatic macrophytes varied greatly between sites and was often scant or absent. Cover was rated poor at five sites, fair at three, good at two, and excellent at two, whereas macrophytes were absent at eight sites, sparse at two, fairly common at one, and abundant at one. Even at the two sites yielding the most Bluespotted Sunfish (eight specimens each), habitat was considerably different (i.e., vegetation was abundant vs. absent; fish cover was excellent vs. poor; water clarity was dark vs. clear. The only habitat parameter that was fairly consistent among the 12 collection sites was stream flow, which we rated slow at 10 sites and moderate at two.

Lepomis auritus, Redbreast Sunfish: This native to the Atlantic Slope drainages was the most abundant centrarchid found in the survey. We collected 684 fish at 45 sites widely distributed over the entire system. The number collected/site varied greatly. The site yielding the most Redbreast Sunfish was #269 (Deep Creek), where we took 143 fish. The length-frequency distribution at this site was: 0–3-inch class, 86 fish; 4-inch class, 19; 5-inch class, 20; 6-inch class, 12; and 7-inch class, 6. This suggests excellent recruitment of the 1987 year class, with growth to 4 or 5 inches by Age-1

and to 6 or 7 inches by Age-2 or 3. The presence of harvestable-size fish shows that a sport fishery for Redbreast existed in these tributary streams.

Lepomis gibbosus, Pumpkinseed: Pumpkinseed was the third most abundant sunfish collected in the survey; 127 fish were taken from 35 sites scattered over the system wherein habitat varied considerably. The species was never common at any one site, with <10 fish collected/site at all but two sites. The two higher counts were due to a proliferation of YOY in the sample.

Lepomis gulosus, Warmouth: We collected Warmouth at 17 sites scattered over the entire system but concentrated in the middle portion. It was uncommon, with the maximum number collected at any individual site being five. The over-whelming majority of Warmouth were YOY. Only two harvestable-size fish were found (one each 6-inch and 7-inch classes), indicating that tributary streams function primary as a nursery area for Warmouth.

Lepomis macrochirus, Bluegill: We collected 406 Bluegill at 45 sites widely scattered over the system, making it the second most abundant sunfish in the survey. Generally <10 specimens were collected/site, but a notable exception was Deep Creek (site 269) where we took 89 Bluegill. YOY fish were collected at most sites, showing recruitment throughout the system in the sampled streams. Harvestable-size Bluegill (up to 7 inches) were collected at several sites, showing a sport fishery for this sunfish. Habitat characteristics of collection sites varied considerably. Bluegill is likely non-native to the James River basin.

Lepomis microlophus, Redear Sunfish: This introduced sunfish was very rare. We only collected three fish at two sites (Swift Creek, #194; and Deep Creek, #269), both relatively large tributaries. A major impoundment was located immediately upstream of the Swift Creek site, which could have been the source of the lone redear (3-inch fish) collected there. The Deep Creek sample yielded two 9-inch fish, indicating a very limited sport fishery for Redear Sunfish in the larger tributaries.

Micropterus dolomieu, Smallmouth Bass: We collected Smallmouth Bass (another introduced species) at eight sites, all but one concentrated in the upper system; the outlier was Deep Creek (site 269) in lower Amelia County. A total of 47 Smallmouth Bass was collected; these were up to 15 inches TL. Most specimens (76.5%) were taken from Rocky Run (site 253). Harvestable-size fish were collected in Deep Creek,

offering a sport fishery for Smallmouth Bass. Habitat at the collection sites was generally riffle/run with pools to depth 1 m; substrate was sand/gravel/cobble. Other habitat characteristics consistent at the sites included stream flow (generally slow), fish cover (generally fair to excellent) and water clarity (generally clear). The pH was slightly alkaline (7.1-7.4) at every site but one.

Micropterus punctulatus, Spotted Bass: We collected 52 specimens of Spotted Bass at six sites widely scattered over the system. The species was introduced by VDGF into the Appomattox system in 1976-78 with the following stockings: 4,104 fish on 21 September 1976, Appomattox County; 3,000 on 20 July 1977, Prince Edward County; and 3,990 on 18 July 1978, Prince Edward County. All stockings were YOY fish, generally 2-3.5 inches. The purpose of the stocking was to establish another sport fish in medium-size Piedmont streams which offer little sport fishery.

Spotted Bass was the most abundant “black bass” in the survey. Specimens ranged from 3-13 inches TL. The collection of harvestable-size fish shows a sport fishery for Spotted Bass was established in these tributary streams. YOY fish were collected at four sites, indicating recruitment. Spotted Bass were found with Largemouth Bass at one site (Deep Creek, #269) and with Smallmouth Bass at two sites (Harris Creek, #260; and Vaughn’s Creek, #261). Where co-existing with the other two *Micropterus* species, Spotted Bass was considerably the more abundant, outnumbering smallmouth bass 13 to 1 and 17 to 3 at those two sites, and largemouth bass 16 to 2. Not knowing the abundance of Smallmouth and Largemouth Bass in these streams prior to Spotted Bass introduction, one cannot say that Spotted Bass has displaced its congeners but it clearly appears that Spotted Bass are competing successfully in Appomattox tributaries. As with Smallmouth Bass, Spotted Bass were generally found in riffle/run habitat with pools to 1 m depth and a substrate of sand/gravel/cobble. Stream flow at every site was slow except for one which was moderate. We rated fish cover as fair at most sites but poor at two sites. The pH was very close to neutral, ranging from 6.9-7.3.

Micropterus salmoides, Largemouth Bass: Largemouth Bass, possibly non-native to the system, was found at nine sites scattered over the system but primarily in the lower portion. Only 14 specimens were taken which made it the least abundant “black bass” in the survey. Total lengths of the bass ranged from 3-9 inches with the 6-inch class being dominant. The presence of only subadult fish indicates that these tributary streams are basically nursery areas for Largemouth Bass. Habitat

characteristics at the collection sites varied considerably but stream flow (generally moderate), fish cover (generally fair) and water clarity (generally clear) were remarkably consistent. The pH ranged from 6.3-7.2, with about an equal number of acidic and alkaline sites.

Pomoxis annularis, White Crappie: We collected three specimens (7-10 inches TL) at one site on the Appomattox River (#270), which was only the second record for White Crappie in the Appomattox system; the other was from Lake Chesdin. White Crappie is an introduced species to East Coast drainages.

Pomoxis nigromaculatus, Black Crappie: Black Crappie was very rare in the survey; only seven fish were collected at three sites, all of which had an impoundment a short distance upstream as likely sources of these occurrences. Specimens ranged from 3-10 inches TL, indicating at least a limited sport fishery in the small streams below impoundments.

Family Percidae – Perches

Etheostoma flabellare, Fantail Darter: This Atlantic Slope member of the fantail darter complex was the second most abundant darter. We collected 452 fish at 43 sites widely scattered in the system but mostly in the upper half. The species was more abundant at upper system sites. The highest number (94 specimens) was collected at Crane Creek (site 257), this being related to the sampling method (rotenone) and survey length (76 m). Habitat characteristics consistent at the sites with the highest concentration of Fantail Darters included: riffle/run over sand/gravel/cobble substrate, mean stream depth 15 cm, almost complete forest cover, and a very narrow pH range (7.0-7.2). Other habitat characteristics were variable.

Etheostoma fusiforme, Swamp Darter: We found this species at 13 sites scattered over most of the system, with only the extreme upper portion excluded. It was uncommon; we collected 35 specimens and generally took <5 specimens/site. It was most abundant at site 197 (unnamed tributary of Surline Branch) in Chesterfield County, where eight specimens were taken. Habitat characteristics at this site included: very small stream (mean width, 1.8 m; mean depth, 15 cm); primarily riffle (with cobble substrate) but some pools; moderate flow; no aquatic vegetation; cover fair; clear water; neutral pH; and complete forest canopy.

Etheostoma longimanum, Longfin Darter: Another rare species in the survey, we collected 59 specimens at three sites, all in the extreme upper system. All but two

were taken at one site (South Fork Appomattox River, #252). Habitat characteristics at this site included: mean stream width and depth of 3.7 m and 15 cm; slow flow; excellent cover; clear water; specific conductance, 78 $\mu\text{s}/\text{cm}$; total hardness, 51 ppm; total alkalinity, 68 ppm; pH 7.2; and complete forest canopy. Our habitat notes for the site indicate the appearance of a mountain trout stream. The site yielded three other darters (Johnny, Stripeback, and Fantail), all of which were also abundant, indicating that it provides excellent habitat for upland darters. Water temperature at the site was relatively cool (23.0° C on July 9), due, at least in part, to the presence of a complete forest canopy. The other two sites harboring Longfin Darters also had complete forest canopy and relatively cool water (20.0° C at each site on August 13 and 14).

Etheostoma nigrum, Johnny Darter (or, *E. olmstedii*, Tessellated Darter): This taxonomically complex species was the most common darter in the survey. We collected a total of 1,653 specimens at 64 sites widely scattered in the system, including >50 specimens at 12 sites and >100 specimens at three sites. Habitat characteristics consistent at the sites where the Johnny Darter was most common included: relatively small stream (mean width, 1.2-3.7 m); slow flow; substrate of sand/pea gravel; and slightly alkaline pH (7.0-7.2). The relationship between the closely related *E. nigrum* and *E. olmstedii* remains incompletely resolved in Atlantic Slope drainages (Jenkins & Burkhead, 1994) and many populations may represent hybrid amalgamations of the two, including in the Appomattox system.

Etheostoma vitreum, Glassy Darter: The Glassy Darter was found at 13 sites scattered over the upper two-thirds of the system but mostly in the upper portion. Generally <5 specimens were collected/site; notable outliers to this were sites 262 (Sayler's Creek, Prince Edward Co.) and 269 (Deep Creek, Amelia Co.), yielding 31 and 75 Glassy Darters, respectively. Other than substrate (sand/gravel/cobble), fish cover (fair), and pH (6.9-7.2), there was little similarity in habitat between these two sites which are at almost opposite ends of the system.

Perca flavescens, Yellow Perch: Yellow Perch was very rare; eight specimens were collected at three sites, including two sites (#189 and #194) on Swift Creek and one (#206) on the North Branch of Nibbs Creek. The presence of Yellow Perch in Swift Creek is not unexpected because it joins the Appomattox River below any mainstem dam and near the confluence with the James River where Yellow Perch are common. Its occurrence as a single specimen (7-inch class) in Nibbs

Creek (above Lake Chesdin) shows that the species has not reproduced well above Brasfield Dam.

Percina notogramma, Stripeback Darter: This species was generally uncommon but was found at 30 sites widely scattered in the upper two-thirds of the system. Generally <5 specimens were encountered at each site; the higher counts were from sites 237 (Ellis Creek) and 252 (South Fork Appomattox River). Habitat characteristics at these sites were: riffle/run over substrate of sand/pea gravel/cobble, considerable fish cover, clear water, and slow flow. There was complete forest canopy at each site.

Percina peltata, Shield Darter: This darter was rare; we collected 29 specimens at four sites, two each in the upper and lower system. All but four specimens were taken at Deep Creek (site 269), the habitat characteristics of which were previously given.

DISCUSSION

We collected 17,210 fish representing 11 families, 35 genera, and 55 species. Species diversity per site ranged from 1 to 33, with 13 sites yielding at least 20 species. The richest sites were: Harris Creek (32 species, #260); Deep Creek (31 species, #269); Vaughn's Creek (26 species, #261), and Little Sayler's Creek (25 species, #262). The number of fish collected per site ranged from 1 to 1,273. Sites with the highest number of fish collected were: Rocky Run (1,273, #253), Deep Creek (993, #269), Poorhouse Creek (958, #258), and Harris Creek (793, #260).

Of the 55 species collected, forty-five (82%) are classified as native to the James River basin; one additional species (Warmouth) is regarded as native, but possibly introduced. Six species (Channel Catfish, Smallmouth Bass, Spotted Bass, Bluegill, White Crappie, and Redear Sunfish) are classified as introduced. Three additional species (Crescent Shiner, Blacktip Jumprock, and Largemouth Bass) are regarded as introduced, but possibly native in the James drainage. Crescent Shiner and Blacktip Jumprock are surely introduced in the Appomattox system. One species (Longfin Darter) is endemic to the James drainage. Stripeback Darter is endemic to the Atlantic slope from the Patuxent drainage in Maryland to the James drainage of Virginia (Jenkins & Burkhead, 1994). Three species are listed as Species of Greatest Conservation Need in Virginia – Bridle Shiner (Tier I), American Eel (Tier IV), and Mud Sunfish (Tier IV) (VDGIF, 2014).

Two new species records for the Appomattox system were encountered in this survey. These were

Mimic Shiner and Blacktip Jumprock. Two new site locations within the Appomattox system were documented for the Bridle Shiner, previously known from only seven sites. Expansion of the range for Crescent Shiner (previously known from only one site in the Appomattox system) was documented. We determined that Spotted Bass (introduced in 1976-78) has spread over the entire system and seems to have partially displaced both Largemouth and Smallmouth Bass as the dominant “black bass”.

The catadromous American Eel was the only diadromous species collected. No shad or herring were found, showing the effectiveness of dams (notably Harvell and Brasfield) in halting fish migration farther upstream. Any shad or herring which might have been impounded upstream of these dams apparently did not survive up to the time of our study. Both Blueback Herring (*Alosa aestivalis*) and Alewife (*A. pseudoharengus*) inhabit small streams typical of this survey, but neither was documented despite considerable sampling during the period corresponding to spawning seasons.

Additional species known from tributaries of the Appomattox River but not collected in this survey are *Notropis rubellus* (Rosyface Shiner) and *N. hudsonius* (Spottail Shiner) (R. E. Jenkins, pers. comm.). Rosyface Shiner is known from seven sites extending from just above Lake Chesdin to the Appomattox headwaters (Jenkins & Burkhead, 1994). Habitat preference of this species is typical of many sites sampled in this survey. Absence of the Rosyface Shiner in our survey is inexplicable. Spottail Shiner is known from three sites (each represented by a single specimen) in the extreme lower portion of the Appomattox system (Jenkins & Burkhead, 1994). The species' abundance in the Coastal Plain is considered usually uncommon or common; it is found chiefly in large rivers and estuaries. With the focus of this survey on small to medium-size tributaries, it is understandable that the Spottail Shiner could have been missed.

Twenty additional species (representing 16 genera and nine families) have been reported from the mainstem of the Appomattox River (Jenkins & Burkhead, 1994) but were not collected in this survey due to our focus on tributaries (only two collections were made on the mainstem).

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