

**CURRENT DISTRIBUTION,  
ABUNDANCE, AND HABITAT  
PREFERENCES OF THE STONECAT  
(NOTURUS FLAVUS) IN MARYLAND**



**CHESAPEAKE BAY AND  
WATERSHED PROGRAMS  
MONITORING AND  
NON-TIDAL ASSESSMENT  
CBWP-MANTA- EA-OO-7**



**Current Distribution, Abundance, and Habitat Preferences  
of the Stonecat (*Noturus flavus*) in Maryland**

**Prepared for:**

**Paul Kazyak  
Maryland Department of Natural Resources  
Monitoring and Non-Tidal Assessment Division  
Annapolis, Maryland**

**Prepared by:**

**Matthew J. Kline  
Raymond P. Morgan II**

**University of Maryland  
Center for Environmental Science  
Appalachian Laboratory  
Frostburg, Maryland**

**February 2000**



## **FOREWORD**

This report, *Current Distribution, Abundance, and Habitat Preferences of the Stonecat (Noturus flavus) in Maryland*, is submitted to Mr. Paul Kazyak, Monitoring and Non-Tidal Assessment Division, Maryland Department of Natural Resources (DNR) in partial fulfillment of contract #: MA98-002-003 to Dr. Raymond P. Morgan II, Appalachian Laboratory (AL), University of Maryland, Center for Environmental Science, Frostburg, Maryland. The purpose of this project was to determine the current geographic range, abundance, and habitat preferences of stonecat in Maryland.

## **ACKNOWLEDGEMENTS**

We acknowledge William Marsh, Derek Wiley, Jay Kilian, Amy Hall, Frank Butera, Sandy Davis, and David Kazyak for long hours spent collecting stonecat and habitat data. We also thank Dr. Ed Pendleton (USGS) and Dr. Ron Klauda (MDNR) for review and constructive comments of this report.

## ABSTRACT

During 1995-97, the Maryland Biological Stream Survey (MBSS) collected data over the entire state and identified physical, chemical, and biological conditions at various spatial scales. These data include the presence of rare fish species within a particular river basin. One of the fish species collected by the MBSS at only two sample site locations was the stonecat (*Noturus flavus*). This project was conducted during Summer 1999 to determine (1) the geographic range of the stonecat in Maryland and (2) an estimate of stonecat abundance within their current range in Maryland.

Qualitative fish sampling was conducted throughout the 4<sup>th</sup>-order reaches of the Casselman River in Maryland, upstream into tributaries flowing directly into the 4<sup>th</sup>-order reaches of the Casselman River, and upstream into the 3<sup>rd</sup>-order reaches of the North and South Branches of the Casselman River. Approximately 3 kilometers of the Youghiogheny River upstream of the Youghiogheny River Lake was also sampled. In addition, quantitative fish collections were conducted at nearly equidistant locations throughout the 4<sup>th</sup> order reaches of the Casselman River in Maryland. Forty-six stonecat were collected while qualitative electrofishing and 61 stonecat were collected at the 20 quantitative sample sites.

Habitat selection, including water depth, mean velocity, velocity along the substrate, fastest velocity within one meter, dominant substrate type, sub-dominant substrate type, and largest boulder within one meter, were measured and recorded at 46 locations where an individual stonecat was collected. We found that stonecat prefer slow to moderate riffle/run areas that are less than 30 cm deep. Stonecat are also found near large boulders and prefer boulder and large cobble substrate.

We estimate that a population of approximately 660 stonecat are present in the 4<sup>th</sup> order reaches of the Casselman River in Maryland. While no other populations of stonecat are known to exist in Maryland, this population extends downstream into the Pennsylvania portion of the Casselman River.

## INTRODUCTION

The Maryland Biological Stream Survey (MBSS) was initiated as a pilot study in 1993 to provide information on the acid deposition effects and other anthropogenic stresses on the biota of Maryland streams. During 1995-97, the MBSS collected data over the entire state and identified physical, chemical, and biological conditions at various spatial scales. These data include the presence of rare fish species within a particular river basin. One of the fish species collected by the MBSS at only two sample site locations was the stonecat (*Noturus flavus*). The stonecat is listed as highly rare and in need of conservation by the Maryland Department of Natural Resources (MDNR 1997). This project was conducted to determine (1) the geographic range of the stonecat in Maryland and (2) an estimate of stonecat abundance within their current range in Maryland.

The stonecat is a member of the catfish family (Ictaluridae) and the genus *Noturus*. The fish species that make up the *Noturus* genus are commonly referred to as madtoms. Madtoms, like other catfish, are opportunistic feeders that consume invertebrates, small fish, and they will scavenge. Madtoms typically scavenge and feed nocturnally (Etnier and Starnes 1993).

The stonecat is native to the Mississippi River, Great Lakes, and Hudson Bay drainages (Jenkins and Burkhead 1993) and is the largest, longest lived, and latest to mature of all madtoms (Walsh and Burr 1985). Stonecat prefer medium to large warmwater streams and rivers of moderate gradient in Virginia (Jenkins and Burkhead 1993), Tennessee (Etnier and Starnes 1993), Ohio (Trautman 1981), and Canada (Scott and Crossman 1973). Stonecat are also found along gravel shorelines of Lake Erie (Trautman 1981) and in some lakes in Canada (Scott and Crossman 1973) where wave induced currents produce stream like conditions.

Stonecat prefer silt-free gravel, boulder, and bedrock areas of riffles and runs. This species seems to be intolerant of fast currents present in high gradient streams and silt bottomed low gradient streams (Trautman 1981). Johnson (1965) found that this species disappears from impounded streams.

Specimens collected from Ohio (Trautman 1981), Tennessee (Etnier and Starnes 1993), and Virginia (Jenkins and Burkhead (1993) ranged from 56 to 313 mm (total length). Stonecat reach sexual maturity at 3 or 4 years. Males reach sexual maturity at about 90 mm and females at about 100 mm. Spawning occurs from April to August when water temperatures reach 25°C (Walsh and Burr 1985). Scott and Crossman (1973) found that peak spawning temperature in Canada was 27.8°C. Females produce up to 1200 eggs per year and the male typically guards the nest (Walsh and Burr 1985).

In Maryland, stonecat is restricted to the Youghiogheny basin, an area that has historically experienced detrimental effects from coal mining practices. Mining began in the 1800's and peaked during the early 1900's (Hendricks 1980). Reppert (1964) considered the Youghiogheny River to be completely lifeless because of impacts from mining activities. An estimated 2100 acres of land and 182 stream miles in the

Youghiogheny basin have been disturbed by mining practices (MDNR 1973). However, there are currently no working coal mining operations in the basin in Maryland (MDE 1998). Since 1950, water quality has been improving in the Youghiogheny River basin in Maryland due to decreased coal production, water quality law enforcement, and abandoned mine reclamation projects.

The Casselman River, downstream of Maryland in Pennsylvania, has been experiencing the effects of more recent acid mine drainage inputs. In 1993, acid mine drainage inputs from Coal Run and Shaw Mines Run killed all aquatic life throughout the Casselman River from Coal Run downstream to the Youghiogheny River (Figure 1) (Smith and Lorson 1999).

Historically, stonecat were found in the mainstem Youghiogheny River, although it is unclear from published sources if they were ever found in the Maryland portion of the river. Stonecat were first collected in the Youghiogheny River in Pennsylvania by Cope (1865). Hendricks (1980) sampled 172 sites throughout the Youghiogheny River basin in West Virginia, Maryland, and Pennsylvania. Hendricks (1980) collected stonecat at only seven sample sites in the Casselman River and at two sites in Laurel Hill Creek, which is a tributary to the Youghiogheny River, downstream of the Youghiogheny River Lake (Figure 1). The Pennsylvania Fish and Boat Commission sampled seven sites along the Casselman River in 1979, 1990, and 1998. The uppermost site was located 9.2 km downstream of the Maryland/Pennsylvania border. Stonecat were collected at this site in 1979 and 1990 and at a site 13.6 km downstream of the Maryland/Pennsylvania border in 1998. Stonecat were also collected at the furthest downstream site in 1998, which was located 5.5 km upstream of the confluence with the Youghiogheny River (Figure 1) (Smith and Lorson 1999). The Pennsylvania Fish and Boat Commission did not sample in the Maryland portion of the Casselman River.

## **METHODS**

### **Fish Survey**

During 1999, qualitative fish sampling was conducted throughout the 4<sup>th</sup>-order reaches of the Casselman River in Maryland, upstream into tributaries flowing directly into the 4<sup>th</sup>-order reaches of the Casselman River, and upstream into the 3<sup>rd</sup>-order reaches of the North and South Branches of the Casselman River. Approximately 3 kilometers of the Youghiogheny River upstream of the Youghiogheny River Lake was also sampled (Figure 2). Qualitative fish sampling was conducted by three personnel. One person was outfitted with a backpack electrofisher and two personnel were present to capture any observed stonecat using dipnets. All available habitats were sampled and all locations where stonecat were captured were marked.

In addition, quantitative fish collections were conducted at 20 sample sites along the 4<sup>th</sup> order reaches of the Casselman River and five additional sites were sampled throughout the North Branch of the Casselman River. The 20 sample site locations along the fourth order reaches of the Casselman River were located at regular intervals from the Maryland/Pennsylvania border upstream to the confluence of the north and south

branches of the Casselman River (Figure 3). Quantitative fish collections were conducted using Maryland Biological Stream Survey fish sampling protocols outlined by Kazyak (1996), except that fish species other than stonecat were not counted and a third electrofishing pass was conducted. Population estimates were calculated using the Zippin method (Zippen 1956).

MBSS quantitative sampling is conducted throughout a 75 m sample segment. Blocknets are used to prevent fish movement into and out of the sample segment and enough anodes are used so a continuous field of electricity is present across the entire wide of the stream. Every fish that is observed during each of two electrofishing passes are collected, weighed, sorted into species, and counted.

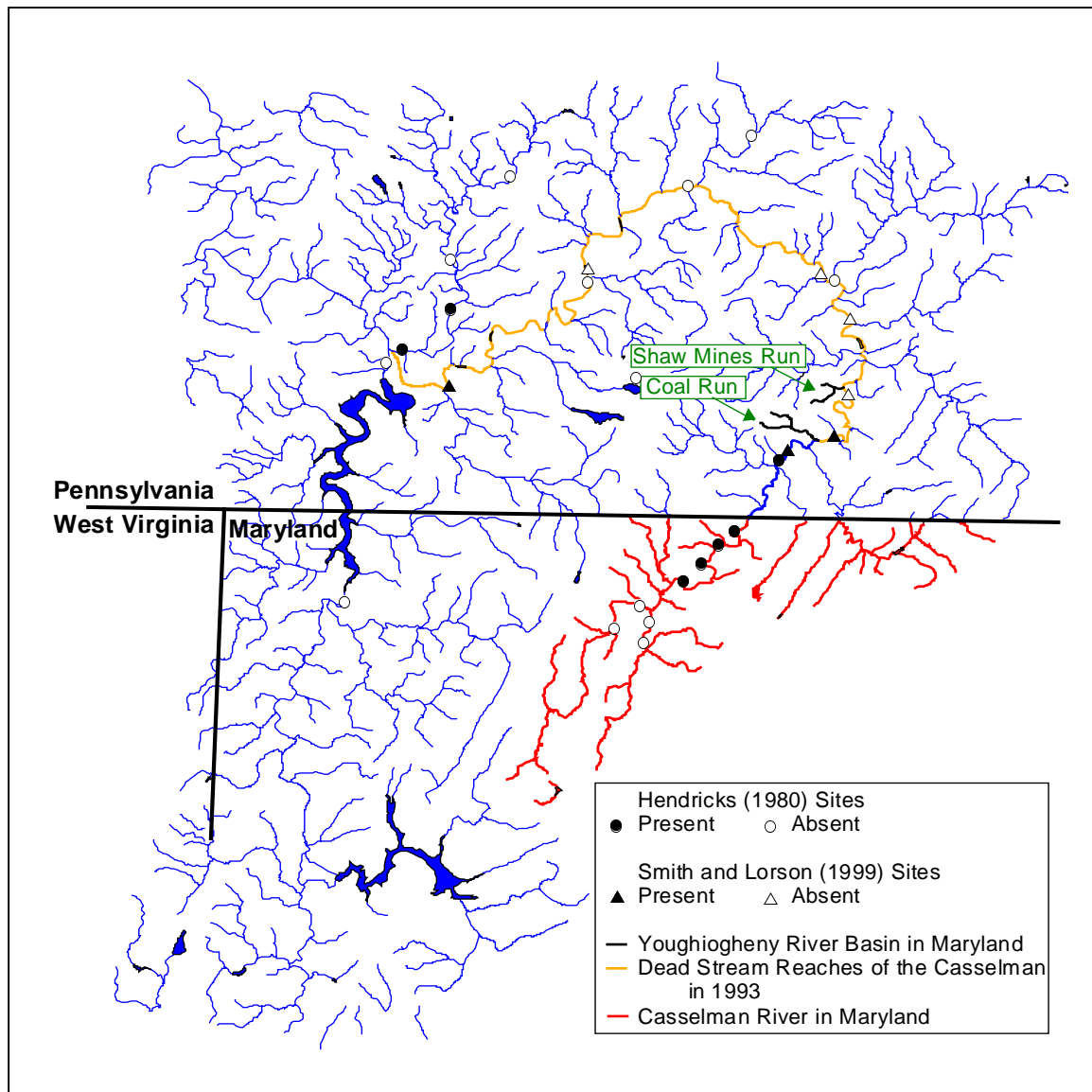


Figure 1. Locations sampled by Hendricks (1980) and the PA DEP (Smith and Lorson 1999) in the Youghiogheny River and Casselman River watersheds.



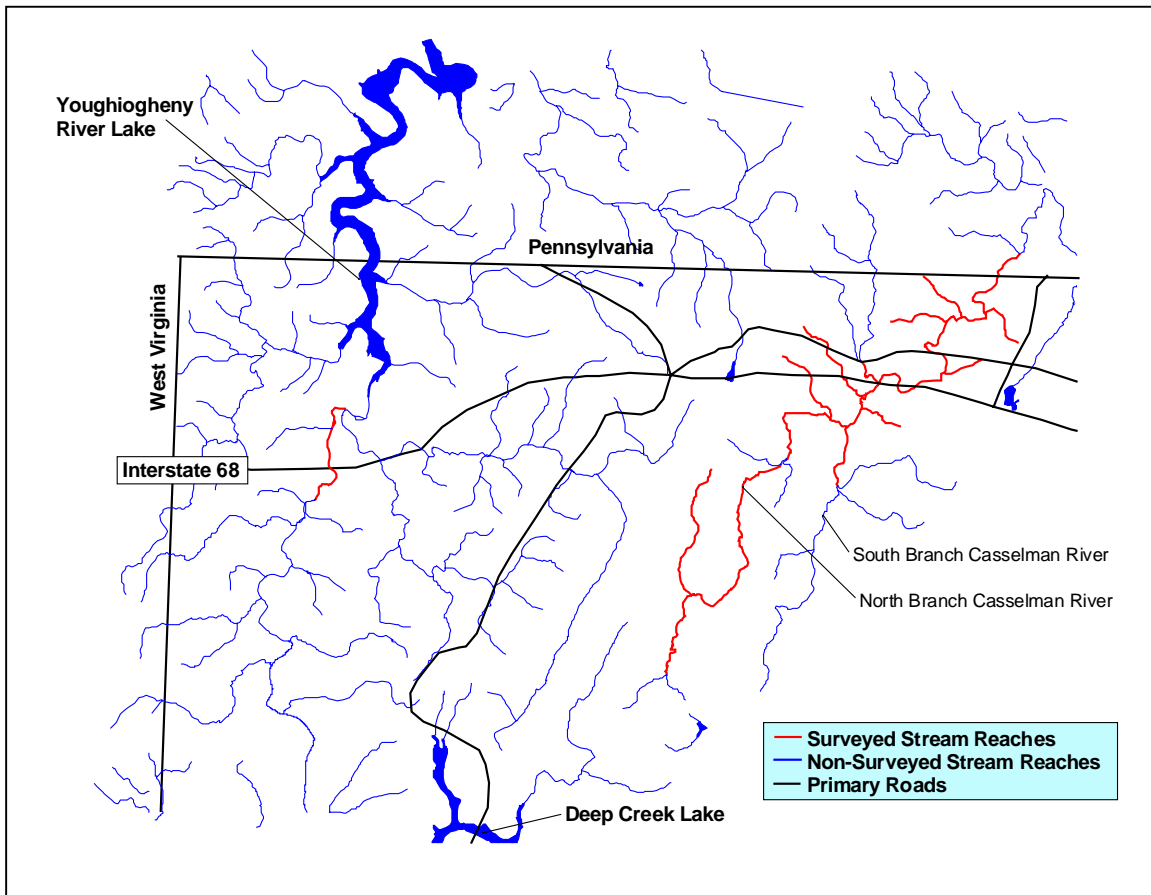


Figure 2. Study area and sampled stream reaches along the Youghiogheny River above the Youghiogheny River Lake and within the Casselman River watershed in 1999.

### Physical Habitat

After qualitative electrofishing was completed, habitat selection, including water depth, mean velocity, velocity along the substrate, fastest velocity within one meter, dominant substrate type, sub-dominant substrate type, and largest boulder within one meter, were measured and recorded at all 46 locations where an individual stonecat was collected (Figure 4). Dominant and sub-dominant substrate types were determined by visual estimation. MBSS habitat data (Kazyak 1996) was collected at each of the 25 quantitative sample site locations.

### Temperature

Temperature loggers were deployed at seven locations throughout the Casselman River drainage (Figure 3) during May 1999 and were recovered in September 1999. Loggers were set to record hourly water temperatures from 15 June to 15 September.

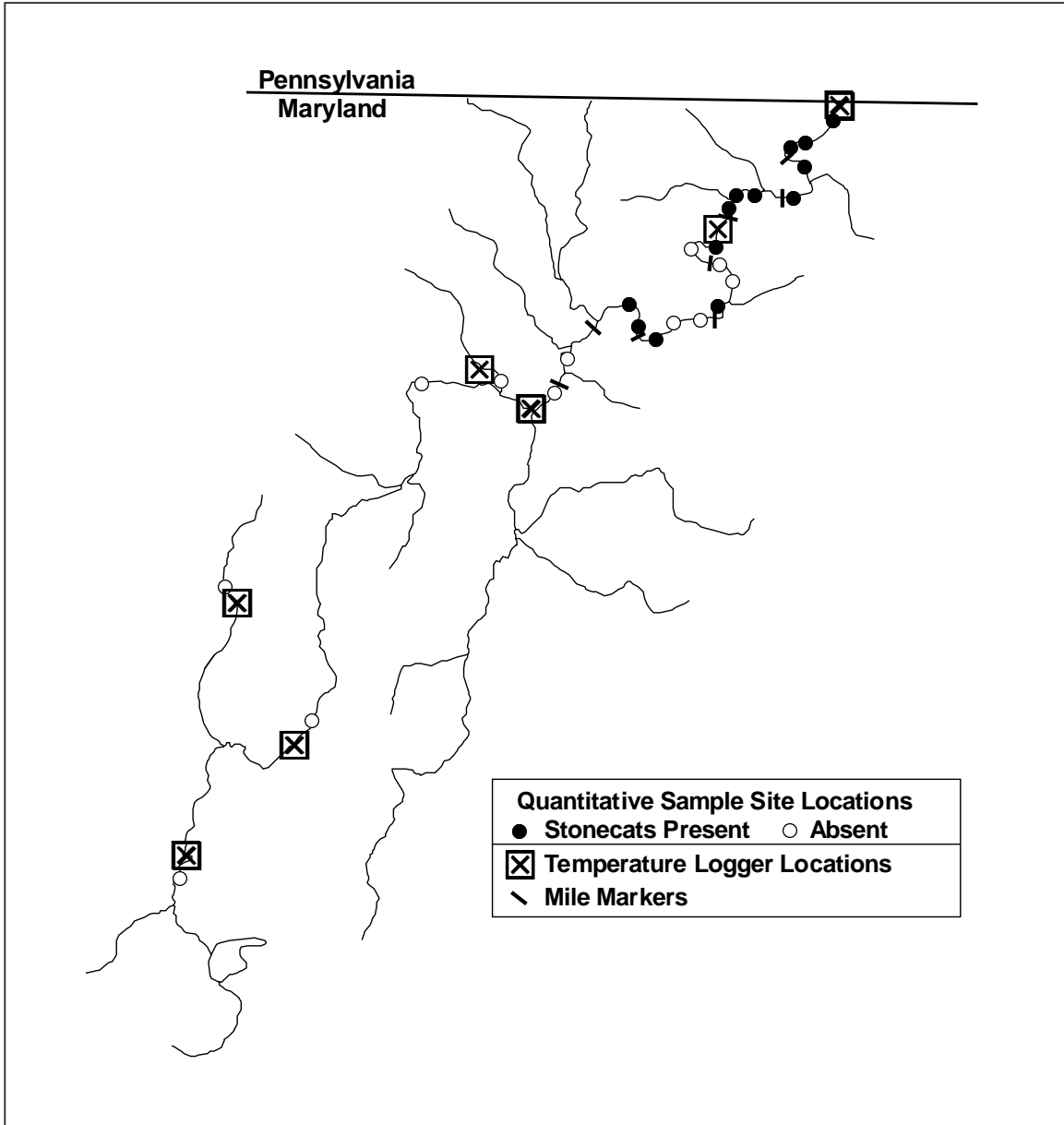


Figure 3. Locations of quantitative sample sites and temperature loggers within the Casselman River watershed in 1999.

## RESULTS

### Qualitative Results

Forty-six stonecat were collected along the fourth order reaches of the Casselman River using qualitative electrofishing (Figure 4). Table 1 lists habitat data that were collected at each of the 46 locations. Stonecat were most likely to be caught in areas that had moderate depth (10-30 cm), slow velocities (< 0.2 m/sec), and cobble/boulder substrates.

Stonecat were collected at depths ranging from 5 to 42 cm and the mean depth was 19.2 cm (Figure 5). Velocities along the substrate (bottom velocity) at locations where stonecat were collected ranged from 0.00 to 0.38 m/sec. The mean velocity along the substrate was 0.07 m/sec (Figure 6). The fastest velocity measured within one meter of the locations where stonecat were collected ranged from 0.03 to 0.59 m/sec and the mean fastest velocity within one meter was 0.18 m/sec (Figure 7). Stonecat were found within one meter of boulders that ranged from 0.34 to 3.43 meters in diameter and the mean for the largest boulder within one meter was 0.98 meters in diameter (Figure 8). Mean velocities (measured at 0.6 depth) ranged from 0.00 to 0.38 m<sup>3</sup>/sec and the overall mean velocity was 0.11 m<sup>3</sup>/sec (Figure 9).

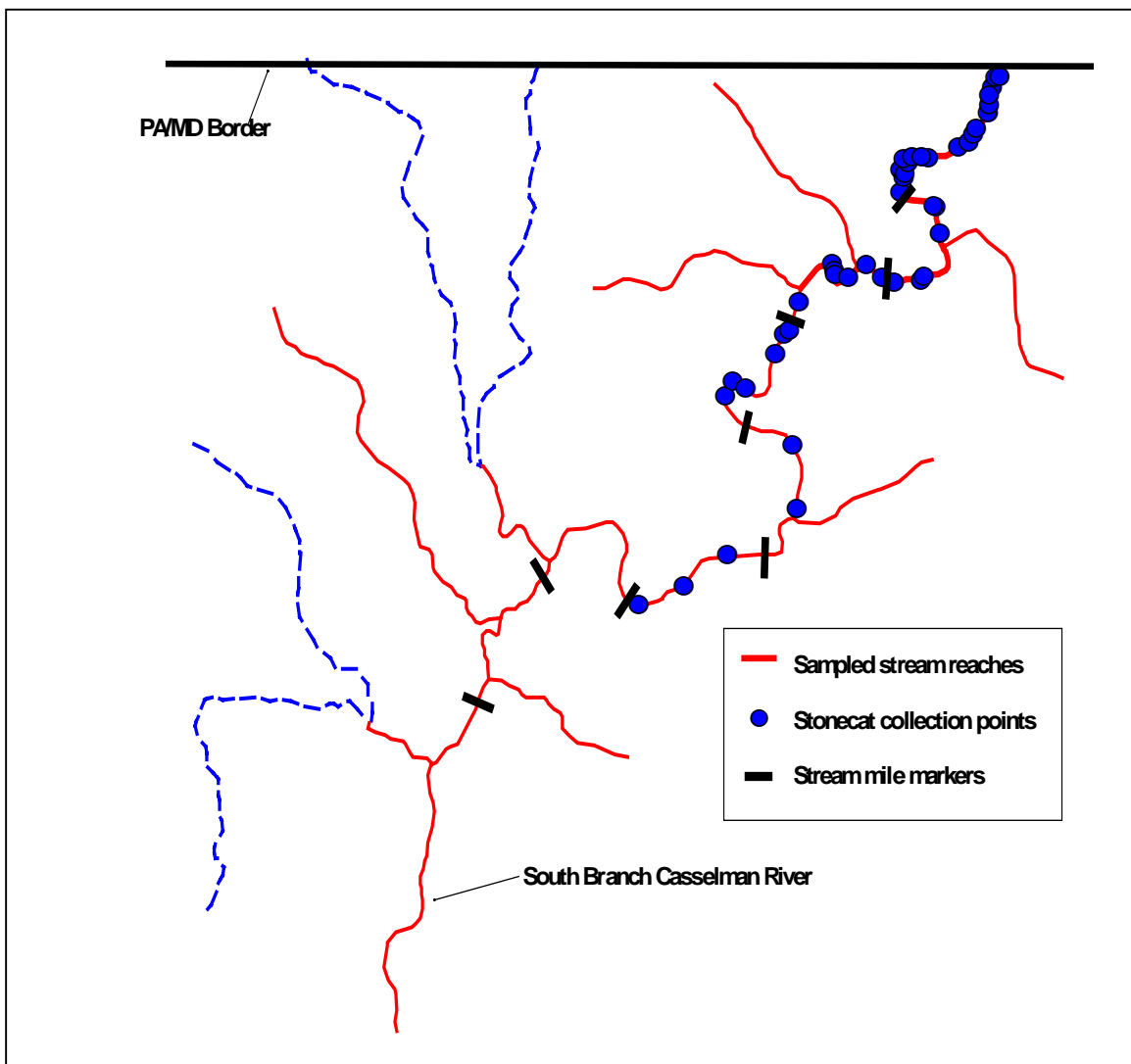


Figure 4. Locations where Stonecat were collected in 1999 using qualitative electrofishing methods (Kazyak 1996).

Table 1. Habitat data collected at each of the 46 locations where stonecat were collected using qualitative electrofishing methods (Kazyak 1996).

<b>Depth (cm)</b>	<b>Bottom Velocity (m/sec)</b>	<b>Mean Velocity (m/sec)</b>	<b>Fastest w/in 1-m (m/sec)</b>	<b>Largest Boulder (m)</b>	<b>Dominant Substrate</b>	<b>Sub-Dominant Substrate</b>
5	0.38	0.38	0.59	1.48	Cobble	Boulder
6	0.05	0.05	0.08	0.56	Smooth Bedrock	Cobble
10	0.01	0.01	0.04	0.95	Cobble	Boulder
10	0.08	0.08	0.09	0.63	Cobble	Boulder
10	0.03	0.03	0.17	1.12	Boulder	Smooth Bedrock
10	0.00	0.02	0.22	0.44	Cobble	Boulder
10	0.13	0.13	0.23	0.93	Cobble	Boulder
11	0.07	0.11	0.15	1.43	Boulder	Cobble
12	0.01	0.01	0.03	0.90	Cobble	Boulder
12	0.00	0.02	0.04	0.54	Cobble	Boulder
12	0.10	0.13	0.13	0.76	Boulder	Cobble
12	0.02	0.03	0.15	0.75	Cobble	Boulder
13	0.11	0.11	0.13	0.82	Boulder	Cobble
14	0.03	0.07	0.12	0.71	Boulder	Cobble
14	0.10	0.16	0.22	0.34	Cobble	Boulder
15	0.16	0.18	0.23	3.26	Cobble	Boulder
16	0.00	0.05	0.05	1.10	Cobble	Boulder
16	0.05	0.12	0.12	0.47	Cobble	Boulder
16	0.09	0.13	0.19	0.47	Cobble	Boulder
18	0.02	0.03	0.03	0.46	Cobble	Boulder
18	0.09	0.16	0.16	0.88	Cobble	Boulder
18	0.03	0.23	0.23	0.88	Cobble	Cobble
18	0.15	0.25	0.23	1.42	Cobble	Boulder
19	0.01	0.01	0.05	0.87	Cobble	Boulder
20	0.07	0.10	0.11	1.22	Cobble	Boulder
20	0.13	0.16	0.16	0.73	Cobble	Boulder
20	0.17	0.27	0.27	0.40	Cobble	Boulder
20	0.14	0.23	0.51	0.78	Cobble	Boulder
20	0.11	0.28	0.54	0.76	Cobble	Boulder
21	0.13	0.15	0.15	0.70	Boulder	Cobble
22	0.04	0.09	0.11	1.31	Boulder	Cobble
22	0.07	0.11	0.11	0.87	Cobble	Boulder
22	0.11	0.13	0.23	0.70	Boulder	Gravel
22	0.02	0.07	0.31	1.40	Cobble	Boulder
22	0.00	0.00	0.33	3.43	Boulder	Cobble
24	0.05	0.06	0.06	1.04	Sand	Boulder
25	0.01	0.01	0.11	0.78	Cobble	Boulder
26	0.01	0.03	0.03	1.42	Boulder	Cobble
26	0.03	0.12	0.28	1.06	Boulder	Cobble
28	0.01	0.02	0.03	1.12	Cobble	Boulder
30	0.05	0.20	0.26	1.22	Boulder	Cobble
30	0.10	0.13	0.27	2.02	Boulder	Cobble
32	0.04	0.10	0.10	0.48	Cobble	Boulder
34	0.19	0.25	0.31	0.62	Boulder	Cobble
42	0.03	0.07	0.07	0.66	Boulder	Cobble
42	0.05	0.10	0.10	0.51	Boulder	Cobble

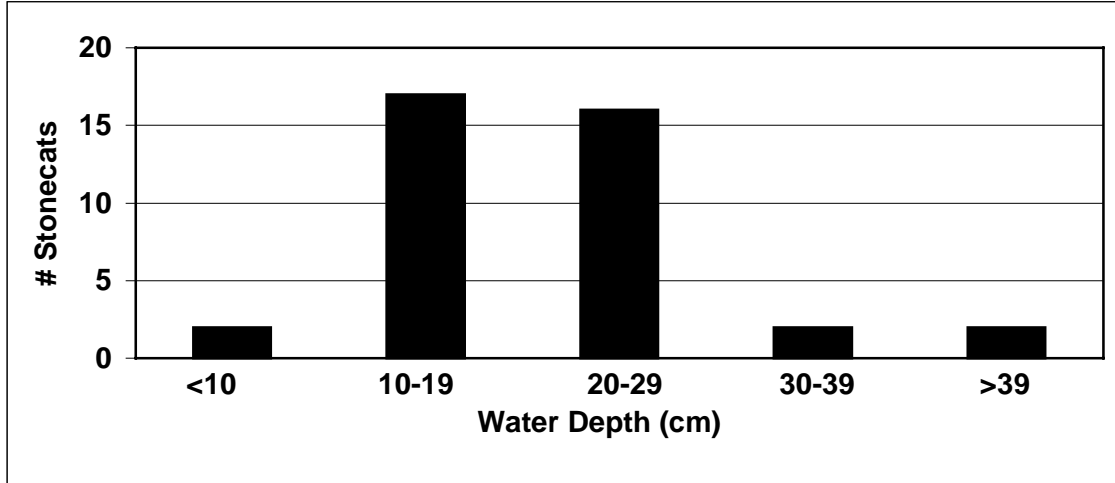


Figure 5. Water depth at stonecat collection locations.

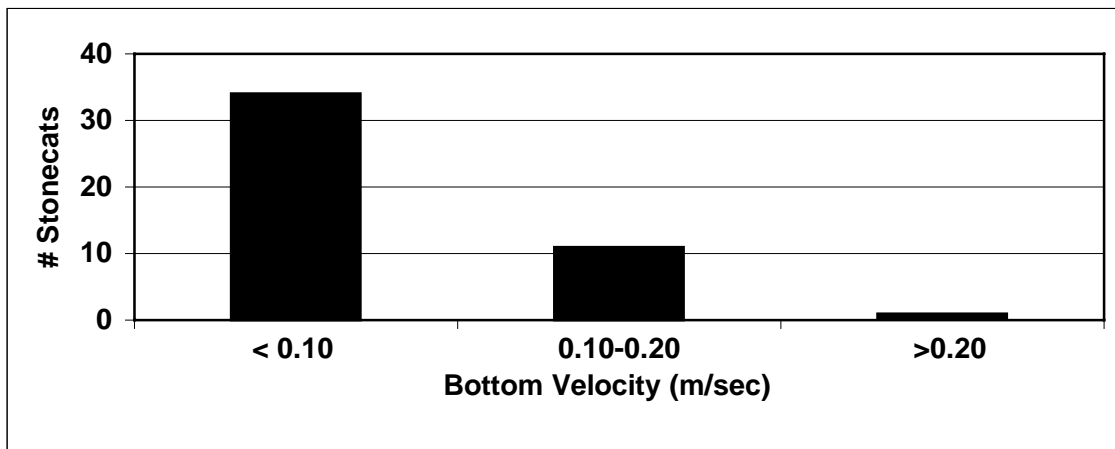


Figure 6. Velocity along the substrate at stonecat collection locations.

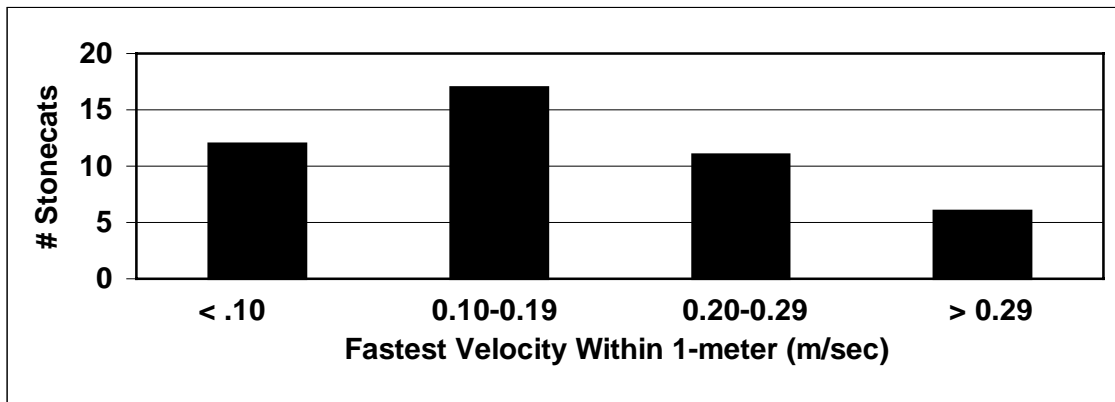


Figure 7. Fastest velocity (m/sec) within one meter of stonecat collection locations

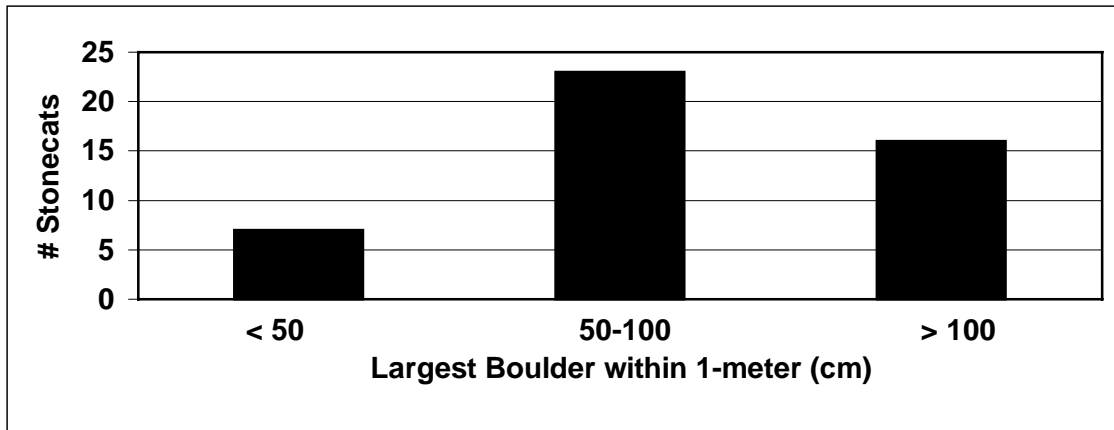


Figure 8. Largest boulder within one meter of stonecat collection locations.

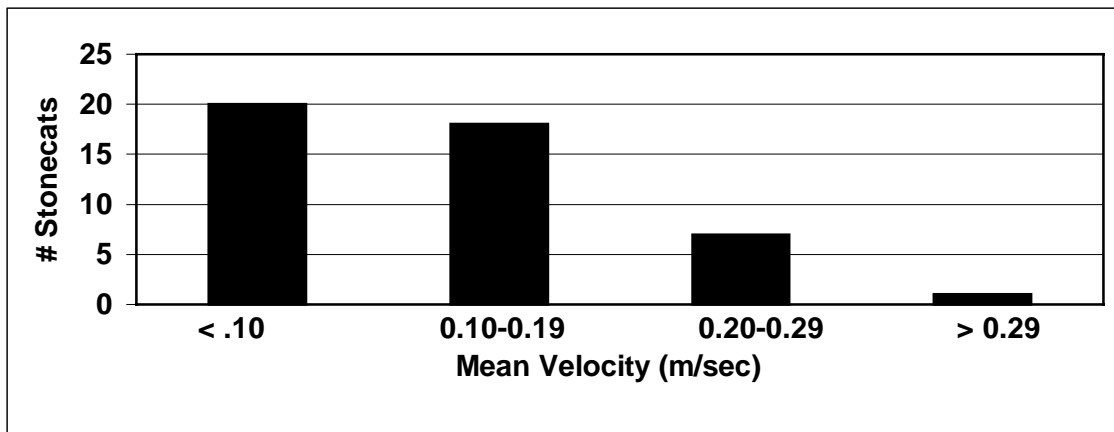


Figure 9. Mean water column velocity at stonecat collection locations.

## Quantitative Results

Stonecat were collected at 14 of the 25 quantitative sample sites (Figure 3). Table 2 lists the number of stonecat collected during each electrofishing pass and the population estimate for each sample site. Sixty-four stonecat were collected at 14 quantitative sites along the 4<sup>th</sup> order reaches of the Casselman River. Population estimates ranged from 0 to 18 for the 75 meter sample segments.

Sixty-four stonecat were collected at the quantitative sample sites. Sixty-three of the stonecat were measured (Total Length) and weighed (Table 3). The one stonecat that was not weighed or measured escaped during fish processing. Only four stonecat were collected that had total lengths less than 100 mm and only five stonecat were collected that had total lengths greater than 150 mm (Figure 10).

MBSS habitat data that was collected at each of the quantitative sample sites is listed in Table 4. Sites are listed from downstream to upstream.

Table 2. Number of stonecat collected during each electrofishing pass, population estimates, and standard errors for 25 quantitative sites in the Casselman River basin.

Site #					Standard	Site #					Standard
	1st Pass	2nd Pass	3rd Pass	Pop. Est.	Error		1st Pass	2nd Pass	3rd Pass	Pop. Est.	Error
1	1	1	0	2	0.384	14	0	0		0	N/A
2	8	1	0	9	0.099	15	0	0		0	N/A
3	7	7	2	18	3.400	16	1	0		1	0.0
4	7	3	0	10	0.419	17	1	0		1	0.0
5	2	2	1	5	1.189	18	1	0		1	0.0
6	3	2	0	5	0.444	19	0	0		0	N/A
7	9	2	0	11	0.218	20	0	0		0	N/A
8	1	0		1	0.000	21	0	0		0	N/A
9	1	0		1	0.000	22	0	0		0	N/A
10	0	0		0	N/A	23	0	0		0	N/A
11	0	0		0	N/A	24	0	0		0	N/A
12	0	0		0	N/A	25	0	0		0	N/A
13	1	0		1	0.000						

Table 3. Length and weight data for 63 stonecat collected at quantitative sample sites in the Casselman River basin.

Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)
68	4	113	11	119	14	129	17
72	4	113	11	119	16	130	18
77	4	114	13	120	15	130	20
82	5	115	12	120	17	131	23
102	8	115	14	120	16	132	24
105	12	115	12	120	17	133	24
106	10	115	14	120	17	134	21
107	15	117	13	121	14	136	24
108	11	117	14	121	17	141	29
110	12	117	14	123	18	148	39
110	11	118	14	123	17	172	42
111	13	118	16	124	18	179	42
111	8	118	16	125	14	210	95
111	12	119	16	126	16	212	82
112	14	119	12	126	18	221	99
112	18	119	15	129	18		

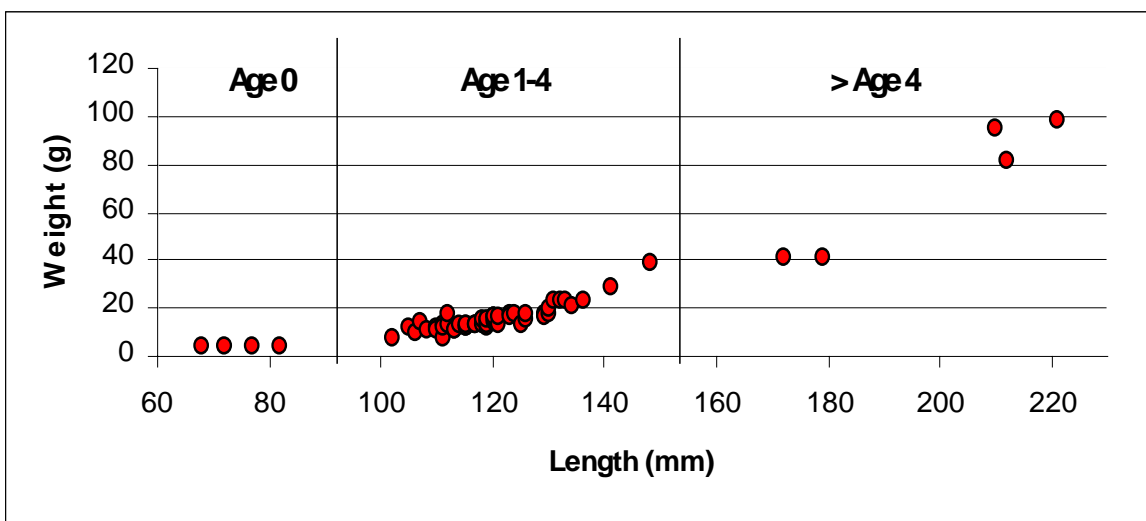


Figure 10. Length and weight data from 63 stonecat collected at quantitative sites within the Casselman River basin. Age classes are approximate based on data from Walsh and Burr (1985).

### Temperature

Three temperature loggers were deployed within the 4<sup>th</sup> order reaches of the Casselman River. The logger that was deployed 400 m upstream of the Maryland border was not recovered. The logger that was deployed 3.5 miles upstream of the Maryland border did not record data for an unknown reason. The third temperature logger, which was deployed 100 m downstream of the confluence of the North and South Branches of the Casselman River, was dewatered during part of the deployment period because of extremely low summer flows present throughout much of the summer 1999 (Figure 11). Temperature from a tributary to the North Branch Casselman River is also plotted on Figure 11 (pink). These data show that the maximum summer water temperature in small streams in this area is between 20 and 25°C. The maximum temperature recorded in this tributary was 23.8°C.

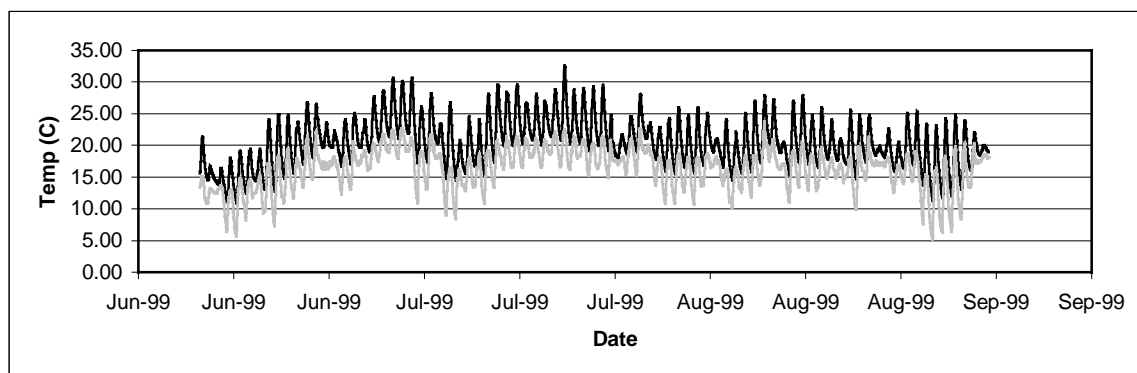


Figure 11. Temperature data from two streams within the Casselman River watershed. Data from a small tributary is the dark solid line and data from the 4<sup>th</sup> order reach is light dashed line.



Table 4. Physical habitat data collected at quantitative sample sites in the Casselman River basin. Grey rows are sites where at least one stonecat was collected. \*-(O) Optimal, (S) Sub-Optimal, (M) Marginal, and (P) Poor.

Site #	Stream Order	Instream Habitat*	Epifaunal Substrate*	Velocity/Depth Diversity*	Pool Quality*	Riffle Quality*	Channel Alteration*	Bank Stability*	Embeddedness (%)	Channel Flow Status (% of bankfull)	Shading (%)	Buffer Zone Width (m)	Remoteness*	Aesthetic Rating*	Maximum Depth (cm)	Average Wetted Width (m)	Average Thalweg Depth (cm)	Average Thalweg Velocity (m <sup>3</sup> /sec)	Stream Gradient (%)	Straight Line Distance (m)	# Woody Debris	# Rootwads	Maryland Physical Habitat Index (MPHI)
1	4	O	O	S	O	O	O	S	35	98	40	5	P	S	82	16.2	43	0.18	1.00	75	2	0	42.1
2	4	O	O	S	O	O	S	O	30	95	25	15	P	O	66	15.9	35	0.23	2.00	75	0	0	44.3
3	4	O	M	S	O	P	O	O	00	95	30	8	P	O	53	20.6	37	0.16	1.00	75	0	0	43.9
4	4	O	O	M	O	O	S	O	30	90	30	20	P	S	48	20.1	37	0.22	1.00	75	0	0	39.9
5	4	O	O	M	O	O	O	S	20	98	45	50	P	S	48	16.3	31	0.27	1.50	75	7	2	52.6
6	4	O	O	M	O	O	O	O	25	85	40	50	P	O	38	18.6	22	0.18	1.00	75	0	0	46.2
7	4	O	O	M	O	O	O	O	20	90	40	10	P	O	43	17.0	18	0.20	1.50	75	0	0	47.6
8	4	O	S	S	O	M	O	O	35	90	35	10	P	S	57	20.6	31	0.14	1.00	75	0	0	31.7
9	4	O	O	M	O	O	O	O	35	95	20	3	P	O	40	15.6	25	0.19	1.50	75	0	0	40.5
10	4	O	M	S	O	S	M	O	45	85	45	0	P	P	103	14.0	44	0.07	1.00	75	0	0	29.2
11	4	S	S	M	M	S	S	O	35	80	15	0	P	S	34	18.8	17	0.19	1.50	75	0	0	24.6
12	4	S	S	M	S	S	O	O	30	80	30	50	M	O	30	00.2	21	0.12	1.50	75	0	0	33.0
13	4	0	M	M	O	M	O	O	35	70	50	0	S	O	42	14.4	31	0.12	1.00	75	0	0	32.0
14	4	0	S	P	M	M	O	S	30	90	20	50	S	O	34	20.9	17	0.06	1.00	75	0	0	26.1
15	4	0	M	S	O	S	O	O	35	70	60	50	S	O	64	11.0	29	0.15	1.50	75	0	0	43.3
16	4	0	M	S	O	M	O	S	40	90	30	50	S	O	51	16.3	35	0.05	1.00	75	0	0	33.0
17	4	0	S	M	S	S	O	M	45	80	60	50	S	O	50	17.6	30	0.06	1.00	75	0	0	25.3
18	4	0	S	S	O	S	O	M	20	85	60	50	S	O	72	15.3	28	0.12	0.50	75	0	0	48.9
19	4	S	O	S	O	M	M	S	15	60	20	50	P	O	56	07.6	27	0.07	0.50	73	0	0	41.3
20	4	S	O	M	M	S	S	S	15	15	10	50	P	O	31	09.8	16	0.09	0.50	75	0	1	40.1
21	2	O	O	M	S	S	M	M	15	65	95	9	M	S	22	02.8	8.5	0.08	3.00	65	3	2	45.4
22	3	O	O	O	O	O	O	O	30	65	70	50	O	O	56	12.5	33	0.19	3.00	72	2	0	51.8
23	3	S	P	S	O	S	P	P	60	85	35	0	S	O	150	07.1	77	0.06	0.50	73	14	0	23.0
24	2	O	O	S	O	O	M	O	35	95	90	50	S	O	65	05.7	19	0.16	1.00	71	1	1	43.3
25	1	O	M	S	O	O	M	S	40	85	95	23	P	O	54	04.2	21	0.11	2.00	73	5	1	40.7

## DISCUSSION

No stonecat were collected from any of the smaller (1<sup>st</sup>-3<sup>rd</sup> order) tributaries of the Casselman River. Water temperatures are typically cold (< 22°C) and gradient is usually moderate to high in small streams in this area. Stonecat prefer low gradient and warmwater streams (Trautman 1981, Jenkins and Burkhead 1993) and therefore, are probably limited to inhabiting the 4<sup>th</sup> order reaches of the Casselman River.

Stonecat were collected from the lower 7 miles of the 4<sup>th</sup> order reaches of the Casselman River (Figures 3 and 4). Figure 12 shows the number of stonecat collected (qualitative and quantitative collections combined) throughout each mile of 4<sup>th</sup> order reaches of the river. Stonecat abundance was highest in the downstream three miles of the Casselman River in Maryland and steadily decreased upstream. No stonecat were collected from the upstream 1.5 miles of 4<sup>th</sup> order river. We calculated population estimates for the twenty quantitative sites that were sampled along the 4<sup>th</sup> order reaches of the Casselman River in Maryland. Sixty-six fish were present within the 20 quantitative sites, which represent approximately 10% of the total length of the 4<sup>th</sup> order portion of the river and therefore, we estimate that the Maryland population of stonecat consists of approximately 660 individuals.

The 8.5 miles of 4<sup>th</sup> order river can be divided into four sections based on overall stonecat habitat quantity and quality. The lower 2 miles of the river are mostly riffle/run areas of moderate depth (0.2-0.5 m), with predominantly boulder/cobble substrate, which is typical of the preferred habitat of stonecat. River miles three and four are wide, mostly shallow riffle/run areas (0.1-0.2 m), and cobble/boulder substrate. River miles five and six are similar to river miles one and two, exhibiting the preferred habitat of stonecat. The upper 2.5 miles are a mix of narrow/deep pool/glide areas with soft substrates and wider, very shallow riffle/run areas with predominantly cobble/gravel substrates. No stonecat were collected in the upper two miles of the river, possibly due to the lack of suitable habitat present and also possibly due to colder water temperatures.

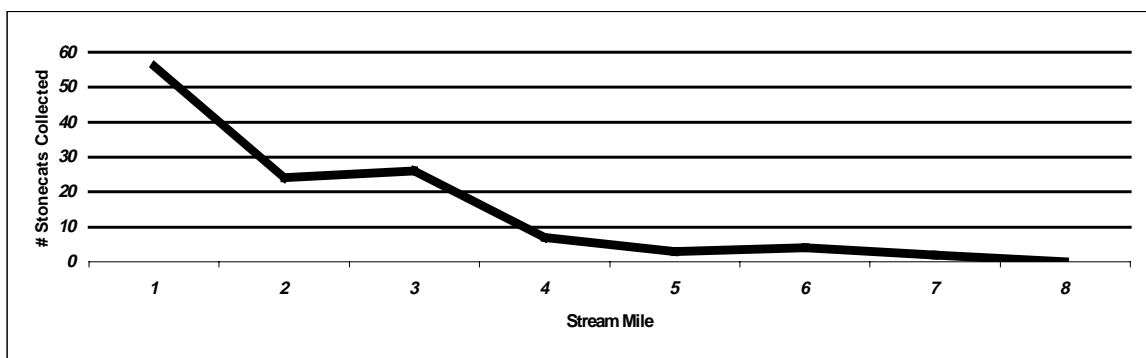


Figure 12. Number of stonecat collected using qualitative and quantitative sampling methods throughout 8.5 4<sup>th</sup> order river miles of the Casselman River in Maryland.

Walsh and Burr (1985) found that stonecat in South Dakota grew to 79 mm standard length (SL) in their first year and that stonecat in Illinois and Missouri averaged 49 mm in length by the end of their first year. They also found that stonecat averaged 137 mm (SL) in South Dakota and 123 mm (SL) in Illinois and Missouri at age four. The age classes shown in Figure 10 are based on Walsh and Burr's (1985) findings. Very few Age 0 and >Age 4 stonecat were collected during sampling for this project. In Illinois and Missouri, stonecat reached sexual maturity at age 3 and females were typically larger (about 100 mm SL) than males (about 90 mm SL) (Walsh and Burr 1985). Most of the stonecat collected during this study were between 90 and 150 mm in total length and thus, we can assume that most of the stonecat population in the Casselman River is sexually mature. Based on our finding four young-of-year stonecat, some successful spawning occurs in this population.

Top predator species (e.g., smallmouth bass, brown trout, and rainbow trout) are present in moderate to high numbers within the 4<sup>th</sup> order reaches of the Casselman River. A possible explanation for our collecting very few young of the year stonecat could be that young stonecat are being preyed upon by these top predators. Rainbow and brown trout, which are stocked by the MDNR in the Casselman River from January to May each year, were still abundant in July when sampling for this project was conducted. While we did not find any evidence in the literature to support this hypothesis, it is widely known that stonecat, as well as other species of madtom, are used as bait by fisherman to catch smallmouth bass. None of the trout and bass individuals that were captured while sampling for this project were sacrificed to determine if stonecat were being preyed upon by these top predators.

While adequate temperature data is not available to determine if suitable spawning temperatures exist in the Casselman for stonecat, it is probable that summer water temperatures do exceed 25°C, the temperature at which stonecat in Missouri begin to spawn (Walsh and Burr 1985), during July, August, and September.

In 1993, the population of stonecat that are present in Maryland and downstream into Pennsylvania was essentially isolated from other populations of the same species by the acid mine drainage source that enters the Casselman River at Coal Run. Data collected by the Pennsylvania DEP in 1998 showed that water quality and the fish community of the Casselman River, downstream of Coal Run, has improved dramatically since 1993 (Smith and Lorson 1999). Continued efforts of the Pennsylvania DEP to restore and protect this section of the Casselman River in Pennsylvania could be beneficial for the Maryland population of stonecat.

## **ADDITIONAL NOTE:**

The hellbender salamander, *Cryptobranchus alleganiensis*, another rare aquatic animal in Maryland, is also found in the Casselman River in Maryland. No hellbenders were observed while conducting sampling for this project in spite of the ease at which these animals are to stun with an electrofisher. We believe that hellbenders are exceedingly rare in Maryland because we did not encounter a single individual. Habitat requirements of hellbenders are similar to that of the stonecat, in that they both prefer cool to warm water streams, large boulder and cobble habitat, and are both intolerant of pollution. As with stonecat, we believe that stocked trout may present a predation threat to the young of this species. Protection of the Casselman River will ultimately benefit both of these rare species.

## **REFERENCES:**

- Cope, E.D. 1865. Partial catalogue of the cold-blooded vertebrates of Michigan, Part I. Proceedings of the National Academy of Science of Philadelphia (1864) 16:276-285.
- Etnier, D.A. and W.C. Starnes. 1993. The Fishes of Tennessee. University of Tennessee Press, Knoxville, Tennessee.
- Hendricks, M.L. 1980. The distribution of the fishes of the Youghiogheny River. MS Thesis, Frostburg State College, Frostburg, Maryland.
- Jenkins, R.E. and N.M. Burkhead. 1993. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland.
- Johnson, M.G. 1965. Estimates of fish populations in warm water streams by the removal method. Transactions of the American Fisheries Society 94(4):350-357.
- Kazyak, P.F. 1996. Maryland Biological Stream Survey Sampling Manual. Maryland Department of Natural Resources, Annapolis, Maryland.
- MDE. 1998. Seventy-fifty Annual Report of the Bureau of Mines. Water Management Administration, Bureau of Mines, Maryland Department of the Environment. Frostburg, Maryland.
- MDNR. 1973. Bureau of Mines Reclamation Program. Water Resources Administration, Frostburg, Maryland.
- MDNR. 1997. Rare, threatened, and endangered animals of Maryland. Maryland Department of Natural Resources, Wildlife and Heritage Division. Annapolis, Maryland.
- Reppert, R.T. 1964. Aquatic life and the acid reaction. Pages 27-45 in the Fifth Annual Symposium on Industrial Waste Control. Frostburg State College and Maryland

Water Pollution Control Commission, Annapolis, Maryland.

Smith, G. and R. Lorson. 1999. Casselman River (819F) Management Report: Sections 01, 02, and 04. Pennsylvania Fish and Boat Commission, Bureau of Fisheries, Fisheries Management Division.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Bulletin 184, Fisheries Research Board of Canada, Ottawa.

Trautman, M.B. 1981. The fishes of Ohio with illustrated keys, revised edition. Ohio State University Press, Columbus, Ohio.

Walsh, S.J. and B.M. Burr. 1985. The biology of the stonecat, *Noturus flavus* (Siluriforms: Ictaluridae), in central Illinois and Missouri streams, and comparisons with Great Lakes populations and congeners. Ohio Journal of Science 85:85-96.

Zippin, C. 1956. An evaluation of the removal method of estimating animal populations. Biometrics 12:163-189.