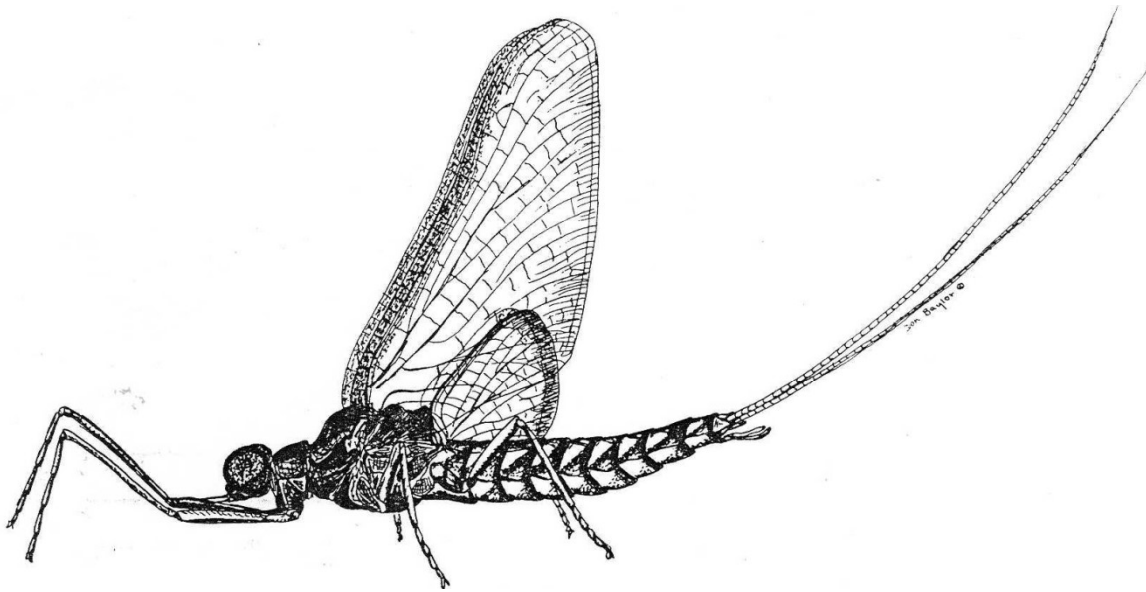


# ENVIRONMENTAL QUALITY OF PIKE COUNTY STREAMS



DECEMBER 2020

ENVIRONMENTAL QUALITY OF  
PIKE COUNTY STREAMS

Prepared For

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December 2020

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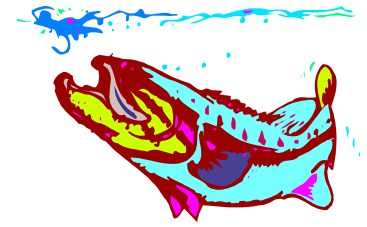
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# AQUATIC RESOURCE CONSULTING



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## INTRODUCTION

Biological monitoring of surface waters serves several purposes. It provides an early warning of hazardous changes in water quality, detects episodic events such as pollution spills, evaluates recovery from disturbed conditions, and reveals environmental trends and cycles.

Aquatic macroinvertebrates (primarily insects) and fish are important biological components of freshwater systems. They are the fundamental sensors of any stress that occurs within a stream ecosystem. This stress, which manifests itself in the health of aquatic organisms, can cause subtle or dramatic changes in overall community structure.

Work in bio-monitoring of stream communities has emphasized cost-effective protocols that attempt to extract maximum information with the least possible expenditure of time and money. Some of these methods have become standards in the field of bio-monitoring.

The United States Environmental Protection Agency (USEPA) provides several rapid bioassessment procedures for macroinvertebrate and fish populations (Plafkin et al, 1989). The Pennsylvania Department of Environmental Protection (PADEP) has developed its own assessment and listing methodology for integrated water quality monitoring (PADEP, 2007, 2009, 2012, 2015). Besides providing a means for monitoring temporal trends in aquatic life communities, it also provides a means for evaluating effects among stations.

Pike County has numerous freshwater streams ranging from small headwaters to large rivers. Nearly all these waterways are classified by the PADEP as “High-Quality” or “Exceptional Value” (PADEP, 1996). The aquatic life communities in these riverine ecosystems have similar characteristics that allow for regional comparisons. However, subtle but recognizable differences do occur between streams of varying size and gradient, and between those waters located above and below impoundments. Consequently, these differences must be noted and considered in any stream comparison or evaluation using the PADEP “Assessment Methodology”.

## **METHODS**

Pike County Conservation District (PCCD) personnel sampled fish at baseline and non-point stream sites in Pike County with the assistance of Aquatic Resource Consulting biologists. These sites were established in 1995 as part of the Pike County Water Quality Program network (PCCD, 1995). Additional sites have subsequently been added. The study was to monitor water quality and determine how sites compared to designated use criteria established for Pennsylvania streams by the Pennsylvania Department of Environmental Protection (PA DEP, 2007, 2009, 2012, 2015).

Macroinvertebrates were scheduled to be sampled at eight sites in April and May of 2020. This part of the study was postponed because of the COVID virus pandemic.

### **Stream Habitat and Water Quality**

The Pennsylvania Department of Environmental Protection (PADEP) Flowing Waterbody Field Data and Water Quality Habitat Assessment Forms were filled out for each station. Field measurements included stream temperature, dissolved oxygen, pH, alkalinity and conductivity. Land use and canopy cover at each site were also assessed. Habitat was evaluated at each station using PADEP's Water Quality Network Habitat Assessment forms for streams with a riffle/run prevalence. Twelve habitat parameters were ranked on a scale of 1-20 and combined for a total habitat score. Scores put habitat into categories of optimal, sub-optimal, marginal, and poor. According to protocols, scores that fall between these category ranges are left to the decision of the investigator for classification.

### **Fish Communities**

Fish communities were sampled in August, 2020 at four baseline stream sites and seven non-point sites identified by the Pike County Conservation District and Aquatic Resource Consulting (ARC) – Appendix. Each stream site was sampled with a battery- powered, variable voltage, Smith-Root backpack electrofishing unit with 6-foot anode probe. Direct-pulsed current at 45 Hz was used to cause electronarcosis in the fish being collected.

Effort was standardized at each site by sampling for a period of 20 minutes or until 300 linear feet of stream had been traversed. As recommended by the PADEP 2007 protocols for sampling fish, the sample reach was at least 10 times the mean width, or a minimum of 300 feet. All fish were collected on the first pass through the sampling area and stored in a live well.

All fish were identified to species and enumerated. Fish were checked for anomalies, such as discoloration, deformities, eroded fins, excessive mucous, fungus, parasites, poor condition, reddening, tumors and/or ulcers. Exotic or introduced species were noted. Following collection of data, fish were returned to the stream unharmed.

Fish habitat was assessed at each station by measuring stream widths (wetted perimeter) at 50-foot intervals and estimating mean width (Appendix). Each station was then placed in a standard stream width category for future comparison to other streams in the region. The categories were as follows: <10 ft. = 1, 10-20 ft. = 2, 21-40 ft. = 3, 41-60 ft. = 4, and >60 ft. = 5.

For this study, ten (10) biological characteristics (metrics) were used to assess the fish communities (Lyons et al., 1996 and Karr et al., 1986). They were based on the fish community's taxonomic and trophic (food guild) composition, and the abundance and thermal tolerance of fish (Table 6). These metrics attempt to quantify the quality of the fish community. Comparing values with those expected for the region scores each of these evaluations. Scoring criteria were based on historical data collected from stream sites in Pike County between 1995 and 2019 by Aquatic Resource Consulting (n=279). Metric values approximating, deviating slightly from, or deviating greatly from values expected in high quality streams are scored as 5, 3, or 1, respectively. The scores for each metric are tabulated to give a sum ranging from 50 (excellent) to 10 (very poor). This score is known as the index of biotic integrity (IBI).

The IBI serves as an integrated analysis because individual components may differ in their relative sensitivity to various levels of biological condition. A description and brief rationale for each of the 10 IBI metrics used for this study is outlined below.

Table 1. Index of biotic integrity (IBI) metrics and the scoring criteria used for each to calculate the IBI scores for Pike County fish populations.

<b><u>IBI Metrics</u></b>	<b>Scoring Criteria</b>		
	<b><u>5</u></b>	<b><u>3</u></b>	<b><u>1</u></b>
1. Number of Intolerant Species	>2	1-2	0
2. Percent of Individuals that are Tolerant	<11%	11-35%	>35%
3. Percent of Individuals that are Top Carnivores	>19%	8-19%	<8%
4. Percent of Individuals that are Coolwater or Coldwater	>83%	43-83%	<43%
5. Percent of Salmonid Individuals that are Brook Trout	>2%	1-2%	<1%
6. Percent of Individuals that are Insectivores	>56%	44-56%	<44%
7. Percent of Individuals that are Pioneering Species	<21%	21-56%	>56%
8. Catch per 20 Minute Effort	>142	96-142	<96
9. Percent of Individuals that are Lithophilic Spawners	>89%	72-89%	<72%
10. Number of YOY Trout Caught Per 20 Minute Effort	>11	1-11	<1

1. Number of intolerant species - recognizes those fish that are sensitive to degradation resulting from siltation and oxygen depletion because they feed and reproduce in benthic (stream bottom) habitats.

2. Percent of individuals that are tolerant species - measures those fish species present that are tolerant to a variety of chemical and physical pollutants, and which tend to dominate a fish community that is degraded.

3. Percent of individuals that are top carnivore species - measures that portion of the fish community that feed on other fish. The dominant carnivores in cold water streams are pollution sensitive adult salmonids (trout).
4. Percent of individuals that are stenothermal coolwater and coldwater species - measures that portion of the fish community that is intolerant to warm water conditions. Stenothermal fish species are often associated with high water quality.
5. Percent of salmonid individuals that are brook trout - Brook trout are often associated with high-quality, cold water streams. They are pollution sensitive to chemicals, elevated water temperatures, and siltation.
6. Percent of individuals that are insectivores - measures that portion of the fish community that feed on insects. The percent of insectivores, which are the dominant trophic guild in clean waters, increases as the physical and chemical habitat improves.
7. Percent of individuals as pioneering species - measures the proportion of the fish community represented by species which dominate in fluctuating environments such as variable flow regimes, chronic shifts in stream temperature, shifting habitats, and pulses of chemical pollutants. Generally, the number of pioneering species increases as water quality declines.
8. Catch per 20 minute effort - measures the density of the fish community, which varies with region and stream size. Generally, the number of fish increases with improving stream conditions.
9. Percent lithophilic spawners - is an estimate of the suitability of the habitat for reproduction by fish species that build nests in sand, gravel and cobble substrates. These fish provide no parental care of their young after the eggs are laid and fertilized. Generally, as environmental degradation increases the number of lithophilic spawners declines.
10. Catch of young-of-year trout per 20 minute effort – measures the capacity of a stream to reproduce trout species. The number of young-of-year trout increases with improving stream conditions.

### **Sampling Stations**

Four baseline and seven non-point stations were sampled for fish in August, 2020 (Appendix). Following are descriptions and co-ordinates:

### **Fish Sites:**

Station 09 – Sawkill Creek, Milford/Dingman Township; 41.317207/-74.799562

Station 11 – Cummins Creek, Westfall Township; 41.345091/-74.76123

Station 14 – Shohola Creek, Shohola Township; 41.455904/-74.923305

Station 15 – Lackawaxen River, Lackawaxen Township; 41.4755779/75.035083

Station 13N – Twin Lakes Creek, Shohola Township; 41.427882/-74.888243

Station 20N – Tom's Creek, Lehman Township; 41.142606/-74.962511

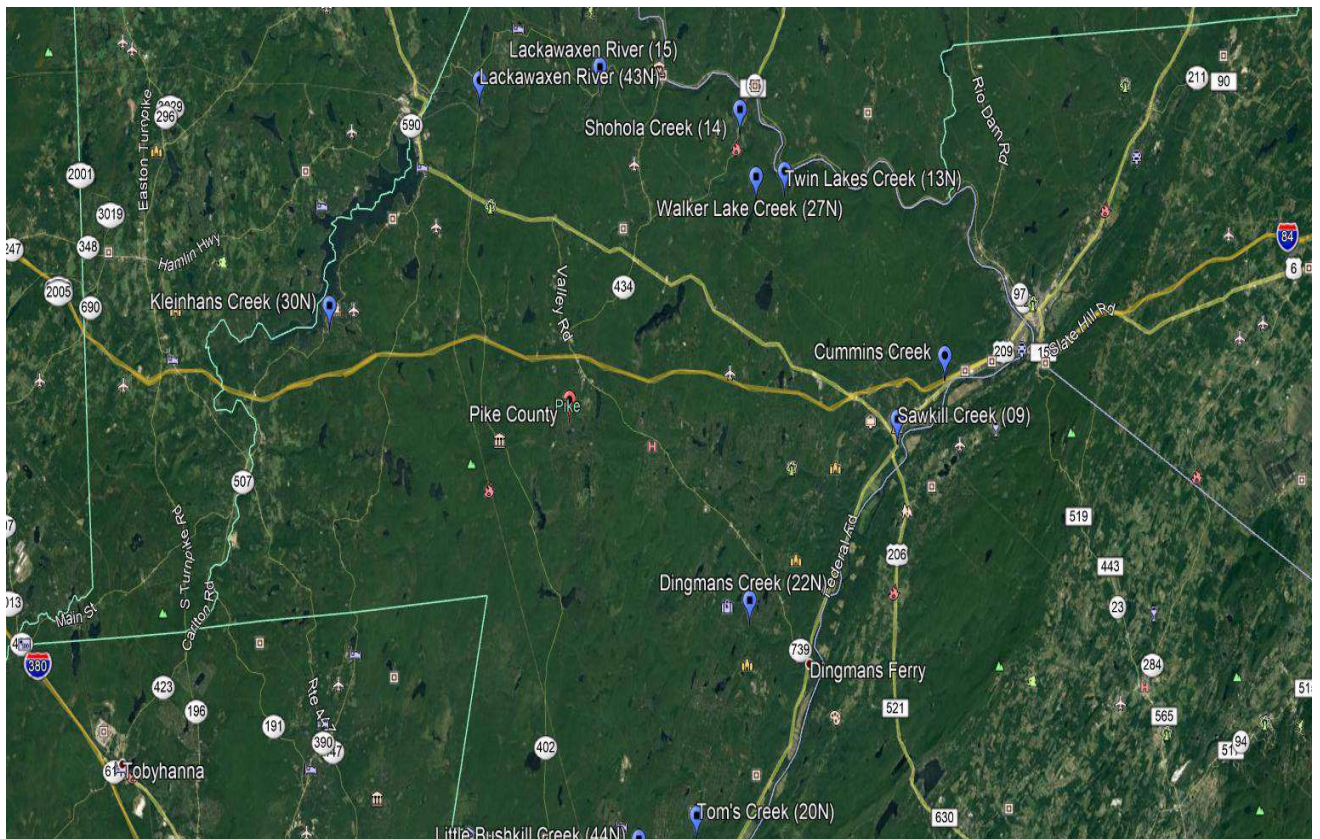
Station 22N - Dingman's Creek, Dingman Township; 41.237985/-74.918941

Station 27N - Walker Lake Creek, Shohola Township; 41.427961/-74.910521

Station 30N - Kleinhans Creek, Palmyra Township; 41.371037/-75.252085

Station 43N - Lackawaxen River, Lackawaxen Township; 41.470209/-75.131452

Station 44N - Little Bushkill Creek, Lehman Township; 41.132621/-75.008715





## **RESULTS AND DISCUSSION**

### **Geography - Stream Basins**

Basin geography, topography, and land use varied from site to site. Drainage areas ranged from 2 to almost 600 square miles (Table 2). Man-made impoundments within each basin system varied from 0 to >3. Drainage area and number of impoundments influences the composition of the stream/river biota. Higher order streams with numerous inflows and impoundments tend to influence higher concentrations of nutrients and elevated temperature regimes. These characteristics, along with land use, must be taken into consideration when evaluating water quality as they have a strong correlation to the composition of the animal biota (fish and macroinvertebrates).

### **Physical – Chemical Field Data**

Physical and chemical parameters measured were similar at both baseline and non-point stream sites surveyed (Table 3). Temperature and dissolved oxygen levels were considered adequate for stream life at the time of sampling. All streams were considered slightly alkaline with low buffering capability. pH readings at most sites were typical for the Pocono region. Conductivity readings at each site were generally low suggesting limited concentrations of dissolved or filterable solids such as minerals, metals, or man-made wastes. The mean value of the world's rivers contains an average of 120 parts per million (ppm) of total dissolved solids (Cole, 1983). A comparable conductivity would equal 240  $\mu$ mhos/cm.

### **Habitat**

All stream sites sampled scored in the optimal range for habitat (Table 4, Appendix). All stations exceeded the PADEP scoring benchmark of 192 for optimal habitat (PA DEP, 2007). Diverse habitat is considered a necessary component to healthy stream conditions. Habitat can be degraded by human activities within a watershed; however, natural events may also degrade habitat at certain times (i.e. floods, dewatering due to drought, pest infestations, etc.). Habitat scores for Pike County streams have averaged 216 and this average has ranged from 196 to 232 units (Ersbak, 2010-2019). Subjective scoring criteria by different field teams has been fairly consistent.

### **Fish**

Eleven stream fish communities in Pike County were assessed by electrofishing techniques. Each survey site was categorized into habitat categories based on stream width (wetted perimeter) to allow for comparative assessments of biotic integrity among streams (Table 2). The streams surveyed fell into one of five width categories ranging from 1 (<10 feet) to 5 (>60 feet).

Trout species were present at five of the eleven stream sites surveyed. Both native brook and wild brown trout were collected from Twin Lakes Creek (30N) and Kleinhans Creek (30N) - Table 5. Wild brown trout were collected from Sawkill Creek (09), Cummins Creek (11), and Tom's Creek (20N). Young-of-year smallmouth bass were collected from Kleinhans Creek (30N), while adult largemouth bass were found in

Table 2. Stream fish communities sampled for width category, impoundments in watershed, drainage area (square miles), and game fish present in Pike County, PA (August, 2020).

STREAM SAMPLED	SITE ID	WIDTH CATEGORY	IMPOUNDMENTS ABOVE SAMPLE SITE	DRAINAGE BASIN AREA (square miles)	GAME FISH PRESENT
Sawkill	09	3	1	24	Brown trout Largemouth bass
Cummins	11	2	0	4	Brown trout
Shohola	14	4	>3	85	
Lackawaxen	15	3	>3	591	
Twin Lakes	13N	2	2	6	Brown trout Brook trout
Toms	20N	2	1	6	Brown trout
Dingmans	22N	3	>3	17	Largemouth bass
Walker Lake	27N	2	3	3	
Kleinhans	30N	2	1	4	Brown trout Brook trout Smallmouth bass
Lackawaxen	43N	4	>3	531	
Little Bushkill	44N	3	3	2	

Sawkill Creek (09) and Dingmans Creek (22N).

Trout are an important sport fish in the region, are temperature sensitive and prefer streams where thermal conditions seldom exceed 65 degrees Fahrenheit (Scott and Crossman, 1979). Impoundments with surface water releases tend to discharge warm water during the summer months, which is considered detrimental to the natural survival and production of trout. Sedimentation of streams is also detrimental to the survival of trout, as they require a clean substrate to incubate their eggs. Brook trout are less tolerant to thermal stress and sedimentation than brown trout and are usually associated with springs and headwater regions of watersheds. Brook trout also require high concentrations of dissolved oxygen to survive. Therefore, brook trout are usually associated with clean water conditions and are fairly intolerant to organic pollutants.

Trout reproduction was evident by the presence of young-of-year (YOY) fish in Sawkill Creek, Cummins Creek, Twin Lakes Creek, Tom's Creek, and Kleinhans Creek (Appendix).

A total of 16 species of fish were collected from the eleven streams surveyed in August of 2020 (Table 5). Blacknose dace (*Rhinichthys atratulus*) were the dominant forage fish and found at ten of the eleven sites. The American eel (*Anguilla rostrata*), which is a catadromous fish (living in fresh water and spawning in salt water), was found at seven of the eleven sites. Sawkill Creek and the Lackawaxen River had the greatest diversity of fish with 9 and 8 species present, respectively.

Table 3. Physical and chemical field data from eleven Pike County stream sites (August, 2020) Pennsylvania Department of Environmental Protection 2009.

PARAMETER	STA. 09 Sawkill	STA. 11 Cummins	STA. 14 Shohola	STA. 15 Lackawaxen	STA. 13N Twin Lakes	STA. 20N Tom's
Sample Date	8/13/20	8/13/20	8/18/20	8/20/20	8/13/20	8/11/20
Temperature (°C)	20.6	18.2	20.3	18.4	20.4	20.2
Dissolved Oxygen (mg/l)	7.52	8.28	8.00	8.30	7.70	7.76
pH	7.43	7.04	7.03	7.74	7.04	7.95
Conductivity (µS/cm)	120.7	50.9	64.3	92.6	65.0	128.8
Alkalinity (mg/l)	30	12.5	15	27.5	15	25
PARAMETER	STA. 22N Dingmans	STA 27N Walker Lake	STA. 30N Kleinhans	STA.43N Lackawaxen	STA.44N Little Bushkill	
Sample Date	8/11/20	8/18/20	8/18/20	8/20/20	8/20/20	
Temperature (°C)	26.0	23.1	17.0	19.6	19.9	
Dissolved Oxygen (mg/l)	6.35	6.32	8.02	8.55	7.94	
pH	7.19	6.92	7.22	7.74	7.10	
Conductivity (µmhos/cm)	69.1	68.1	109.1	108.6	44.6	
Alkalinity (mg/l)	15	15	20	35	12.5	

Table 4. Habitat assessment of 11 sampling stations on Pike County streams (August, 2020) – Pennsylvania Department of Environmental Protection, 2009.

HABITAT PARAMETER	STA 09 Sawkill 8/13/20	STA 11 Cummins 8/13/20	STA 14 Shohola 8/18/20	STA 15 Lackawaxen 8/20/20	STA 13N Twin Lakes 8/13/20	Station 20N Tom's 8/11/20
1. Instream Cover	19	20	14	15	20	18
2. Epifaunal Substrate	19	18	17	16	20	20
3. Embeddedness	18	18	18	19	16	19
4. Velocity/Depth Regimes	20	20	15	13	20	10
5. Channel Alteration	18	18	18	16	20	20
6. Sediment Deposition	19	19	18	17	18	19
7. Frequency of Riffles	20	18	18	17	20	20
8. Channel Flow Status	18	18	17	20	19	18
9. Condition of Banks	15	16	17	19	13	16
10. Bank Vegetative Protection	17	16	19	20	20	18
11. Grazing or Other Disruptive Pressure	18	19	20	18	19	18
12. Riparian Vegetative Zone Width	17	19	18	16	19	20
<b>TOTAL SCORE</b>	<b>218</b>	<b>219</b>	<b>209</b>	<b>206</b>	<b>224</b>	<b>216</b>

HABITAT PARAMETER	STA 22N Dingmans 8/11/20	STA 27N Walker Lake 8/18/20	STA 30N Kleinhans 8/18/20	STA 43N Lackawaxen 8/20/20	STA 44N Little Bushkill 8/20/20
1. Instream Cover	16	18	18	15	20
2. Epifaunal Substrate	18	19	19	18	20
3. Embeddedness	18	17	15	16	18
4. Velocity/Depth Regimes	20	10	14	15	20
5. Channel Alteration	20	19	18	14	19
6. Sediment Deposition	15	15	15	19	19
7. Frequency of Riffles	20	19	19	20	20
8. Channel Flow Status	19	19	18	17	20
9. Condition of Banks	15	18	9	18	18
10. Bank Vegetative Protection	16	17	16	17	19
11. Grazing or Other Disruptive Pressure	18	20	18	19	19
12. Riparian Vegetative Zone Width	16	18	19	10	19
<b>TOTAL SCORE</b>	<b>211</b>	<b>209</b>	<b>198</b>	<b>198</b>	<b>231</b>

Score ranges: Optimal 240-192, Suboptimal 180-132, Marginal 120-72, Poor <60

Fish species were classified for calculation of an index of biotic integrity at each station surveyed (Table 6). These categories included pollution tolerance, trophic position (carnivore, omnivore or insectivore), thermal tolerance (stenothermal vs. eurythermal), adaptability to changing conditions (pioneer), spawning requirements (lithophil), and salmonid reproductive capacity (presence of young-of-year) – Lyons et al., 1996, Scott and Crossman, 1979; Plafkin et al., 1989; and Cooper, 1983. The index of biotic integrity for the eleven (11) stream sites surveyed ranged from twelve at Little Bushkill Creek (44N) to forty-two at Twin Lakes Creek (13N) – Table 6. All but three sites had IBI indices considered normal and approximating that found historically in high quality streams of the region where IBI has averaged  $29.5 \pm 7.8$  (Ersbak, 1995-2019). Only the Twin Lakes Creek site exceeded the statistical average with an IBI of 42. Cummins Creek (n=11), Dingmans Creek (n=8), Walker Lake Creek (n=5), and Little Bushkill Creek (n=3) had IBI scores that were significantly lower than previous years sampled. It should be noted that stream water levels were higher than preferred at some of the sites, and this may have impacted the fish sampling results, namely in Little Bushkill Creek (44N), Shohola Creek (14), Sawkill Creek (09), Twin Lakes Creek (13N), and Lackawaxen River (15).

It is noteworthy, that of the 615 individual fish sampled, no external deformities (tumors, ulcers, etc.) indicative of stress resulting from chemical or physical pollutants were observed.

Table 5. Fish species collected from eleven stream sites in Pike County, PA (August, 2020).

		8/13/20	8/13/20	8/18/20	8/20/20	8/13/20	8/11/20	8/11/20
Scientific Name	Common Name	Sawkill 09	Cummins 11	Shohola 14	Lackawaxen 15	Twin Lakes 13N	Toms 20N	Dingmans 22N
<i>Anguilla rostrata</i>	American eel	22	4	12	9	1	11	
<i>Catostomus commersoni</i>	white sucker	1		2				
<i>Rhinichthys atratulus</i>	blacknose dace	5		8	19	1	36	11
<i>Rhinichthys cataractae</i>	longnose dace	4			19			
<i>Salmo trutta</i>	brown trout	14	29			3	19	
<i>Salvelinus fontinalis</i>	brook trout					15		
<i>Micropterus salmoides</i>	largemouth bass	3						3
<i>Exoglossum maxillingua</i>	cutlips minnow	6		29	14			
<i>Semotilus atromaculatus</i>	creek chub							9
<i>Etheostoma olmstedii</i>	tessellated darter	2			5			
<i>Hypentelium nigricans</i>	Northern hogsucker				1			
<i>Lepomis macrochirus</i>	bluegill							4
<i>Noturus insignis</i>	marginated madtom	3		1				3
<i>Semotilus corporalis</i>	fallfish			16	13			
<b>TOTAL</b>		<b>60</b>	<b>33</b>	<b>68</b>	<b>80</b>	<b>20</b>	<b>66</b>	<b>30</b>

Table 5 (cont.).

		8/18/20	8/18/20	8/20/20	8/20/20			
Scientific Name	Common Name	Walker Lake 27N	Kleinbans 30N	Laekawaxen 43N	Little Bushkill 44N			
<i>Anguilla rostrata</i>	American eel			19				
<i>Catostomus commersoni</i>	white sucker			2				
<i>Rhinichthys atratulus</i>	blacknose dace	42	1	13	16			
<i>Rhinichthys cataractae</i>	longnose dace			18				
<i>Salmo trutta</i>	brown trout		2					
<i>Salvelinus fontinalis</i>	brook trout		2					
<i>Micropterus dolomieu</i>	smallmouth bass		3					
<i>Exoglossum maxillingua</i>	cutlips minnow			1				
<i>Semotilus atromaculatus</i>	creek chub				1			
<i>Etheostoma olmstedi</i>	tessellated darter		4	25				
<i>Noturus insignis</i>	marginated madtom			8	7			
<i>Semotilus corporalis</i>	fallfish		1	25	3			
<i>Ameiurus nebulosis</i>	brown bullhead	4	1					
<b>TOTAL</b>		<b>46</b>	<b>14</b>	<b>111</b>	<b>27</b>			

Table 6. Index of biotic integrity (IBI) test scores at 11 stream sites in Pike County, Pennsylvania (August, 2020).

IS	Number of intolerant species
TOL	% of individuals that are tolerant species
CARN	% of individuals that are top carnivore species
STENO	% of individuals that are stenothermal coolwater & coldwater species
ST	% of salmonid individuals that are brook trout
I	% of individuals that are insectivores
P	% of individuals that are pioneering species
CPE	Catch per 20 minute effort
L	% of individuals that are lithophilic spawners
YOY	Number of young-of-year trout

### INDEX OF BIOTIC INTEGRITY

#### STATION 09

##### Sawkill Creek

IBI Metrics	Metric Value	Test Score
IS	2	3
TOL	10	5
CARN	65	5
STENO	70	3
ST	0	1
I	77	5
P	48	3
CPE	54	1
L	50	1
YOY	2	3

**IBI Score = 30**

#### STATION 11

##### Cummins Creek

Metric Value	Test Score
0	1
0	5
100	5
100	5
0	1
100	5
48	3
28	1
88	3
13	5

**34**

#### STATION 14

##### Shohola Creek

Metric Value	Test Score
2	3
15	3
18	3
60	3
0	1
43	1
29	3
68	1
73	3
0	1

**22**

#### STATION 15

##### Lackawaxen River

IBI Metrics	Metric Value	Test Score
IS	1	3
TOL	25	3
CARN	11	3
STENO	29	1
ST	0	1
I	58	5
P	41	3
CPE	80	1
L	83	3
YOY	0	1

**IBI Score = 24**

#### STATION 13N

##### Twin Lakes Creek

Metric Value	Test Score
1	3
5	5
95	5
95	5
83	5
95	5
10	5
20	1
95	5
4	3

**42**

#### STATION 20N

##### Tom's Creek

Metric Value	Test Score
0	1
54	1
45	5
45	3
0	1
45	3
71	1
66	1
83	3
8	3

**22**



Table 6. (cont.).

IS	Number of intolerant species
TOL	% of individuals that are tolerant species
CARN	% of individuals that are top carnivore species
STENO	% of individuals that are stenothermal coolwater & coldwater species
ST	% of salmonid individuals that are brook trout
I	% of individuals that are insectivores
P	% of individuals that are pioneering species
CPE	Catch per 20 minute effort
L	% of individuals that are lithophilic spawners
YOY	Number of young-of-year trout

**STATION 22N**

Dingmans Creek

IBI Metrics	Metric Value	Test Score
IS	1	3
TOL	67	1
CARN	10	3
STENO	0	1
ST	0	1
I	23	1
P	67	1
CPE	30	1
L	67	1
YOY	0	1

**IBI Score = 14**

**STATION 27N**

Walker Lake Creek

Metric Value	Test Score
0	1
100	1
0	1
0	1
0	1
9	1
91	1
46	1
91	5
0	1

**14**

**STATION 30N**

Kleinhans Creek

Metric Value	Test Score
1	3
14	3
50	5
50	3
50	5
92	5
36	3
14	1
43	1
3	3

**32**

**STATION 43N**

Lackawaxen River

IBI Metrics	Metric Value	Test Score
IS	2	3
TOL	14	3
CARN	17	3
STENO	17	1
ST	0	1
I	86	5
P	51	3
CPE	111	3
L	74	3
YOY	0	1

**IBI Score = 26**

**STATION 44N**

Little Bushkill Creek

Metric Value	Test Score
1	3
65	1
0	1
0	1
0	1
37	1
63	1
27	1
74	1
0	1

**12**


## RECOMMENDATIONS

PCCD should continue its monitoring program of streams and rivers in the County. The cyclical rotation schedule of sites to be surveyed should be reviewed, and a schedule of sampling established. Physical and chemical data should continue to be collected at all sites along with habitat assessment as per PADEP protocols (2009). Consideration should be given to sample those sites cancelled for 2020 due to the COVID virus pandemic. It is important that all macroinvertebrate samples be collected between mid-April and the end of May as per PADEP protocols. Samples should be collected when conditions permit. High water or spate conditions should be avoided whenever possible. Fish should be collected at the season low water mark, typically in August or September. This sampling schedule will maintain consistency with previous years of study and allow for better comparative analysis.

Based on historical data it is suggested the following be included in the 2021 sampling rotation for macroinvertebrate and fish populations:

### Macroinvertebrates

- |                          |                    |                 |
|--------------------------|--------------------|-----------------|
| • Big Bushkill 02        | Little Bushkill 03 | Hornbecks 05    |
| • Dingmans 06            | Adams 07           | Raymondskill 08 |
| • Bushkill (Millrift) 12 | Twin Lakes 13N     | Masthope 16N    |
| • Saw Creek 19           | Toms 20N           | Sawkill 24N     |
| • Rosetown 26N           | Balliard 33N       | Shohola 35N     |
| • Pond Eddy 36N          | Westfalls 40N      | Lackawaxen 43N  |
| • Saw Creek 01           |                    |                 |

### Fish

- |                |               |                |
|----------------|---------------|----------------|
| • Saw Creek 01 | Saw Creek 19N | Dwarfskill 23N |
| • Shohola 35N  | Pond Eddy 36N |                |

The watershed of each sampling site should be mapped and further delineated by basin characteristics for both fish and macroinvertebrates. These data will assist in the interpretation of water quality indices. The USGS Streamstats Program (<http://streamstats.usgs.gov/ss/>) is an available software tool for this purpose.

Further testing should be considered for other new or existing stream sites threatened by environmental impacts or significant land use changes. Proposed large development projects should be considered in scheduling additional special study sites in the County's water quality monitoring program.

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Taxa, numbers, and site description for the eleven electrofishing stream sites in Pike County for 2020.

# FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY

Stream/River – Sawkill Creek	Township - Dingman	DEP Water Use Classification	EV, MF
Site I.D. #09	Date – 8/13/2020		
Location – N41.317207/W74.799562	Air Temperature – 20 Celsius		
Sampling duration – 22 minutes	Sampling Distance – 155 feet		
Sampling area (ft2) – 4,921	Mean Stream Width – 32 feet		
Weather /Comments – sunny, warm, no precipitation			
Water temperature – 20.6 Celsius	Dissolved Oxygen – 7.52 ppm	pH – 7.43	
Gear used - DC Electroshocker	Habitat rating – 218	Alkalinity- 30 mg/l	
Voltage – 300	Stream Width Category- 3	Conductivity-120.7µS/cm	

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Anguilla rostrate</i>	American eel	22	0
<i>Noturus insignis</i>	Margined madtom	3	0
<i>Etheostoma olmsted</i>	Tessellated darter	2	0
<i>Rhinichthys cataractae</i>	Longnose dace	4	0
<i>Exoglossum maxillingua</i>	Cutlips minnow	6	0
<i>Rhinichthys atratulus</i>	Blacknose dace	5	0
<i>Salmo trutta</i>	Brown trout (YOY)	2	0
<i>Salmo trutta</i>	Brown trout (adult)	12	0
<i>Micropterus salmoides</i>	Largemouth bass	3	0
<i>Catostomus commersoni</i>	White sucker	1	0

**TOTAL 60**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

# FISH FIELD COLLECTION DATA SHEET

## PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Cummins Creek      Township - Westfall      DEP Water Use  
 Site I.D. #11      Date – 8/13/2020      Classification HQ-CWF  
 Location – N41.345091/W74.761123      Air temperature – 23 Celsius  
 Sampling duration – 23 minutes      Sampling Distance – 210 feet  
 Sampling area (ft2) – 3,185      Mean Stream Width – 15.2 feet  
 Weather /Comments – sunny/warm  
 Temperature – 18.2 Celsius      Dissolved oxygen – 8.28 ppm      pH – 7.04  
 Gear used - Backpack Electroshocker      Habitat rating- 219      Alkalinity – 12.5 mg/l  
 Voltage – 300      Stream Width Category – 2      Conductivity- 50.9 µS/cm

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Anguilla rostrate</i>	American eel	4	0
<i>Salmo trutta</i>	Brown trout (YOY)	13	0
<i>Salmo trutta</i>	Brown trout (adult)	16	0

**TOTAL      33**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

# FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY WATER QUALITY  
SURVEY

Stream/River – Shohola Creek	Township - Shohola	DEP Water Use Classification	HQ-CWF
Site I.D. #14	Date – 8/18/2020		
Location – N41.455904/W74.923305	Air temperature – 21 Celsius		
Sampling duration – 20 minutes	Sampling Distance – 180 feet		
Sampling area (ft2) – 7,500	Mean Stream Width – 41.6 feet		
Weather /Comments – sunny, mild			
Temperature – 20.3 Celsius	Dissolved oxygen – 8.00 ppm	pH – 7.03	
Gear used-Backpack Electroshocker	Habitat rating- 209	Alkalinity- 15 mg/l	
Voltage - 300	Stream Width Category – 4	Conductivity- 64.3 µS/cm	

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Exoglossum maxillingua</i>	Cutlips minnow	29	0
<i>Semotilus corporalis</i>	Fallfish	16	0
<i>Noturus insignis</i>	Margined madtom	1	0
<i>Anguilla rostrata</i>	American eel	12	0
<i>Rhinichthys atratulus</i>	Blacknose dace	8	0
<i>Catostomus commersoni</i>	White sucker	2	0

**TOTAL 68**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.



# FISH FIELD COLLECTION DATA SHEET

## PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Lackawaxen River      Township - Lackawaxen      DEP Water Use Classification      HQ-TSF

Site I.D. #15      Date – 8/20/2020

Location – N41.4755779/W75.035083      Air temperature – 25 Celsius

Sampling duration – 20 minutes      Sampling Distance – 93 feet

Sampling area (ft2) – 3069      Mean Stream Width – 33 feet

Weather /Comments - sunny/mild

Temperature – 18.4 Celsius      Dissolved oxygen – 8.30 ppm      pH – 7.74

Gear used - Backpack Electroshocker      Habitat rating – 206      Alkalinity – 27.5 mg/l

Voltage – 300      Stream Width Category – 5      Conductivity- 92.6 µS/cm

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Anguilla rostrata</i>	American eel	9	0
<i>Semotilus corporalis</i>	Fallfish	13	0
<i>Etheostoma olmstedii</i>	Tessellated darter	5	0
<i>Rhinichthys cataractae</i>	Longnose dace	19	0
<i>Rhinichthys atratulus</i>	Blacknose dace	19	0
<i>Exoglossum maxillina</i>	Cutlips minnow	14	0
<i>Hypentelium nigricans</i>	Northern hogsucker	1	0

**TOTAL      80**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

# FISH FIELD COLLECTION DATA SHEET

## PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Twin Lakes Creek	Township – Shohola	DEP Water Use Classification	HQCWF
Site I.D. #13N	Date – 8/13/2020		
Location – N41.427882/W74.888243	Air temperature – 20 Celsius		
Sampling duration – 20 minutes	Sampling Distance - 192		
Sampling area (ft2) – 2,904	Mean Stream Width – 15.1 feet		
Weather /Comments – sunny/warm			
Temperature – 20.4 Celsius	Dissolved oxygen – 7.70 ppm	pH – 7.04	
Gear used - Backpack Electroshocker	Habitat rating – 224	Alkalinity – 15 mg/l	
Voltage - 300	Stream Width Category – 2	Conductivity- 65.0 µS/cm	

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Anguilla rostrata</i>	American eel	1	0
<i>Salmo trutta</i>	Brown trout (adult)	3	0
<i>Salvelinus fontinalis</i>	Brook trout (YOY)	4	0
<i>Salvelinus fontinalis</i>	Brook trout (adult)	11	0
<i>Rhinichthys atratulus</i>	Blacknose dace	1	0

**TOTAL 20**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

# FISH FIELD COLLECTION DATA SHEET

## PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Tom's Creek	Township – Lehman	DEP Water Use Classification EV
Site I.D. #20N	Date – 8/11/2020	
Location – N41.142606/W74.9622511	Air temperature – 27 Celsius	
Sampling duration – 20 minutes	Sampling Distance – 115 feet	
Sampling area (ft2) – 2,357	Mean Stream Width – 20.5 feet	
Weather /Comments – sunny, warm		
Temperature – 20.2 Celsius	Dissolved oxygen – 7.76 ppm	pH - 7.95
Gear used - Backpack Electroshocker	Habitat rating – 216	Alkalinity – 25 mg/l
Voltage - 300	Stream Width Category – 3	Conductivity- 128.8 µS/cm

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Salmo trutta</i>	Brown trout (young of year)	8	0
<i>Salmo trutta</i>	Brown trout (adult)	11	0
<i>Anguilla rostrata</i>	American eel	11	0
<i>Rhinichthys atratulus</i>	Blacknose dace	36	0

**TOTAL 66**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

# FISH FIELD COLLECTION DATA SHEET

## PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Dingman's Creek Creek      Township – Dingman      DEP Water Use Classification      HQCWF

Site I.D. #22N      Date – 8/11/2020

Location – N 41.237985/W 74.918941      Air Temperature – 21 Celsius

Sampling duration – 20 minutes      Sampling Distance – 200 feet

Sampling area (ft2) – 5,000      Mean Stream Width – 25 feet

Weather /Comments – sunny, warm

Temperature – 26 Celsius      Dissolved oxygen – 6.35      pH – 7.19

Gear used - Backpack Electroshocker      Habitat rating – 211      Alkalinity – 15 mg/l

Voltage - 300      Stream Width Category 3      Conductivity- 69.1 µS/cm

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Micropterus salmoides</i>	Largemouth bass	3	0
<i>Lepomis macrochirus</i>	Bluegill	4	0
<i>Semotilus atromaculitis</i>	Creek chub	9	0
<i>Rhinichthys atratulus</i>	Blacknose dace	11	0
<i>Noturus insignis</i>	Margined madtom	3	0

**TOTAL      30**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

**FISH FIELD COLLECTION DATA SHEET**  
**PIKE COUNTY WATER QUALITY**  
**SURVEY**

Stream/River – Walker Lake Creek	Township – Shohola	DEP Water Use Classification    HQCWF
Site I.D. #27N	Date – 8/18/2020	
Location – N 41.427961/W 74.910521	Air Temperature – 19 Celsius	
Sampling duration – 20 minutes	Sampling Distance – 168 feet	
Sampling area (ft2) – 2,352	Mean Stream Width – 14 feet	
Weather /Comments – sunny, cool		
Temperature – 23.1 Celsius	Dissolved oxygen – 6.32	pH – 6.92
Gear used - Backpack Electroshocker	Habitat rating – 209	Alkalinity – 15 mg/l
Voltage - 300	Stream Width Category- 2	Conductivity- 68.1 µS/cm

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Ameiurus nebulosis</i>	Brown bullhead	4	0
<i>Rhinichthys atratulus</i>	Blacknose dace	42	0

**TOTAL            46**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

# FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY WATER QUALITY  
SURVEY

Stream/River – Kleinhans Creek	Township – Palmyra	DEP Water Use Classification	HQCWF
Site I.D. #30N	Date – 8/18/2020		
Location – N 41.371037/W 75.252085	Air Temperature – 16 Celsius		
Sampling duration – 20 minutes	Sampling Distance – 185 feet		
Sampling area (ft2) – 3,053	Mean Stream Width – 16.5 feet		
Weather /Comments – sunny, mild			
Temperature – 17 Celsius	Dissolved oxygen – 8.02	pH – 7.22	
Gear used - Backpack Electroshocker	Habitat rating – 198	Alkalinity – 20 mg/l	
Voltage - 300	Stream Width Category- 2	Conductivity- 109.1 µS/cm	

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Salmo trutta</i>	Brown trout (young of year)	1	0
<i>Salmo trutta</i>	Brown trout (adult)	1	0
<i>Salvelinus fontinalis</i>	Brook trout (young of year)	2	0
<i>Micropterus dolomieu</i>	Smallmouth bass (young of year)	3	0
<i>Semotilus corporalis</i>	Fallfish	1	0
<i>Ameiurus nebulosus</i>	Brown bullhead	1	0
<i>Etheostoma olmsted</i>	Tesselated darter	4	0
<i>Rhinichthys atratulus</i>	Blacknose dace	1	0

**TOTAL 14**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

# FISH FIELD COLLECTION DATA SHEET

## PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Lackawaxen River      Township – Lackawaxen      DEP Water Use  
Classification      HQTsf

Site I.D. #43N      Date – 8/20/2020

Location – N 41.470209/W 75.131452      Air Temperature – 16 Celsius

Sampling duration – 20 minutes      Sampling Distance – 89 feet

Sampling area (ft<sup>2</sup>) – 4,687      Mean Stream Width – 52.6 feet

Weather /Comments – sunny, mild

Temperature – 19.6 Celsius      Dissolved oxygen – 8.55      pH – 7.74

Gear used - Backpack Electroshocker      Habitat rating – 198      Alkalinity – 35 mg/l

Voltage - 300      Stream Width Category- 4      Conductivity- 108.6 µS/cm

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Anguilla rostrata</i>	American eel	19	0
<i>Rhinichthys atratulus</i>	Blacknose dace	13	0
<i>Rhinichthys cataractae</i>	Longnose dace	18	0
<i>Semotilus corporalis</i>	Fallfish	25	0
<i>Etheostoma olmstedii</i>	Tessellated darter	25	0
<i>Noturus insignis</i>	Margined madtom	8	0
<i>Catostomus commersoni</i>	White sucker	2	0
<i>Exoglossum maxillingua</i>	Cutlips minnow	1	0

**TOTAL      111**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

# FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY WATER QUALITY  
SURVEY

Stream/River – Little Bushkill Creek	Township – Lehman	DEP Water Use Classification EV
Site I.D. #44N	Date – 8/20/2020	
Location – N 41.132621/W 75.008715	Air Temperature – 32 Celsius	
Sampling duration – 20 minutes	Sampling Distance – 100 feet	
Sampling area (ft2) – 2,900	Mean Stream Width – 29 feet	
Weather /Comments – sunny, warm		
Temperature – 19.9 Celsius	Dissolved oxygen – 7.94	pH – 7.10
Gear used - Backpack Electroshocker	Habitat rating – 231	Alkalinity – 12.5 mg/l
Voltage - 300	Stream Width Category- 3	Conductivity- 44.6 µS/cm

Scientific Name	Common Name	Number	Number of
Genus/Species		Collected	Anomalies
<i>Noturus insignis</i>	Margined madtom	7	0
<i>Semotilus corporalis</i>	Fallfish	3	0
<i>Rhinichthys atratulus</i>	Blacknose dace	16	0
<i>Semotilus atromaculitis</i>	Creek Chub	1	0

**TOTAL 27**

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.