ROARING CREEK WATERSHED COLDWATER CONSERVATION PLAN

COLUMBIA COUNTY, PA

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and

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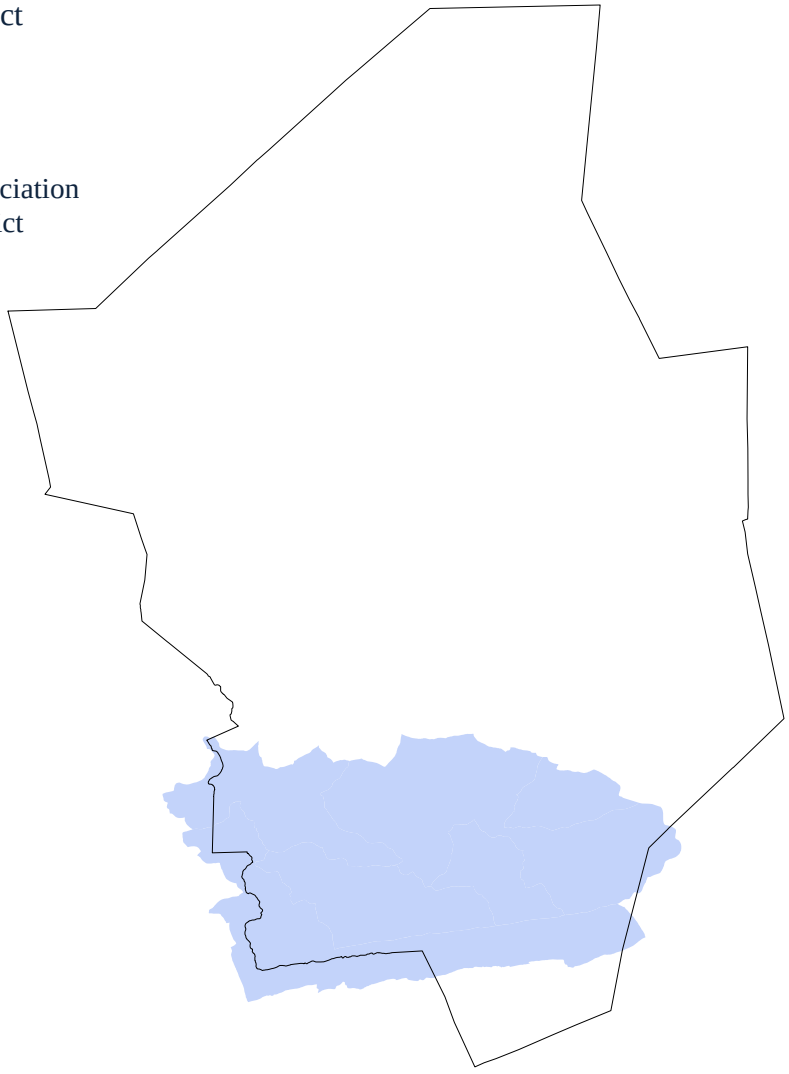

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INTRODUCTION

All citizens of the Commonwealth, present and future, have the right to *clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment* (Pennsylvania Constitution, Article 1, Section 27). However, nearly 20% of Pennsylvania's stream miles do not meet their designated use and are included on the state list of impaired waters (PA DEP 2008). The majority of impairments are attributed to many, diffuse sources resulting from polluted runoff, or non-point source pollution. To address the wide array of non-point source pollution, federal, state, and local government natural resource agencies have been working collaboratively with private landowners and community-based, non-profit organizations to reduce non-point source pollution in our waterways to allow for healthy ecosystems, clean drinking water, and recreational opportunities.

In Columbia County, the Roaring Creek Valley Conservation Association formed in February 2006 with a mission to conserve the natural resources of the Roaring Creek basin and its rich culture through watershed stewardship, education, and monitoring. As this conservation plan will describe, this watershed in southern Columbia County is unique for the area. Many of the streams in surrounding watersheds are impacted by acid mine drainage from coal extraction, making them virtually devoid of aquatic life. The geology of the Roaring Creek watershed, however, safeguarded the valley from that devastating legacy. Although impacts of human land use decisions are evident in the streams, nearly the entire watershed is designated a high quality coldwater fishery. The Roaring Creek Valley Conservation Association wanted to learn more about the state of their streams and how the group can help to protect and restore healthy aquatic ecosystems for this and future generations.

Gracious financial support from the Coldwater Heritage Partnership has enabled RCVCA and Columbia County Conservation District to compile and summarize biological, chemical, and physical data in this Roaring Creek Watershed Coldwater Conservation Plan. Several project partners contributed data, gave formal presentations to the watershed association, helped train volunteers, and provided technical support during the writing of this Plan including the Pennsylvania Department of Environmental Protection (DEP), Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Conservation and Natural Resources (DCNR), and Bloomsburg University. The goals of this Plan are to describe the current

condition of the Roaring Creek watershed and outline future conservation actions to ensure healthy streams in perpetuity.

WATERSHED DESCRIPTION

The 88 square mile Roaring Creek watershed is located in the ridge and valley physiographic province of Pennsylvania and includes portions of Columbia, Montour, Northumberland, and Schuylkill Counties (Map 1). Five small watersheds comprise the Roaring Creek watershed including the main branch of Roaring Creek, the south branch of Roaring Creek, Mill Creek, Lick Run, and Mugser Run (Map 2, Table 1). Roaring Creek and its South Branch flow 37 stream miles to their confluence with the north branch of the Susquehanna River just west of the Borough of Catawissa. Mugser Run is the largest tributary of the Creek, totaling 8 stream miles along its main stem. Mill Creek is the smallest with its main stem only 3 stream miles long. Lick Run is 4 stream miles in length.

There are approximately 3, 500 residents in the Roaring Creek watershed (U. S. Census Bureau 2000). Primary land cover in the Roaring Creek valley includes deciduous and evergreen forests, mixed forests, and agriculture. Forest land accounts for over 40% of land cover in the watershed. This is largely attributed to the 9, 000 acres of water company property along the South Branch Roaring Creek that was acquired by the Department of Conservation and Natural Resources (DCNR) in 2003. A private water company continues to have rights to the water on about 6600 acres which includes four reservoirs on the South Branch, however the DCNR owns and manages the surrounding forest using best management practices. Although Northumberland County does not account for a large percentage of the Roaring Creek basin, water from the reservoirs supplies drinking water to surrounding communities including Coal, Mt. Carmel and Shamokin Townships (more than 15, 400 people, U.S. Census Bureau 2004) because their groundwater has been contaminated by mining practices. Nearly 40% of land cover is agriculture (e. g. cropland, orchards, pasture, tree farms). Low or medium density residential property covers approximately 2% of the watershed; however this percentage may increase as new housing developments emerge each year (pers. obs.).

There are several ecologically significant features in the Roaring Creek watershed as described in the Columbia County Natural Areas Inventory (TNC 2004). Near the confluence of

the Susquehanna River, Roaring Creek bluffs ascend from the creek. The Natural Areas Inventory identified a state threatened plant species, Jeweled Shooting-Star (*Dodecatheon radicatum*), along the wet ledges of this prominent feature. Only fourteen populations are known to exist in the state (Felbaum 1995). Forested ridges and valleys of Catawissa Mountain and the south branch of Roaring Creek (Weiser State Forest) connect the Pocono Mountains to the Susquehanna River. This important natural corridor allows for wildlife migration, plant dispersal, and excellent recreational activities. The palustrine hemlock forest community in Weiser State Forest supports unique assemblages of flora and fauna, including rare and vulnerable species. Vernal pools, important breeding habitat for amphibians, are scattered throughout these forests. Eastern hemlocks (*Tsuga canadensis*) – the state tree of Pennsylvania - are threatened, however, by infestations of hemlock woolly adelgid (*Adelges tsugae*) and elongate hemlock scale (*Fiorinia externa*), non-native insects that attack and ultimately kill the trees. The DCNR has been looking at various ways to control these pests and is hopeful that the low elevation hemlocks in Weiser State Forest – Roaring Creek tract may fair better than those on upland sites (R. Martynowich, DCNR Forester, personal communication).

METHODS

Baseline biological, chemical, and physical data were collected from a variety of sources. Biological data were supplied by Martin Friday, PA Department of Environmental Protection Water Pollution Biologist III (macroinvertebrates) and Robert Wnuk, PA Fish and Boat Commission Area 4 Fisheries Manager (fish). In 2003, Martin Friday assessed streams at 37 sampling locations throughout the Roaring Creek watershed following EPA's rapid biological assessment protocol (Plafkin et al. 1989). Streams were determined to be 'attaining' or 'not attaining' their designated use as defined by Chapter 93 of the Pennsylvania Code (25 Pa. Code § 93.9) based on the relative abundance of macroinvertebrate taxa at each site. Between 2003 and 2004, Robert Wnuk conducted fisheries surveys along every named stream in the watershed to produce a Roaring Creek Basin Fisheries Management Report (Wnuk et al. 2004). The report includes species presence/absence and biomass estimates per stream section (Appendix B). Recommendations for stream classifications (HQ-CWF, CWF, TSF, etc.) and fisheries management were also included.

Basic water chemistry data (pH, alkalinity, conductivity, temperature) were associated with the biological data supplied by state agencies. Nutrient data were contributed by Dr. Steven Rier, Bloomsburg University biology professor. In 2006, his lab quantified total nitrogen and total phosphorus from 22 of the 33 DEP sampling sites according to standard methods (APHA 1996). In addition, they measured basic water chemistry parameters, calculated discharge, and estimated percent canopy cover at each location.

Assessments of physical stream habitat features important to coldwater fish were conducted by Martin Friday at the time of macroinvertebrate sampling in 2003 and in 2007 by members of Roaring Creek Valley Conservation Association. Roaring Creek Valley Conservation Association members intentionally overlapped sampling locations of DEP and Bloomsburg University to ascertain a complete understanding of the biology, chemistry, and habitat parameters at these sites. Private landowners were contacted for permission to access their property. Watershed association volunteers walked 100 m upstream and 100 m downstream of a central location and ranked in-stream cover, fine particle sediments, flow pattern, bank condition, disruptive pressure to the riparian area, riparian zone vegetative growth, human land use in the watershed, and litter on a scale from 'poor' to 'excellent'. These scores were summed and divided by the total possible score to determine a final score. Because human land use in the watershed was difficult to determine in the field, this parameter was ultimately discarded from the tally, making the highest possible score 28 points.

To determine potential land use influences at each sampling point, Julian Whitley, a student in the Department of Geography & Geosciences at Bloomsburg University, under the guidance of Dr. Jeff Brunskill, delineated the upstream watershed from each sampling location and summarized land use statistics using Spatial Analyst in ESRI® ArcMap™ 9.2 (ESRI®, Inc., Redlands, CA). Regression analysis of land use and in-stream water chemistry parameters was performed in SYSTAT© version 10 (SPSS Inc. 2000).

RESULTS AND DISCUSSION

Biological

Nearly the entire watershed is classified as a high quality coldwater fishery (Table 1, Map 3) in the Pennsylvania Code. Simply defined, high quality waters are those in which water

quality exceeds minimum values for macroinvertebrate abundance, fish propagation, and/or chemistry (25 Pa Code § 93.4b).

The PFBC found 31 fish species across 20 sampling sites during their basin-wide survey in 2003-2004, which is comparable to historic surveys (PFBC 2004). The most common species was blacknose dace (*Rhinichthys atratulus*), occurring at 85% of their sites, while several species with historic occurrences were absent, namely golden shiners (*Notemigonus crysoleucas*), fallfish (*Semotilus corporalis*), yellow bullheads (*Ameiurus natalis*), American eels (*Anguilla rostrata*), greenside darters (*Etheostoma blennioides*) and walleyes (*Sander vitreus*) (PFBC 2004). The most common game species encountered was wild brown trout, with native wild brook trout the more limited in its distribution. Based on the biomass of game species found, PFBC made recommendations for several stream sections to be upgraded from previous classifications. Mill Creek and the headwaters of Mugser Run were added to the list of Class A wild trout waters, Roaring Creek downstream from the confluence of Lick Run was recommended to be upgraded from a trout stocked fishery to coldwater fishery, and Lick Run was proposed to be promoted to a high quality coldwater fishery. 'High quality' and 'exceptional value' streams are afforded special protection by the Department of Environmental Protection to guard against degradation of water quality (from erosion, sedimentation and nutrient pollution, for example). The authors noted, however, that sedimentation was ubiquitous across surveyed streams and recommended that the Columbia, Montour, and Northumberland Conservation Districts address siltation problems throughout the watershed. They also commented that agricultural impacts were especially apparent in Mill Creek and Lick Run.

The 2003 benthic macroinvertebrate surveys conducted by PA DEP determined 36 of the 37 streams were not impaired. Most streams were dominated by taxa with low tolerances for organic pollution (see Hilsenhoff et al. 1982) (Table 2). One 0.44 mile tributary to the main branch of Roaring Creek was deemed to be impaired due to siltation from agricultural runoff (Map 3). This tributary is devoid of riparian trees that would provide a buffer between field runoff and the stream. The biologist noted this impaired stream was dominated by snails, suggesting a low dissolved oxygen level. Potential problems in the watershed include sedimentation and nutrient pollution due to lack of riparian forests, stormwater runoff from

agriculture, roads, and housing developments, acid precipitation in the headwaters of South Branch Roaring Creek, and improperly managed timbering operations.

Chemical

PFBC and Bloomsburg University biologists found higher acidity in Weiser State Forest than other streams in the watershed. Low pH (5.5 - 5.7) in the headwaters of South Branch Roaring Creek may be attributed to underlying geology and naturally low buffering capacity of the soils, organic acids from the upstream wetland, and/or acid precipitation. Although it may be fruitful to further investigate the cause of acidification, concentrating time and energy on a relatively pristine protected area over stream habitat enhancement projects on more degraded streams in the watershed may not be warranted.

Along with pH and alkalinity, water temperature is another important factor in determining the distribution of coldwater fish species and the aquatic organisms on which they feed. Native eastern brook trout have been found to prefer water temperature around 18.9 ^{0}C (66 ^{0}F), whereas non-native rainbow and brown trout prefer slightly higher water temperature, around 21.1 ^{0}C (70-80 ^{0}F) (Greene 1950). Brown trout and rainbow trout can tolerate a maximum temperature of 26.7 ^{0}C (80 ^{0}F). Brook trout abundance and distribution can become limited at 23.8 ^{0}C, or 75 ^{0}F. Water temperature measured at base flow in July 2006 across Roaring Creek watershed sampling sites decreased as the percentage of tree canopy cover increased at the respective sampling locations ($p<0.05$) (Figure 1). Water temperature also decreased when a higher percentage of the upstream sections from the sampling locations had at least a 50 m wide riparian buffer, however this was not statistically significant ($p>0.05$) (Figure 1). To support a viable coldwater fishery, it will be important to maintain low water temperatures by protecting existing riparian forests and replanting those that have been lost.

Excessive nitrogen (N) and phosphorus (P) loading to streams and rivers has been the subject of intense research for several decades, has been the focus of a nationwide effort to establish nutrient criteria for water bodies (USEPA 1998), and has driven the development of the many best management practices currently employed throughout the Roaring Creek watershed. Atmospheric deposition (N only), runoff from agriculture, and sewage discharges all contribute

to the problem of N and P loading, which continues to amplify with human population growth (Vitousek et al. 1997, Carpenter et al. 1998). Excess nutrient loading can result in the eutrophication (excessive production) of downstream estuaries (e.g., Chesapeake Bay) and coastal zones, which can cause declines in fish populations and other economically important aquatic life. Locally, excess N and P can also lead to eutrophication of streams and rivers which often involves excess algal growth and a decline in the diversity of aquatic organisms. Excess algal growth can lead to the accumulation of organic matter which may cause oxygen to decline at night below the tolerance thresholds for fish and macroinvertebrates and cause other toxic products such as hydrogen sulfide and ammonium to be produced (USEPA 1998). Excessively high nitrogen in the form of ammonium can be toxic to fish and excessively high nitrate (>10,000 µg/L) can cause human health problems.

In the current study, Nitrogen and Phosphorus, measured as total nitrogen (TN) and total phosphorus (TP) at base flow, ranged from 3 to 38 µg/L P and from 209 to 7,238 µg/L N (Table 4). Since the ratio of total nitrogen to total phosphorus far exceeds the Redfield (1958) N:P ratio of 16:1 it is most likely that phosphorus is the nutrient that limits algal accrual in the streams of the Roaring Creek watershed. Typical TP concentrations for pristine streams that are minimally impacted by humans in the mid-Atlantic region of the United States are ~10 µg/L TP (Stevenson et al. 2008). Concentrations above 12 µg/L TP typically result in measurable increases in algal accrual and shifts in algal community composition (Stevenson et al. 2008). 17 out of the 21 streams sampled by Bloomsburg University had concentrations that exceeded the 12 µg/L P threshold. Although there were no algal blooms observed during the survey (Chlorophyll *a* <10 µg/cm^2), TP concentrations in several streams were at or near levels that could potentially produce excessive algal growths (see Rier and Stevenson 2006). Such growths could result in detrimental effects to the macroinvertebrate and fish communities (see Wang et al. 2007).

Land use practices affect all aspects of stream ecosystems, for better or worse, and will be expressed in the water chemistry. An intact riparian forest can act as natural flood control, filter sediments and nutrients before reaching the stream, provide leaf litter and woody debris to streams which fuel the food chain, and is a home for an array of wildlife (see Sweeney and Blaine 2007 for a good discussion of the importance of riparian forests). As such, we would

expect to see lower total nitrogen in streams with at least a 50 m 'buffer' between the stream and adjacent land use. Figure 2 illustrates that total nitrogen decreases with a greater percentage of riparian buffer upstream of the sample location ($p<0.05$). This suggests that having an intact riparian forest can significantly reduce the amount of nitrogen the stream receives. Conserving and restoring riparian forests in conjunction with best management practices on farms (no-till, proper manure storage, having a nutrient management plan, e.g.) and residential properties (reducing lawn fertilizer application, landscaping with native plants to reduce water use, installing rain barrels and rain gardens, e.g.) can reduce nutrient pollution to streams and maintain their ecological and recreational value for future generations.

Physical

Visual assessments conducted by DEP and RCVCA revealed that, although the majority of the streams are coldwater or high quality coldwater fisheries, potential for degradation exists. None of the streams were considered to be 'pristine'. In fact, many received low visual assessment grades (Map 5). The three primary reasons for low scores were poor riparian buffer quality (sparse vegetation, inadequate width of vegetation to be effective, e.g.), sedimentation, and flow pattern (lack of heterogeneity in stream channel with riffles, runs, and pools). Unstable banks and poor in-stream habitat were of concern in certain areas.

These issues can be addressed on a site by site basis throughout the watershed using a variety of constructed options. However, the best option for coldwater streams in the long term is to protect currently vegetated stream banks (perhaps through conservation easements) and revegetate those lacking trees.

RECOMMENDATIONS

In September 2008, a public meeting was held to review results of biological, chemical, and physical data and establish a plan for future protection/restoration measures that will ensure healthy streams (i.e. nutrient processing, sediment transport). Table 5 lists primary concerns resulting from this study and suggested methods of addressing those concerns. Three major conservation actions are highlighted below.

1. Establish a long-term stream monitoring program.

The Roaring Creek Valley Conservation Association officers will work with the Columbia County Conservation District, Bloomsburg University, DCNR, and DEP, and other partners to establish monitoring protocols, determine sampling sites, and conduct stream monitoring at intervals pertinent to the data being collected. Because ubiquitous sedimentation and high nutrient concentrations in select sub basins are primary threats to water quality, parameters measured are likely to include turbidity, total nitrogen, and total phosphorous along with pH, alkalinity, and discharge.

2. Convey information from stream sampling to the public in an appropriate format.

One objective of the Roaring Creek Valley Conservation Association is to educate watershed residents about local water quality as a means of engaging their interest in the streams they drive by everyday. The Association would like to develop and disseminate a 'state of the watershed' report on an annual basis. An outreach tool used in other watersheds in the Chesapeake Bay is a "watershed report card" that conveys scientifically rigorous data analysis in a way non-scientists can understand. The goal is to raise awareness of watershed issues and, ultimately, motivate residents to become actively engaged in conserving water resources.

3. Assist private landowners to get conservation projects on the ground (wetland restoration, riparian plantings, e.g.).

The watershed association would like to continue to market the organization and lead by example rather than directly approach private landowners. Many individuals have approached the group for assistance. As the relatively new association builds credibility in the small watershed, more individuals will likely turn to them for assistance. Through leading by example, they are confident that important projects will be implemented and more projects will emerge.

ACKNOWLEDGEMENTS

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Martin Friday of Pennsylvania Department of Environmental Protection, Mark Deibler of Pennsylvania Department of Conservation and Natural Resources, and Dr. Steve Rier of Bloomsburg University. In addition, their review and comments of previous drafts greatly improved this Plan. Special thanks to Kevin Nawrocki and Mike Dzwonek, biology students from Bloomsburg University, who helped collect samples and run nutrient analyses in Dr. Rier's lab. Dr. Rier contributed to the discussion of nutrients in this plan. Dr. Jeff Brunskill of Bloomsburg University and his advanced GIS students provided spatial data and analysis for use in this plan. Julian Whitley, a geography student at Bloomsburg University, was particularly helpful by delineating drainage basins above each sampling point and determining land uses within each drainage. Sean Levan, Montour Conservation District, provided insightful comments on a previous draft of this plan. We also thank the many private landowners who allowed stream access to watershed association volunteers to conduct visual assessments. We hope to continue fruitful partnerships with these watershed neighbors to enhance the quality of life and enjoyment of the beautiful streams throughout the basin.

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Table 1. Characteristics of subwatersheds within the Roaring Creek watershed, Columbia County, PA.

Subwatershed	Stream miles (main stem)	Size (mi^2)	Stream designation and protected uses	Impairments
Main Branch Roaring Creek	20	40	Headwaters to Lick Run confluence: HQ-CWF, main stem is Class A wild trout water Lick Run confluence to Susquehanna River: TSF Tributaries: Headwater tributaries HQ-CWF, all others CWF	0.44 mile tributary (siltation)
South Branch Roaring Creek	17	25	HQ-CWF State Road 3008 to Campground Road: Class A wild trout stream	
Mugser Run	8	12	HQ-CWF Headwaters to Fisherdale Road: Class A wild trout water	
Lick Run	4	6	CWF (proposed HQ-CWF) Headwaters to mouth along mainstem: Class A wild trout water	
Mill Creek	3	5	HQ-CWF Headwaters to mouth along mainstem: Class A wild trout water	

Definitions (as defined by Pennsylvania Code, Title 25, Chapter 93 – Water Quality Standards)

CWF (Cold Water Fishes): Maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat

HQ-CWF (High Quality Cold Water Fishes): CWF plus attains biological and/or chemical criteria to meet high quality standards

Class A wild trout water: Classified by PFBC, based on species-specific biomass standards, which supports a population of naturally produced trout of sufficient size and abundance to support a long-term and rewarding sport fishery

TSF (Trout Stocking): Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.

Table 2. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04. 0 = intolerant; 10 = tolerant

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
Main Branch Roaring Creek 1				
	Philopotamidae	Abundant	25-100	3
	Ephemerellidae	Common	10-25	2
	Psephenidae	Common	10-25	4
	Nigronia	Common	10-25	2
	Hydropsychidae	Common	10-25	5
	Rhyacophilidae	Common	10-25	1
	Oligochaeta	Present	3-9	10
	Baetidae	Present	3-9	6
	Isonychiidae	Present	3-9	3
	Perlidae	Present	3-9	3
	Glossosomatidae	Present	3-9	0
	Cambaridae	Rare	<3	6
	Ephemeridae	Rare	<3	4
	Heptageniidae	Rare	<3	3
	Gomphidae	Rare	<3	4
	Peltoperlidae	Rare	<3	2
	Perlodidae	Rare	<3	2
	Pteronarcyidae	Rare	<3	0
	Ptilodactylidae	Rare	<3	5
	Sialidae	Rare	<3	6
	Brachycentridae	Rare	<3	1
	Tipulidae	Rare	<3	4
Main Branch Roaring Creek 3				
	Isonychiidae	Abundant	25-100	3
	Hydropsychidae	Abundant	25-100	5
	Perlodidae	Common	10-25	2
	Elmidae	Common	10-25	5
	Psephenidae	Common	10-25	4
	Baetidae	Present	3-9	6
	Heptageniidae	Present	3-9	3
	Nigronia	Present	3-9	2
	Philopotamidae	Present	3-9	3
	Oligochaeta	Rare	<3	10
	Cambaridae	Rare	<3	6
	Ephemerellidae	Rare	<3	2
	Corydalus	Rare	<3	4
	Sialidae	Rare	<3	6
	Athericidae	Rare	<3	2
	Simuliidae	Rare	<3	6
	Tipulidae	Rare	<3	4

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
Main Branch Roaring Creek 4				
	Isonychiidae	Abundant	25-100	3
	Perlidae	Abundant	25-100	3
	Hydropsychidae	Abundant	25-100	5
	Baetidae	Common	10-25	6
	Elmidae	Common	10-25	5
	Psephenidae	Common	10-25	4
	Corydalus	Common	10-25	4
	Oligochaeta	Present	3-9	10
	Heptageniidae	Present	3-9	3
	Nigronia	Present	3-9	2
	Philopotamidae	Present	3-9	3
	Athericidae	Present	3-9	2
	Turbellaria	Rare	<3	9
	Sphaeriidae	Rare	<3	8
	Cambaridae	Rare	<3	6
	Gomphidae	Rare	<3	4
	Coenagrionidae	Rare	<3	8
	Simuliidae	Rare	<3	6
	Tipulidae	Rare	<3	4
Main Branch Tributary 1				
	Philopotamidae	Abundant	25-100	3
	Leptophlebiidae	Common	10-25	4
	Gomphidae	Common	10-25	4
	Leuctridae	Common	10-25	0
	Hydropsychidae	Common	10-25	5
	Tipulidae	Common	10-25	4
	Perlidae	Present	3-9	3
	Perlodidae	Present	3-9	2
	Elmidae	Present	3-9	5
	Lepidostomatidae	Present	3-9	1
	Rhyacophilidae	Present	3-9	1
	Empididae	Present	3-9	6
	Cambaridae	Rare	<3	6
	Baetidae	Rare	<3	6
	Ephemerellidae	Rare	<3	2
	Heptageniidae	Rare	<3	3
	Isonychiidae	Rare	<3	3
	Nemouridae	Rare	<3	2
	Peltoperlidae	Rare	<3	2
	Pteronarcyidae	Rare	<3	0
	Nigronia	Rare	<3	2
	Limnephilidae	Rare	<3	4

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORES
Main Branch Tributary 1 (cont.)				
	Dixidae	Rare	<3	1
	Simuliidae	Rare	<3	6
Main Branch Tributary 2				
	Philopotamidae	Abundant	25-100	3
	Baetidae	Common	10-25	6
	Perlidae	Common	10-25	3
	Perlodidae	Common	10-25	2
	Pteronarcyidae	Common	10-25	0
	Ephemerellidae	Present	3-9	2
	Elmidae	Present	3-9	5
	Psephenidae	Present	3-9	4
	Ptilodactylidae	Present	3-9	5
	Nigronia	Present	3-9	2
	Hydropsychidae	Present	3-9	5
	Oligochaeta	Rare	<3	10
	Cambaridae	Rare	<3	6
	Isonychiidae	Rare	<3	3
	Leptophlebiidae	Rare	<3	4
	Aeshnidae	Rare	<3	3
	Cordulegastridae	Rare	<3	3
	Gomphidae	Rare	<3	4
	Leuctridae	Rare	<3	0
	Peltoperlidae	Rare	<3	2
	Polycentropodidae	Rare	<3	6
	Rhyacophilidae	Rare	<3	1
	Tipulidae	Rare	<3	4
Main Branch Tributary 3				
	Leuctridae	Abundant	25-100	0
	Hydropsychidae	Abundant	25-100	5
	Nigronia	Common	10-25	2
	Philopotamidae	Common	10-25	3
	Turbellaria	Present	3-9	9
	Cambaridae	Present	3-9	6
	Baetidae	Present	3-9	6
	Heptageniidae	Present	3-9	3
	Leptophlebiidae	Present	3-9	4
	Psephenidae	Present	3-9	4
	Sialidae	Present	3-9	6
	Rhyacophilidae	Present	3-9	1
	Oligochaeta	Rare	<3	10

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
Main Branch Tributary 3 (cont.)				
	Isonychiidae	Rare	<3	3
	Gomphidae	Rare	<3	4
	Perlidae	Rare	<3	3
	Glossosomatidae	Rare	<3	0
	Polycentropodidae	Rare	<3	6
	Athericidae	Rare	<3	2
Main Branch Tributary 4				
	Perlidae	Common	10-25	3
	Hydropsychidae	Common	10-25	5
	Philopotamidae	Common	10-25	3
	Cambaridae	Present	3-9	6
	Baetidae	Present	3-9	6
	Gomphidae	Present	3-9	4
	Leuctridae	Present	3-9	0
	Peltoperlidae	Present	3-9	2
	Pteronarcyidae	Present	3-9	0
	Elmidae	Present	3-9	5
	Psephenidae	Present	3-9	4
	Nigronia	Present	3-9	2
	Athericidae	Present	3-9	2
	Tipulidae	Present	3-9	4
	Oligochaeta	Rare	<3	10
	Ephemerellidae	Rare	<3	2
	Heptageniidae	Rare	<3	3
	Leptophlebiidae	Rare	<3	4
	Rhyacophilidae	Rare	<3	1
Main Branch Tributary 6				
	Leuctridae	Common	10-25	0
	Perlidae	Common	10-25	3
	Hydropsychidae	Common	10-25	5
	Philopotamidae	Common	10-25	3
	Isonychiidae	Present	3-9	3
	Leptophlebiidae	Present	3-9	4
	Psephenidae	Present	3-9	4
	Nigronia	Present	3-9	2
	Tipulidae	Present	3-9	4
	Sphaeriidae	Rare	<3	8
	Cambaridae	Rare	<3	6
	Baetidae	Rare	<3	6
	Aeshnidae	Rare	<3	3
	Gomphidae	Rare	<3	4

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
Main Branch Tributary 6 (cont.)				
	Peltoperlidae	Rare	<3	2
	Rhyacophilidae	Rare	<3	1
	Simuliidae	Rare	<3	6
Main Branch Tributary 7				
	Hydropsychidae	Abundant	25-100	5
	Turbellaria	Common	10-25	9
	Baetidae	Common	10-25	6
	Heptageniidae	Common	10-25	3
	Leptophlebiidae	Common	10-25	4
	Perlidae	Common	10-25	3
	Philopotamidae	Common	10-25	3
	Oligochaeta	Present	3-9	10
	Cambaridae	Present	3-9	6
	Psephenidae	Present	3-9	4
	Nigronia	Present	3-9	2
	Tipulidae	Present	3-9	4
	Ephemerellidae	Rare	<3	2
	Isonychiidae	Rare	<3	3
	Gomphidae	Rare	<3	4
	Leuctridae	Rare	<3	0
	Peltoperlidae	Rare	<3	2
	Elmidae	Rare	<3	5
	Athericidae	Rare	<3	2
Lick Run 1				
	Isonychiidae	Common	10-25	3
	Hydropsychidae	Common	10-25	5
	Cambaridae	Present	3-9	6
	Ephemerellidae	Present	3-9	2
	Peltoperlidae	Present	3-9	2
	Nigronia	Present	3-9	2
	Philopotamidae	Present	3-9	3
	Rhyacophilidae	Present	3-9	1
	Oligochaeta	Rare	<3	10
	Turbellaria	Rare	<3	9
	Baetidae	Rare	<3	6
	Perlidae	Rare	<3	3
	Ptilodactylidae	Rare	<3	5
	Tipulidae	Rare	<3	4
Lick Run 2				
	Elmidae	Abundant	25-100	5
	Psephenidae	Abundant	25-100	4

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
Lick Run 2 (cont.)				
	Hydropsychidae	Abundant	25-100	5
	Crangonyctidae	Common	10-25	4
	Baetidae	Common	10-25	6
	Philopotamidae	Common	10-25	3
	Cambaridae	Present	3-9	6
	Isonychiidae	Present	3-9	3
	Perlidae	Present	3-9	3
	Glossosomatidae	Present	3-9	0
	Rhyacophilidae	Present	3-9	1
	Oligochaeta	Rare	<3	10
	Turbellaria	Rare	<3	9
	Cordulegastridae	Rare	<3	3
	Leuctridae	Rare	<3	0
	Nigronia	Rare	<3	2
	Simuliidae	Rare	<3	6
Mill Creek				
	Nigronia	Common	10-25	2
	Hydropsychidae	Common	10-25	5
	Philopotamidae	Common	10-25	3
	Ephemerellidae	Present	3-9	2
	Heptageniidae	Present	3-9	3
	Gomphidae	Present	3-9	4
	Perlidae	Present	3-9	3
	Perlodidae	Present	3-9	2
	Pteronarcyidae	Present	3-9	0
	Sialidae	Present	3-9	6
	Limnephilidae	Present	3-9	4
	Oligochaeta	Rare	<3	10
	Cambaridae	Rare	<3	6
	Baetidae	Rare	<3	6
	Ephemeridae	Rare	<3	4
	Isonychiidae	Rare	<3	3
	Leptophlebiidae	Rare	<3	4
	Leuctridae	Rare	<3	0
	Peltoperlidae	Rare	<3	2
	Dytiscidae	Rare	<3	5
	Psephenidae	Rare	<3	4
	Polycentropodidae	Rare	<3	6
	Rhyacophilidae	Rare	<3	1
	Tipulidae	Rare	<3	4
Mugser Run 1				
	Sphaeriidae	Abundant	25-100	8
	Hydropsychidae	Abundant	25-100	5

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
Mugser Run 1 (cont.)				
	Philopotamidae	Abundant	25-100	3
	Turbellaria	Common	10-25	9
	Oligochaeta	Present	3-9	10
	Isonychiidae	Present	3-9	3
	Elmidae	Present	3-9	5
	Psephenidae	Present	3-9	4
	Glossosomatidae	Present	3-9	0
	Simuliidae	Present	3-9	6
	Cambaridae	Rare	<3	6
	Baetidae	Rare	<3	6
	Ephemerellidae	Rare	<3	2
	Heptageniidae	Rare	<3	3
	Aeshnidae	Rare	<3	3
	Leuctridae	Rare	<3	0
	Nigronia	Rare	<3	2
	Limnephilidae	Rare	<3	4
	Tipulidae	Rare	<3	4
Mugser Run 2				
	Psephenidae	Abundant	25-100	
	Hydropsychidae	Abundant	25-100	
	Philopotamidae	Abundant	25-100	
	Heptageniidae	Common	10-25	
	Isonychiidae	Common	10-25	
	Oligochaeta	Present	3-9	
	Cambaridae	Present	3-9	
	Baetidae	Present	3-9	
	Perlidae	Present	3-9	
	Elmidae	Present	3-9	
	Glossosomatidae	Present	3-9	
	Asellidae	Rare	<3	
	Ephemerellidae	Rare	<3	
	Leptophlebiidae	Rare	<3	
	Gomphidae	Rare	<3	
	Leuctridae	Rare	<3	
	Perlodidae	Rare	<3	
	Nigronia	Rare	<3	
	Rhyacophilidae	Rare	<3	
	Athericidae	Rare	<3	
	Tipulidae	Rare	<3	
Mugser Run 3				
	Perlidae	Abundant	25-100	3
	Hydropsychidae	Abundant	25-100	5
	Philopotamidae	Abundant	25-100	3

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
Mugser Run 3 (cont.)				
	Ephemerellidae	Common	10-25	2
	Heptageniidae	Common	10-25	3
	Isonychiidae	Common	10-25	3
	Psephenidae	Common	10-25	4
	Oligochaeta	Present	3-9	10
	Glossosomatidae	Present	3-9	0
	Baetidae	Rare	<3	6
	Leptophlebiidae	Rare	<3	4
	Gomphidae	Rare	<3	4
	Elmidae	Rare	<3	5
	Nigronia	Rare	<3	2
	Polycentropodidae	Rare	<3	6
	Rhyacophilidae	Rare	<3	1
	Tipulidae	Rare	<3	4
Mugser Tributary 1				
	Leptophlebiidae	Abundant	25-100	4
	Leuctridae	Abundant	25-100	0
	Nemouridae	Common	10-25	2
	Simuliidae	Common	10-25	6
	Baetidae	Present	3-9	6
	Ephemerellidae	Present	3-9	2
	Perlodidae	Present	3-9	2
	Dytiscidae	Present	3-9	5
	Elmidae	Present	3-9	5
	Psephenidae	Present	3-9	4
	Nigronia	Present	3-9	2
	Glossosomatidae	Present	3-9	0
	Hydropsychidae	Present	3-9	5
	Tipulidae	Present	3-9	4
	Oligochaeta	Rare	<3	10
	Turbellaria	Rare	<3	9
	Physidae	Rare	<3	8
	Cambaridae	Rare	<3	6
	Heptageniidae	Rare	<3	3
	Peltoperlidae	Rare	<3	2
	Limnephilidae	Rare	<3	4
	Philopotamidae	Rare	<3	3
	Rhyacophilidae	Rare	<3	1
	Empididae	Rare	<3	6
South Branch Roaring Creek 2				
	Hydropsychidae	Abundant	25-100	5
	Philopotamidae	Abundant	25-100	3

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
South Branch Roaring Creek 2 (cont.)				
	Leuctridae	Common	10-25	0
	Oligochaeta	Present	3-9	10
	Baetidae	Present	3-9	6
	Ephemerellidae	Present	3-9	2
	Aeshnidae	Present	3-9	3
	Gomphidae	Present	3-9	4
	Perlidae	Present	3-9	3
	Pteronarcyidae	Present	3-9	0
	Nigronia	Present	3-9	2
	Tipulidae	Present	3-9	4
	Cambaridae	Rare	<3	6
	Heptageniidae	Rare	<3	3
	Peltoperlidae	Rare	<3	2
	Perlodidae	Rare	<3	2
	Psephenidae	Rare	<3	4
	Polycentropodidae	Rare	<3	6
	Rhyacophilidae	Rare	<3	1
South Branch Roaring Creek 3				
	Hydropsychidae	Abundant	25-100	5
	Philopotamidae	Abundant	25-100	3
	Isonychiidae	Common	10-25	3
	Psephenidae	Common	10-25	4
	Oligochaeta	Present	3-9	10
	Turbellaria	Present	3-9	9
	Baetidae	Present	3-9	6
	Ephemerellidae	Present	3-9	2
	Heptageniidae	Present	3-9	3
	Perlidae	Present	3-9	3
	Pteronarcyidae	Present	3-9	0
	Nigronia	Present	3-9	2
	Glossosomatidae	Present	3-9	0
	Simuliidae	Present	3-9	6
	Physidae	Rare	<3	8
	Cambaridae	Rare	<3	6
	Gomphidae	Rare	<3	4
	Leuctridae	Rare	<3	0
	Nemouridae	Rare	<3	2
	Lepidostomatidae	Rare	<3	1
	Tipulidae	Rare	<3	4

Table 2 *continued*. Macroinvertebrate taxa and Hilsenhoff pollution tolerance scores identified at each sampling location by Pennsylvania Department of Environmental Protection in 2003-04.

SITE	TAXA	ABUNDANCE	NUMBER OF INDIVIDUALS	HILSENHOFF POLLUTION TOLERANCE SCORE
South Branch Tributary 1				
	Leptophlebiidae	Abundant	25-100	4
	Hydropsychidae	Abundant	25-100	5
	Philopotamidae	Abundant	25-100	3
	Baetidae	Present	3-9	6
	Heptageniidae	Present	3-9	3
	Perlidae	Present	3-9	3
	Perlodidae	Present	3-9	2
	Elmidae	Present	3-9	5
	Psephenidae	Present	3-9	4
	Nigronia	Present	3-9	2
	Rhyacophilidae	Present	3-9	1
	Tipulidae	Present	3-9	4
	Oligochaeta	Rare	<3	10
	Cambaridae	Rare	<3	6
	Ephemerellidae	Rare	<3	2
	Chloroperlidae	Rare	<3	0
	Leuctridae	Rare	<3	0
	Nemouridae	Rare	<3	2
	Peltoperlidae	Rare	<3	2
	Lepidostomatidae	Rare	<3	1
	Simuliidae	Rare	<3	6

Table 3. Visual assessment results, Roaring Creek watershed, Columbia County, PA. Visual assessments were completed by Roaring Creek Valley Conservation Association volunteers in October-November 2007.

Date sampled	Site	Lat_DD	Long_DD	Instream cover	Sediment	Flow pattern	Banks	Disruptive pressure	Riparian zone	Litter	Total Score	%
28-Nov	LIRU1	40.870295	-76.374530	2.5	2	3	2.5	2	1.5	3	16.5	59
14-Oct	LIRU2	40.895433	-76.387594	2.5	3.5	3	3.5	3	3	2	20.5	73
28-Nov	MBRC1	40.884373	-76.338746	2	2.5	2	2.5	2	1.5	3	15.5	55
21-Oct	MBRC2	40.911933	-76.424060	2.5	3	4	2.5	3.5	2.5	3	21	75
28-Oct	MBRC3	40.907119	-76.494123	2.5	3.5	4	3	3.5	3.5	3	23	82
28-Oct	MBRC4	40.919814	-76.527535	3	3	4	4	2.5	2.5	3	22	79
28-Nov	MBTR1	40.865882	-76.331570	3	2.5	3	3	3	2.5	3	20	71
28-Nov	MBTR2	40.872021	-76.327031	3	2	2	2.5	2.5	2.5	3	17.5	63
21-Oct	MBTR3	40.891536	-76.414286	2.5	3	3	3.5	3	2.5	4	21.5	77
21-Oct	MBTR4	40.915408	-76.427592	3	3	3	3	3	3	4	22	79
5-Oct	MBTR5	40.911461	-76.487873	2.5	2	2	2.5	2.5	2.5	3	17	61
21-Oct	MBTR6	40.903445	-76.447786	4	3.5	3	4	4	4	3	25.5	91
5-Oct	MBTR7	40.901185	-76.467264	3	3	2	3	3	3	2	19	68
1-Oct	MICR	40.898238	-76.348658	2.5	3	3	3	2.5	2.5	4	20.5	73
1-Nov	MURU1	40.852184	-76.443013	3	2	2	3	3	3	3	19	68
1-Nov	MURU3	40.877083	-76.495773	3	3	3	3	2	2	4	20	71
1-Nov	MUTR1	40.854461	-76.443677	2	2	2	3	2	3	3	17	61
28-Oct	SBRC1	40.839076	-76.348771	3	1	4	4	4	4	4	24	86
28-Oct	SBRC2	40.832495	-76.503671	3.5	3.5	4	3	2.5	2.5	2.5	21.5	77
5-Oct	SBRC3	40.900180	-76.512377	2	3	3	2	2.5	2	2	16.5	59
5-Oct	SBTR1	40.851750	-76.497194	3	3	3	3	3	3	3	21	75

Score

0-1	Poor	LIRU	Lick Run	MURU	Mugser Run
1-2	Marginal	MICR	Mill Creek	TR	Tributary
2-3	Good	MBRC	Main Branch Roaring Creek	SBRC	South Branch Roaring Creek
3-4	Excellent				

Table 4. Chemical and physical parameters in Roaring Creek watershed, Columbia County, PA collected by S. T. Rier at Bloomsburg University, summer 2006.

Site	Temperature (°C)	Specific Conductance (µS/cm)	pH	Alkalinity (mg/L)	Canopy%	Discharge(L/s)	Algal Biomass (µg chlorophyll *a*/cm²)	Total Phosphorous (µg/L)	Total Nitrogen (µg/L)
LIRU1	19.6	75	6.02	50.0	90	28.2	0.02	13.1	1854.8
LIRU2	23.7	106	7.21	34.0	50	39.8	1.21	16.3	1842.7
MBRC1	23.0	49	6.50	5.1	0	12.2	0.34	12.6	956.5
MBRC2	25.0	11	6.89	32.0	10	243.5	0.01	22.5	2343.1
MBRC3	25.0	119	7.34	21.0	75	216.7	0.16	28.6	1987.4
MBRC4	25.9	127	8.27	25.0	30	271.6	1.07	12.9	1559.4
MBTR1	21.0	51	5.68	9.9	85	3.0	0.01	5.2	245.2
MBTR2	21.7	32	5.63	8.0	87	7.8	0.04	3.2	239.2
MBTR3	22.2	148	6.41	63.0	95	4.0	0.99	12.8	7238.1
MBTR4	23.9	88	6.92	17.0	20	12.4	0.58	12.8	2144.1
MBTR5	20.2	151	6.22	18.0	95	1.3	0.02	35.6	5325.1
MBTR6	20.9	6	6.64	8.0	88	2.7	1.40	7.2	2204.4
MBTR7	22.7	146	6.74	3.0	87	4.6	2.30	15.5	1004.8
MICR	21.4	68	5.98	55.0	95	24.1	0.27	37.5	1661.9
MURU1	19.7	102	6.33	18.0	85	42.8	2.66	8.7	1487.0
MURU2	21.2	102	6.70	10.0	50	38.8	2.00	15.5	1613.6
MURU3	22.3	93	6.84	11.0	50	35.2	2.58	7.2	1119.3
MUTR1	20.5	147	6.68	37.0	20	4.5	0.21	18.5	1065.0
SBRC1	17.6	35	5.38	9.4	93	32.9	0.22	12.6	275.3
SBRC2	20.6	64	5.80	7.0	40	142.3	1.49	26.4	209.0
SBRC3	22.4	146	6.41	19.0	40	33.3	3.81	13.8	1155.5
SBTR1	21.6	112	6.15	18.0	60	6.0	0.90	13.1	2885.6

Table 5. Coldwater fisheries concerns (derived from field data) in the Roaring Creek watershed, Columbia County, ways to address these concerns, potential funding sources, and potential partnerships.

Concern	Ways to address the concern	Possible funding source	Potential project partners
Siltation	Quantify extent of problem in streams	Foundation for Pennsylvania Watersheds; DEP Growing Greener	Bloomsburg University, DCNR, townships, Columbia County TU, CCCD
	Permanent easements on forested stream banks	DCNR, Degenstein Foundation	Northcentral Pennsylvania Conservancy
	Streambank planting projects	NRCS CREP, CBF, DCNR	DCNR, USDA, CBF, DEP
	Streambank fencing projects	USDA, CBF, DEP	CCCD, USDA, CBF, DEP
	Assess streambank erosion throughout watershed		CCCD, Columbia County TU
	Promote no-till practices on farms	Education grants - PACD, WREN, DEP	CCCD, DEP Bay Program, Penn State Extension
	Encourage use of cover crops on farms	Education grants - PACD, WREN, DEP	CCCD, DEP Bay Program, NRCS
	Promote conservation planning on farms	Education grants - PACD, WREN, DEP	CCCD, DEP Bay Program, NRCS
	Educate township supervisors on the importance of maintaining riparian forests and encourage them to preserve established streamside trees whenever possible.	Education grants - PACD, WREN, DEP	CCCD, DEP, WREN
	Educate township supervisors on the importance of reducing runoff from <u>all</u> dirt and gravel roads in the township - not just heavily used roads	Education grants - PACD, WREN, DEP	CCCD, DEP Dirt & Gravel Roads program

Table 5 *continued*. Coldwater fisheries concerns (derived from field data) in the Roaring Creek watershed, Columbia County, ways to address these concerns, potential funding sources, and potential partnerships.

Concern	Ways to address the concern	Possible funding source	Potential project partners
Nutrient pollution	Establish continuous stream monitoring program	Foundation for Pennsylvania Watersheds; DEP Growing Greener	Bloomsburg University, DCNR, townships, Columbia County TU, CCCD
	Promote no-till practices on farms	Education grants - PACD, WREN, DEP	CCCD, DEP Bay Program
	Encourage use of cover crops on farms	Education grants - PACD, WREN, DEP	CCCD, DEP Bay Program
	Educate residential landowners about proper lawn fertilizer use	Education grants - PACD, WREN, DEP	CCCD, DEP Bay Program
	Work with golf courses to reduce runoff by implementing best management practices	Education grants - PACD, WREN, DEP	CCCD, DEP Bay Program, Audubon
	Encourage nutrient management planning on farms	Education grants - PACD, WREN, DEP; REAP	CCCD, DEP Bay Program, NRCS
Warm water temperature - restricted brook trout distribution	Streambank planting projects to lower water temperature	NRCS CREP, CBF, DCNR	
	Reduce siltation (see above)		
Stream access - particularly Mill Creek	Access agreements on private property	DCNR, PFBC, PA Land Trust Association	Pennsylvania Fish and Boat Commission, PA Land Trust Association

DEP = Department of Environmental Protection; DCNR = Department of Conservation and Natural Resources; PFBC = Pennsylvania Fish and Boat Commission; CCCD = Columbia County Conservation District; NRCS = Natural Resource Conservation Service; CREP = Conservation Reserve Enhancement Program; PACD = Pennsylvania Association of Conservation Districts; WREN = Water Resource Education Network; REAP = Resource Enhancement and Protection

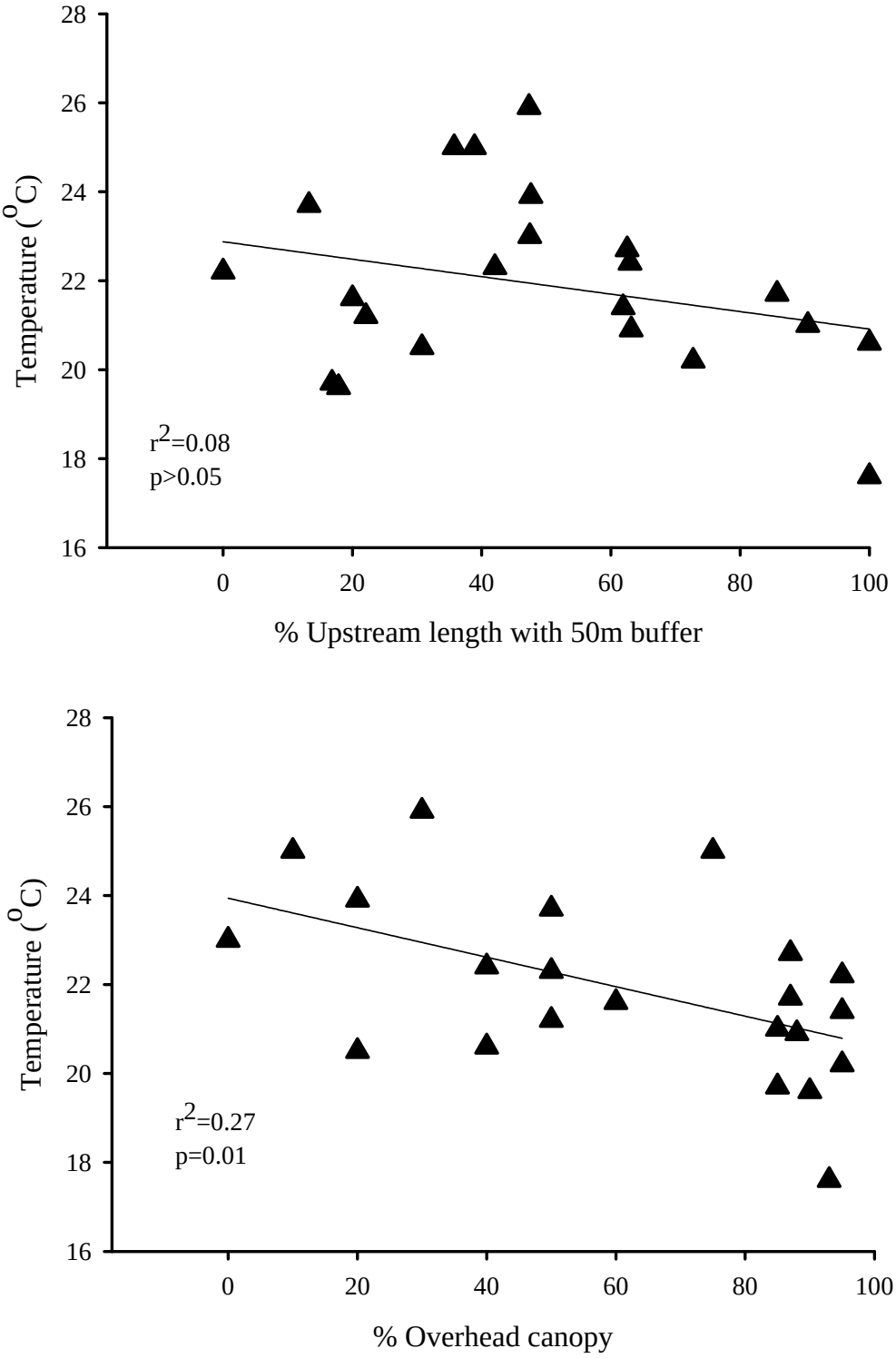


Figure 1. Water temperature as a function of buffer width and overhead canopy in the Roaring Creek watershed, Columbia County, July 2006. Data were provided by Dr. Steven Rier, Bloomsburg University.

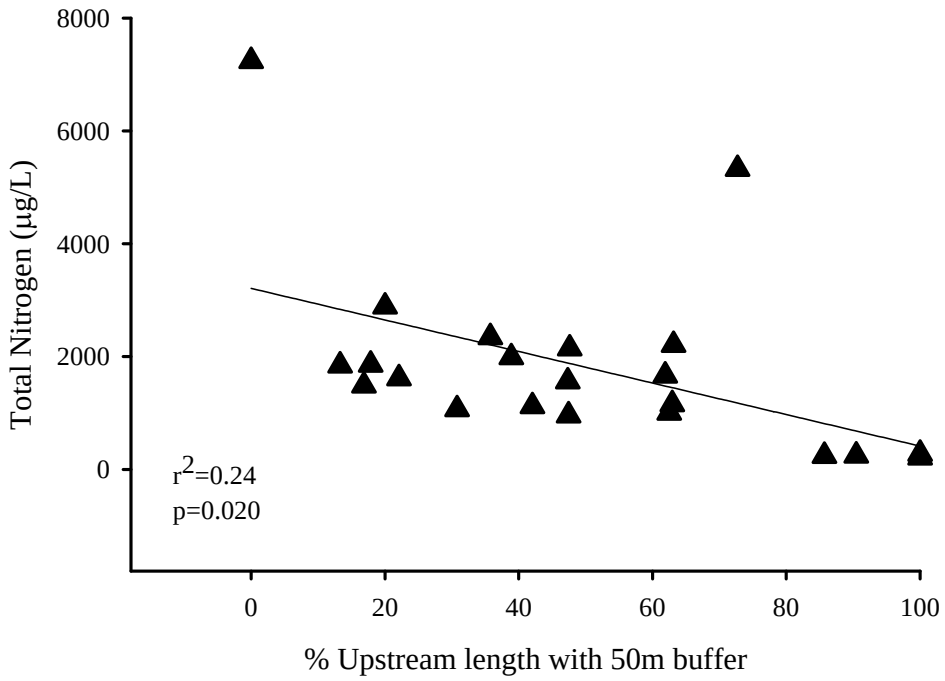


Figure 2. Total nitrogen as a function of percentage of upstream length with at least a 50 m buffer in Roaring Creek watershed, Columbia County. July 2006. Data were provided by Dr. Steven Rier, Bloomsburg University.

APPENDIX A: Roaring Creek Watershed Maps

- Roaring Creek Watershed Boundary
- Small Watersheds in Roaring Creek Watershed
- Stream Designations in Roaring Creek Watershed
- Public Land and Natural Areas in Roaring Creek Watershed
- 2007 Visual Assessment Grades

ROARING CREEK WATERSHED BOUNDARY

Columbia, Northumberland, Montour Counties

0 20 40 Kilometers

Columbia County Conservation District
C. D. Haffner 1/09

ROARING CREEK WATERSHED

SMALL WATERSHEDS

Susquehanna River

Montour

ROARING CREEK

MILL CREEK

LICK RUN

MUGSER RUN

SOUTH BRANCH ROARING CREEK

Northumberland

Columbia

Schuylkill

Legend

- LICK RUN
- MILL CREEK
- MUGSER RUN
- SOUTH BRANCH ROARING CREEK
- ROARING CREEK

N

W E

S

0 15 30

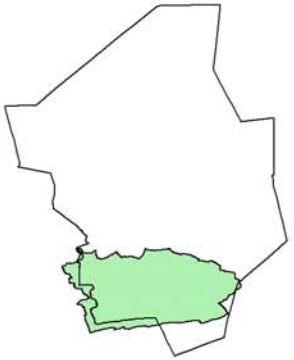
Kilometers

Columbia County Conservation District

CDH 1/09

ROARING CREEK WATERSHED

STREAM DESIGNATIONS



Susquehanna River

Montour

Northumberland

Columbia

Schuylkill

Legend

- COLDWATER FISHES
- HIGH QUALITY-COLDWATER FISHES
- TROUT STOCKING
- BIOLOGICALLY IMPAIRED STREAM (Siltation)

N

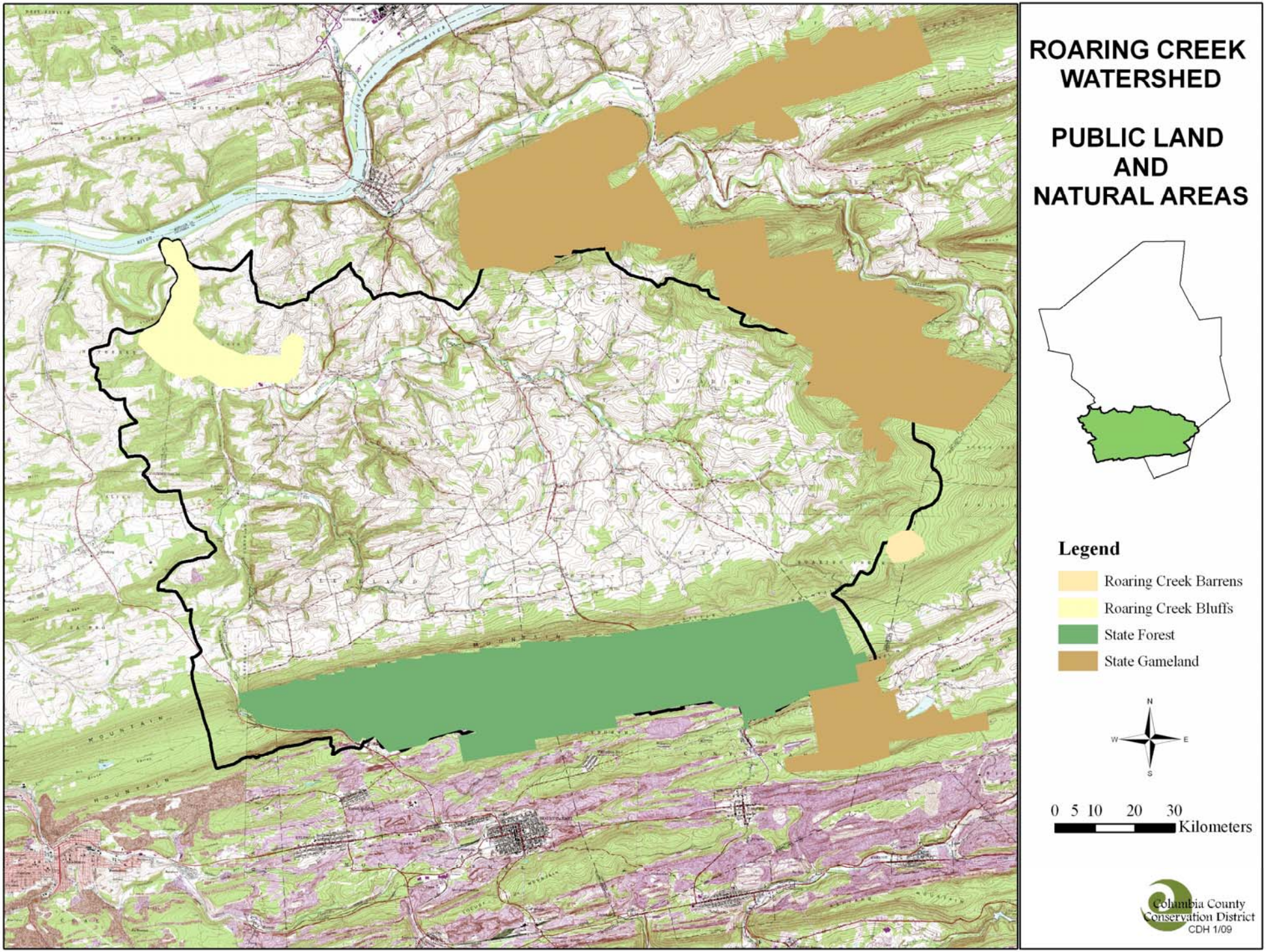
W E

S

0 25 50 Kilometers

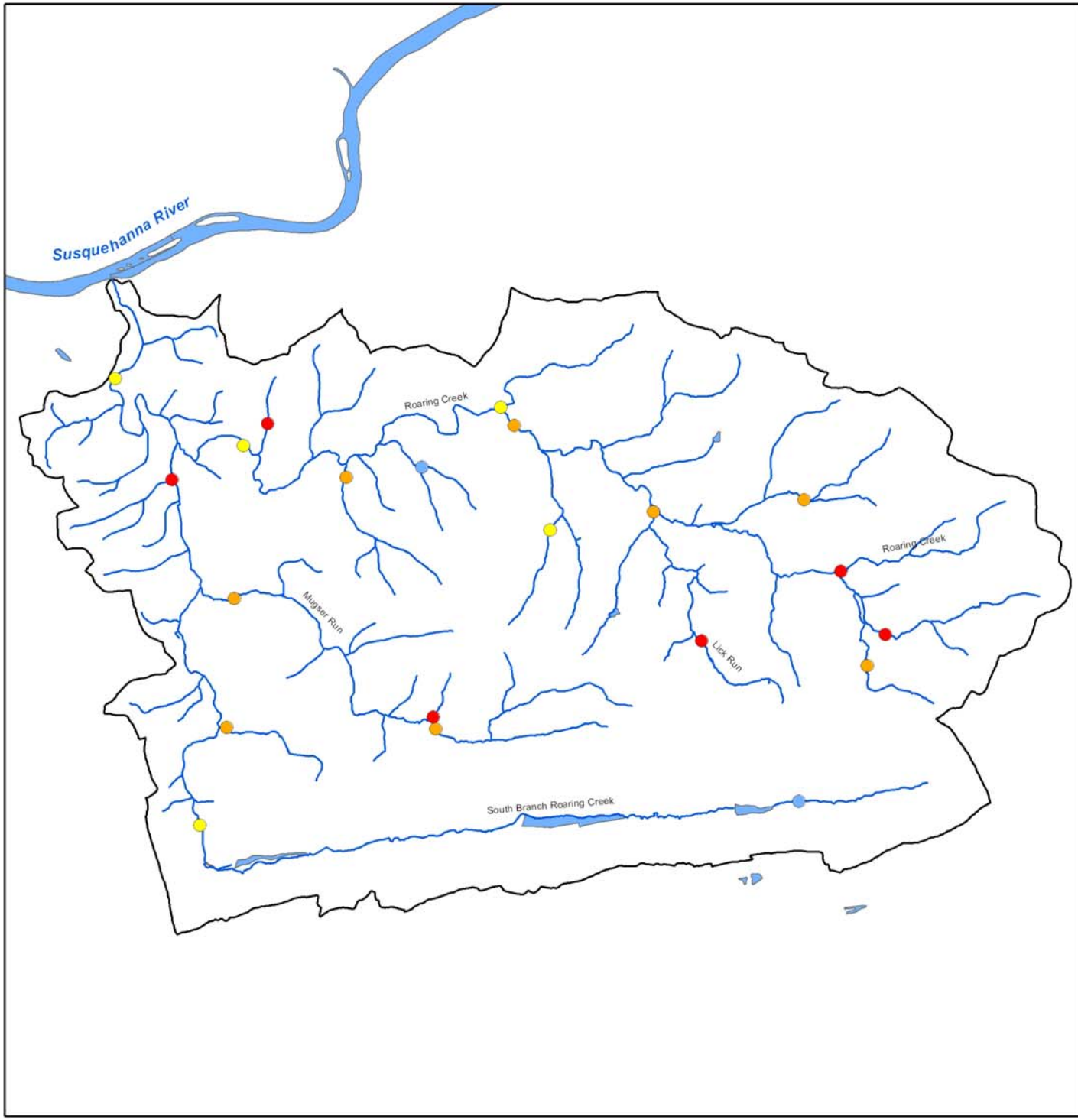
Columbia County Conservation District

C. D. Haffner 1/09


ROARING CREEK
WATERSHED
PUBLIC LAND
AND
NATURAL AREAS
Legend
Roaring Creek Barrens
Roaring Creek Bluffs
State Forest
State Gameland
N
W
E
S
0 5 10 20 30
Kilometers
Columbia County
Conservation District
CDH 1/09

ROARING CREEK WATERSHED

2007 VISUAL ASSESSMENT GRADES



Legend

- 55 - 65%
- 65 - 75%
- 75 - 85%
- 85 - 95%
- 95 - 100%

0 20 40 Kilometers

Columbia County Conservation District

C. D. Haffner 1/09

APPENDIX B: Select pictures from visual assessment surveys, 2007.

Lick Run 2 (LIRU2). Note siltation. There is also a lack of trees along the stream at this site. Photo by Dave Ernest.

Main Branch Roaring Creek 2 (MBRC2). Note siltation. Photo by Dave Ernest.

Main Branch Roaring Creek 2 (MBRC2). Good in-stream habitat and shade in this section. Photo by Dave Ernest.

Main Branch Roaring Creek 3 (MBRC3). Good in-stream habitat and forested riparian zone in this section. Photo by Kristen Vitkauskas.

Main Branch Tributary 4 (MBTR4). Disruptive pressures adjacent to stream. Lack of heterogeneity of in-stream habitat. Photo by Dave Ernest.

Mugser Run 3 (MURU3). Note unstable bank and failed riprap project. Photo by Winnie McNelis.

South Branch Roaring Creek 1 (SBRC1). Weiser State Forest – Roaring Creek tract. Geology, soils, and acid precipitation contribute to low buffering capacity in this headwaters section of the South Branch. Photo by Steve Rier.

APPENDIX C: Pennsylvania Fish and Boat Commission Fisheries Management Report for Roaring Creek Watershed.

PA FISH AND BOAT COMMISSION
COMMENTS AND RECOMMENDATIONS
March 28, 2007

WATER: Roaring Creek Basin (405E) Columbia, Montour, and Northumberland Counties

EXAMINED: Summer 2003/2004

BY: Moase, Wnuk, and Vitale

Bureau Director Action:_____ Date:_____

Division Chief Action:_____ Date:_____

WW Unit Leader Action:_____ Date:_____

CW Unit Leader Action:_____ Date:_____

==========

CWU COMMENTS:

The Roaring Creek Basin (405E) was examined during the 2003 and 2004 field seasons to update inventory information on Roaring Creek, Sections 02 and 03, Roaring Creek, South Branch, Sections 04-06 Lick Run, Section 01, and Mugser Run, Sections 01 and 02. Baseline inventory information was collected on Roaring Creek, South Branch, Sections 01-03 and Mill Creek, Section 01.

Roaring Creek

Section 02

Section 02 can be characterized as a moderate size, coldwater stream. Historically, this section has been managed with the planting of PFBC adult trout. The 2003 and 2004 examinations (conducted at five sample sites) recorded the presence of 24 fish species, including a wild brown trout population estimated at 9.53 kg/ha. Overall, the estimated abundance of legal size (≥ 7 inches) wild brown trout was 42/km. Based on a section length of 19.4 km (12.03 miles) this translated into an estimated total of 815 legal size wild brown trout ranging from seven to sixteen inches in length in Roaring Creek, Section 02.

Section 03

This segment of stream can be characterized as a large, freestone stream. Historically, Section 03 has been managed with the planting of PFBC adult trout. The 2003 examination recorded the presence of nine fish species, including one sublegal wild brown trout.

Roaring Creek, South Branch

Section 01

Section 01 can be characterized as a small, infertile, coldwater stream. A total of four fish species were captured during the 2004 examination. The fish community sampled appeared to be influenced by the proximity of the site to a reservoir.

Section 02

This segment can be characterized as a small, infertile, coldwater stream. A total of five fish species were captured during the 2004 inventory. The fish community sampled appeared to be influenced by reservoirs located upstream and downstream of the sample site.

Section 03

Section 03 can be characterized as an infertile, coldwater stream. The 2004 examination (conducted at two sample sites) recorded the presence of 10 fish species, including a sparse population of wild brook trout estimated at 1.86 kg/ha.

Section 04

This segment of stream can also be characterized as an infertile, coldwater stream. A total of six species were captured during the 2004 inventory, including a wild brown trout population estimated at 10.25 kg/ha. Currently, this section is closed to the angling public.

Section 05

Section 05 can be characterized as an infertile, coldwater stream. This section has been managed as a Class A wild brown trout water since 1983. The 2004 examination recorded the presence of 11 fish species, including a wild brown trout population estimated at 30.53 kg/ha. The estimated abundance of legal size ($\geq$ 7 inches) wild brown trout was 106/km. Based on a section length of 5.0 km (3.1 miles) this translated into an estimated total of 530 legal size wild brown trout ranging from seven to fourteen inches in length in Roaring Creek, South Branch, Section 05.

Section 06

This segment can be characterized as a moderate size, coldwater stream. Historically, Section 06 has been managed with the planting of PFBC adult trout. The 2004 inventory (conducted at two sample sites) recorded the presence of 18 fish species, including a wild brown trout population estimated at 31.2 kg/ha. The estimated abundance of legal size ($\geq$ 7 inches) wild brown trout was 180/km. Based on a section length of 5.0 km (3.1 miles) this translated into an estimated total of 900 legal size wild brown trout ranging from seven to seventeen inches in length in Roaring Creek, South Branch, Section 06.

Lick Run

Section 01 can be characterized as a small, coldwater stream. This section has been managed as a Class A wild brown trout water since 1983. The 2003 examination (conducted at two sample sites) recorded the presence of 15 fish species, including a wild brown trout population estimated at 47.38 kg/ha. The estimated abundance of legal size (≥ 7 inches) wild brown trout was 64/km. Based on a section length of 7.1 km (4.4 miles) this translated into an estimated total of 454 legal size wild brown trout ranging from seven to eighteen inches in length in Lick Run, Section 01.

Mill Creek

Section 01 can be characterized as a small, infertile, coldwater stream. The 2004 examination recorded the presence of five fish species, including a wild brown trout population estimated at 48.28 kg/ha and a wild brook trout population estimated at 23.92 kg/ha. The estimated abundance of legal size (≥ 7 inches) wild brown trout was 110/km and the estimated abundance of legal size wild brook trout was 83/km. Based on a section length of 5.1 km (3.2 miles) this translated into an estimated total of 561 legal size wild brown trout ranging from seven to twelve inches and 423 legal size wild brook trout ranging from seven to eleven inches in length in Mill Creek, Section 01. Currently, this section is closed to the angling public.

Mugser Run

Section 01

Section 01 can be characterized as a small, coldwater stream. The 2004 examination recorded the presence of 11 fish species, including a wild brown trout population estimated at 77.65 kg/ha. The estimated abundance of legal size (≥ 7 inches) wild brown trout was 133/km. Based on a section length of 5.8 km (3.6 miles) this translated into an estimated total of 771 legal size wild brown trout ranging from seven to fourteen inches in length in Mugser Run, Section 01. Currently, this section is closed to the angling public.

Section 02

This segment can be characterized as a small, coldwater stream. Historically, Section 02 has been managed with the planting of PFBC adult trout. The 2004 examination (conducted at two sample sites) recorded the presence of 12 fish species, including a wild brown trout population estimated at 76.52 kg/ha. The estimated abundance of legal size (≥ 7 inches) wild brown trout was 169/km. Based on a section length of 7.5 km (4.7 miles) this translated into an estimated total of 1,268 legal size wild brown trout ranging from seven to fifteen inches in length in Mugser Run, Section 02.

CWU RECOMMENDATIONS:

1. Roaring Creek (405E), Sections 02 and 03, should continue to be managed with the planting of PFBC adult trout. Stocking rates and frequencies should be determined by classification according to program guidelines.

2. Roaring Creek, South Branch (405E), Sections 01-04, should be managed as biomass Class D waters. Special catch-and-release regulations apply under Miscellaneous Waters with Special Regulations for the Roaring Creek, South Branch, watershed located upstream of the SR 3008 Bridge at Bear Gap.

3. Roaring Creek, South Branch (405E), Section 05, should continue to be managed as a Class A wild brown trout water. Statewide regulations should apply with no stocking.

4. Roaring Creek, South Branch (405E), Section 06, should continue to be managed with the planting of PFBC adult trout. Stocking rate and frequency should be determined by classification according to program guidelines.

5. Lick Run (405E), Section 01, should continue to be managed as a Class A wild brown trout water. Statewide regulations should apply with no stocking.

6. Mill Creek (405E), Section 01, should be managed as a Class A mixed wild brook and brown trout water. Statewide regulations should apply with no stocking.

7. Mugser Run (405E), Section 01, should be managed as a Class A wild brown trout water. Statewide regulations should apply with no stocking.

8. Mugser Run (405E), Section 02, should continue to be managed with the planting of PFBC adult trout. Stocking should be conducted on a preseason only basis according to program guidelines. The Area 4 staff should reinventory Mugser Run, Section 02, to monitor the status of the wild brown trout population.

9. Based on the presence of a Class A wild brown trout population, the DEP Chapter 93 Water Quality Standards for Lick Run, Section 01, should be upgraded to HQ-CWF. The special protected use classification should apply to the entire Lick Run basin.

10. Based on the presence of a wild brown trout population, the DEP Chapter 93 Water Quality Standards for Roaring Creek, Sections 02 and 03, should be upgraded from TSF to CWF. The CWF classification should apply to the Roaring Creek basin from the confluence with Lick Run downstream to the mouth.

11. The Area 4 office should revise the database entry for the Mugser Run to indicate that Roaring Creek, South Branch is the receiving water for this stream.

This work made possible by funding from the Sport Fish Restoration Act Project F-57-R Fisheries Management.

Pennsylvania Fish & Boat Commission

Bureau of Fisheries
Division of Fisheries Management

Roaring Creek Basin (405E)
Fisheries Management Report

Prepared by:
Robert Wnuk, Robert Moase, and Gerald Vitale

Fisheries Management Database Name: Roaring Ck
Lat/Lon: 405621763144

Date Sampled: Summer 2003/2004 Date Prepared: December 2004

Introduction

There is a substantial fishery resource in the 40,000+ miles of flowing water throughout Pennsylvania. To realize the potential of this resource the Pennsylvania Fish and Boat Commission (PFBC) has established a policy of resource examination and classification. The primary objectives of the examination are to document a stream's fish populations and to collect social, physical, and chemical data that influence the way we manage its fishery. Establishing relationships among these parameters allows us to place each individual stream section into a resource category. Once we've assigned a section to a resource category, we can implement a management program that is consistent with statewide goals and objectives.

The Area 4 fisheries management office has been conducting stream examinations on a drainage basin level to facilitate management by resource classification. We selected the Roaring Creek basin for investigation in 2003/2004 because the Pennsylvania Department of Conservation and Natural Resources (DCNR) recently purchased a 3,500+ ha tract in the South Branch Roaring Creek watershed from a private water company. This property had not been open to the public and we had never surveyed the portion of the South Branch that flows through it. Additionally, we had never surveyed Mill Creek, a small tributary to Roaring Creek, and the data we possessed on other basin tributaries was old. Thus, the objectives of our examination were: 1) to collect baseline data on the fishery in the upper portion of the South Branch Roaring Creek and Mill Creek so that we could assign them to resource categories and 2) to evaluate past management practices in the Roaring Creek watershed and implement new management strategies where appropriate.

Study Area

Roaring Creek is a 33.16 km long tributary to the North Branch Susquehanna River at River Mile (RM) 16.70 south of Catawissa. The 228 km^2 drainage includes portions of Montour,

Columbia, and Northumberland Counties. Land use in the watershed is generally a mixture of agricultural areas and woodlots, although significant forested public land exists in the Wyoming State Forest and State Game Lands Number 58. The underlying geology of the basin is a complex mixture of Mississippian and Devonian Aged sandstones, siltstones, claystones, shales, and conglomerates. Local outcrops of marine fossils, calcareous beds, and limestone provide fertility in the lower basin. Additionally, deposits of mineable coal flank the South Branch Roaring Creek/Shamokin Creek divide. The Roaring Creek basin contains five named streams (Table 1). Routes 487, 42, and 54 provide major road access (Figure 1).

Historic Perspective

The PFBC has conducted historic work on all basin streams except for Mill Creek. Wnuk et al. (2002) sampled the upper reaches of Roaring Creek for five straight years as part of the statewide Class A wild trout study. Copeland (1990a) and Daniels et al. (1977) documented Class A wild trout populations in the upper reaches of Roaring Creek with declining wild trout biomass further downstream. Biological surveys of the South Branch Roaring Creek have been limited to the lower portions of the stream because of historic posting in the upper end. Daniels and Moase (1983) and Daniels (1982) found a Class A wild brown trout *Salmo trutta* population in the South Branch between SR 3008 and T-355, with wild brown trout numbers declining downstream. Copeland (1990b), Daniels et al. (1982), and Daniels et al. (1976a) found substantial wild brown trout populations in Lick Run. Following the 1982 survey, the PFBC removed Lick Run from the adult trout stocking program in favor of wild trout management. Finally, Daniels et al. (1976b) found limited brown trout reproduction in Mugser Run.

Current Management Strategies

The Pennsylvania Department of Environmental Protection (DEP), in its Chapter 93 Water Quality Standards, maintains several different classifications for streams in the Roaring Creek basin. DEP classifies the Roaring Creek watershed upstream from Lick Run and the entire South Branch Roaring Creek watershed as high quality coldwater fisheries (HQ-CWF). They classify the main stem of Roaring Creek from Lick Run downstream to the mouth as a trout stocked fishery (TSF), and unnamed tributaries to this portion of Roaring Creek as well as Lick Run as coldwater fisheries (CWF). There are no exceptions to specific criteria.

Chapter 93 Water Quality Standards control the amount of pollutants that National Pollution Discharge Elimination System (NPDES) permitted discharges can introduce to receiving waters. We found six NPDES discharges in the Roaring Creek basin (United States Environmental Protection Agency 2004). Four originated from private residences, one from a campground, and one from the Slabtown sewage treatment plant.

The PFBC administers Mill Creek and Lick Run as single sections extending from the headwaters downstream to the mouth. We split the other named streams into multiple sections based on biological and social differences. We present the sectioning strategies for these streams in the body of this report. The sections we manage with adult hatchery trout are Roaring Creek, Sections 02 and 03; South Branch Roaring Creek, Section 06; and Mugser Run, Section 02. The only special stocking instructions are a prohibition against substituting rainbow trout *Oncorhynchus mykiss* in Section 06 of the South Branch.

Methods

We examined the Roaring Creek basin between July 2, 2003, and June 14, 2004. We had planned to complete the survey in 2003 but weather conditions and other commitments prevented us from doing so. All procedures of the survey followed Marcinko et al. (1986). We surveyed all of the named streams in the basin with the exception of Roaring Creek, Section 01. We collected physical and some social data for all stream sections. We did not evaluate parking characteristics.

This survey assessed physical, chemical, and biological characteristics at 20 sampling stations (Table 2). We evaluated total alkalinity with a mixed indicator, pH with a colorimetric method, and total hardness with EDTA titration. We used backpack electrofishing gear to assess fish populations. Backpack setups included a Coffelt unit (Model BP 1C, alternating current) and a Smith-Root unit (Model 12-A POW, pulsed direct current) with a single anode and a rat-tail cathode. The choice of backpack electrofishing gear generally depended on station width.. The Coffelt unit was employed at the wider stations because the Smith-Root unit was generally ineffective when stream width exceeded 4 m. In this work, we used the Coffelt unit at 14 sites and the Smith-Root unit at six sites. We identified the fish we captured at each site to species with the exception of sculpins *Cottus spp*. We only identified sculpins to genus because it was difficult to accurately separate mottled sculpins *Cottus bairdi* from slimy sculpins *Cottus cognatus* in the field. The scientific and common names of the fish species we captured follow Robins et al. (1991).

We classified all of the trout we captured as being of wild or hatchery origin based on species, coloration, size, and fin wear. We measured the wild trout to 25 mm length groups and gave them an upper caudal fin clip while we noted the hatchery trout but excluded them from further analysis. When we captured at least 30 wild trout at an individual site we made a second electrofishing pass to obtain a Chapman modified Petersen population estimate (Ricker 1975). At all other sites, we considered the number of wild trout captured to be the total population present. We obtained wild trout population abundance and biomass estimates for stream sections by expanding the estimated number and weight of trout at a site to number and kilograms per hectare using state average weights calculated on December 9, 2004.

Results and Discussion

Roaring Creek and its tributaries possessed low to moderate gradients. The highest gradient for any section in the basin was 29.8 m/km (Table 3). All stream sections exhibited rural human population densities except for the South Branch Roaring Creek, Sections 04 and 05 (Table 4). Human population density for these sections was suburban.

Chemically, the Roaring Creek basin was infertile but was not as acidic as many other watersheds in the Area 4 Fisheries Management Region. Total alkalinity values ranged from 2 to 24 mg/l and pH values ranged from 5.7 to 7.2 standard units (Table 5). These values occurred over a period of generally high stream

flow. Total alkalinity was < 10 mg/l at seven (35%) of our 20 sites. Most of the low alkalinity sites were in the upper portion of the South Branch. A combination of the underlying geology and agricultural influences produced the water quality parameters we observed. Agricultural influences on water chemistry parameters were especially pronounced at Lick and Mugser Runs.

The fish community in the Roaring Creek basin was diverse. We documented 31 fish species during this work (Table 6). Transitional and coldwater species dominated fish communities at most of our sites (Tables 7,8, and 9). Blacknose dace *Rhinichthys atratulus* was the most common fish we encountered as we captured this species at 17 of the 20 sites. The next most common species were white suckers *Catostomus commersoni* (16 sites), brown trout (16 sites), longnose dace *Rhinichthys cataractae* (14 sites), cutlips minnows *Exoglossum maxillingua* (13 sites), and bluegills *Lepomis macrochirus* (12 sites).

Basin-wide fish species diversity in 2003/2004 compared favorably to historic work. We found 33 fish species in all historic surveys combined. Those species present historically but absent during our work were golden shiners *Notemigonus crysoleucas*, fallfish *Semotilus corporalis*, yellow bullheads *Ameiurus natalis*, American eels *Anguilla rostrata*, greenside darters *Etheostoma blennioides*, and walleyes *Sander vitreus*. None of these species was present at more than two historic sites. Conversely, we documented redside dace *Clinostomus elongatus*, fathead minnows *Pimephales promelas*, creek chubsuckers *Erimyzon oblongus*, and green sunfish *Lepomis cyanellus* in the basin for the first time during this work. These species were also rare.

The gamefish species we documented in the Roaring Creek basin were hatchery rainbow trout, wild and hatchery brown trout, wild and hatchery brook trout *Salvelinus fontinalis*, chain pickerel *Esox niger*, smallmouth bass *Micropterus dolomieu*, and largemouth bass *Micropterus salmoides*. Hatchery trout were common during the 2004 work (Table 10). The wet, cool summer we experienced in combination with low angling pressure allowed for high survival of stocked fish. We published timely Internet reports on this situation to attract anglers to the area.

Wild brown trout were the most common gamefish we found. Many of the stream sections in the basin supported substantial wild brown trout densities (Tables 11-15), and most of these sections supported good numbers of legal size fish (Figures 2-5). Wild brook trout were more limited in their distribution. The only substantial wild brook trout population we found during this work was in Mill Creek. Chain pickerel, largemouth bass, and smallmouth bass were uncommon. The chain pickerel and largemouth bass had escaped from local reservoirs. Smallmouth bass were restricted to the downstream portions of Roaring Creek and the South Branch. Smallmouth bass population densities were low at all sites where they occurred.

Water quality, fish species occurrence, and wild trout abundance varied among the Roaring Creek basin streams. We will next discuss specific findings for each stream and section individually, as the PFBC currently manages on a stream/section basis. This approach will facilitate presenting the resource classifications (Table 16) needed to generate management plans (PFBC 1997).

Roaring Creek, Section 01

Section 01 extended 9.8 km from the headwaters downstream to Lick Run. We did not examine Section 01 during this work because we had surveyed it for five straight years, from 1998 through 2002, as part of the statewide wild trout study. During this period wild brown trout biomass fluctuated from 44.97 to 65.32 kg/ha and wild brook trout biomass fluctuated from 10.96 to 19.38 kg/ha (Wnuk et al. 2002). Abiotic factors were the most likely reason for these fluctuations. Most of the section was posted against public access and so received little fishing pressure. Those landowners who permitted fishing did so by permission only and on a strict catch-and-release basis.

State Game Lands Number 58 contains the upper 1.3 km of Section 01. This portion is open to public angling, but it would be difficult to fish because it is very narrow.

Roaring Creek, Section 02 (Approved Trout Water)

Section 02 extends 19.4 km from Lick Run downstream to a point located 3.7 km upstream from the mouth. We currently manage this section with hatchery trout. It receives a preseason and one inseason stocking. Species composition is 70% rainbow, 30% brook preseason and 70% brown, 30% rainbow inseason. We do not recommend brook trout for inseason plants in this section because of potentially warm water temperatures.

We surveyed five sites in Section 02, completing the lower three in 2003 and the upper two in 2004. There were enough trout at the upper two sites to conduct a recapture run, and this enabled us to estimate the number of hatchery trout in the section in 2004. Of the total number stocked, we estimated that 17% of the hatchery rainbow trout and 14% of the hatchery brook trout remained. Our hatchery brown trout estimate, however, exceeded the total number stocked. This could have occurred through bias in the estimates, immigration, or hatchery substitution. Regardless, the number of hatchery brown trout remaining in the section was excessive. The species composition of future inseason plants should favor rainbow trout to improve angler harvest. The few anglers we spoke to during the survey were not catching many fish despite the large number of hatchery trout present. Further, inseason plants should be completed by the second week of May when there is still sufficient angler interest. This year, we stocked Section 02 during the week of May 24.

Wild brown trout biomass in Section 02 exhibited a small decline from 13.42 kg/ha in 1990 to 9.53 kg/ha in 2003/2004. The 1977 survey estimated 23.41 kg/ha of wild brown trout but this estimate likely included hatchery fish. Wild brown trout were more abundant in the upstream areas of the section because of colder water temperatures. Section 02 transitioned to warmer water as it flowed through farmlands and open areas.

Section 02 did not support a very dense wild brown trout population but some large individuals were present. We sampled at RM 10.98 in both 2003 and 2004. We did not complete the 2003 sample due to equipment malfunction so we did not include it in this report. The 2003 sample produced brown trout in the 550 mm length group that we judged to be a wild fish.

Roaring Creek, Section 03 (Approved Trout Water)

Section 03 extends 3.7 km from the lower limit of Section 02 downstream to the mouth. We currently manage this section with hatchery trout. It receives a preseason and one inseason stocking. The species composition is 30% brook, 70% rainbow preseason and 70% brown, 30% rainbow inseason.

Section 03 supported minimal gamefish populations. Seasonally warm water temperatures limited wild trout and physical habitat limited smallmouth bass. Copeland (1990a) and Daniels et al. (1977) also found low density wild trout populations in this section. Neither historic survey found smallmouth bass.

DEP classifies Sections 02 and 03 of Roaring Creek as TSF but we captured wild trout throughout both sections. For this reason, DEP should upgrade the Chapter 93 classifications of these sections to CWF.

Mill Creek

Mill Creek is a small, posted tributary to Roaring Creek downstream from Mill Grove. This work was the first time the PFBC had ever surveyed the stream. We captured 132 brown trout and 88 brook trout in 300 m of electrofishing. We did not make a second pass to complete the population estimate because of landowner sensitivities. Nevertheless, simply by considering the number of trout captured on the first pass to be the total population present, Mill Creek supported a Class A biomass. Excellent physical habitat in the form of numerous deep holes produced a good supply of legal fish.

Lick Run

Lick Run is a small tributary to Roaring Creek upstream from Slabtown. The PFBC managed this stream with hatchery trout until 1982. We removed Lick Run from the stocking program in favor of wild trout management beginning with the 1983 season. Wild brown trout biomass has been stable in the four surveys we've conducted since 1976 with the exception of 1982, when biomass declined to 20.73 kg/ha. This year, we found 47.43 kg/ha of wild brown trout. Most of these fish were concentrated at our upper station. At the lower station, we did not capture enough trout to do a recapture run. Historic surveys found a similar pattern in brown trout distribution. Siltation in the lower end of the stream could be a contributing factor.

DEP classifies Lick Run as a CWF. We documented Class A wild brown trout biomass in Lick Run during three of our four surveys. For this reason, DEP should upgrade Lick Run to HQ-CWF.

South Branch Roaring Creek, Sections 01, 02, and 03

Our sectioning strategy for the upper portion of the South Branch Roaring Creek reflects the presence of the water company dams. Section 01 extends 3.4 km from the headwaters

downstream to the backwaters of Klines Reservoir. Section 02 extends 2.6 km from the outlet of Klines Reservoir downstream to the backwaters of McWilliams Reservoir. Section 03 extends 5.0 km from the outlet of McWilliams Reservoir downstream to the backwaters of Bear Gap Reservoir.

DCNR, Wyoming State Forest, owns the land surrounding these sections. Regulations permit public angling but prohibit harvest. The PFBC initially applied catch-and-release regulations on an emergency basis at DCNR's request. DCNR wished to protect fish populations until we conducted a survey and determined the best management approach. The PFBC finalized catch-and-release regulations this year because of public demand to keep the area in its "natural state." This demand also prevented DCNR from opening a portion of the access road, from Route 42 to McWilliams Reservoir, to public vehicular travel.

Our work was the first time the PFBC had ever surveyed this portion of the South Branch Roaring Creek. Locals believed the area harbored numerous large wild brook trout. However, we did not capture any brook trout in Sections 01 and 02, and only captured seven brook trout at two sites combined in Section 03. All three sections were acidic. Total alkalinity across the sections ranged from 2 to 8 mg/l and pH ranged from 5.7 to 6.6. Acidic water chemistry, poor physical habitat, and seasonally warm discharges from the reservoirs combined to limit wild trout populations on the DCNR property. Local reports of individuals removing large brook trout prior to implementation of the catch-and-release regulations probably reflected the harvest of hatchery fish. The water company maintained a private hatchery on the property and stocked the stream for company outings.

Given the low density wild trout populations, continued use of the reservoirs for water supply, lack of vehicle access, and public desire for the area to remain in its "natural state", there is little we can do to improve the fishery in these three sections.

South Branch Roaring Creek, Section 04

Section 04 extends 1.6 km from the outlet of Bear Gap Reservoir downstream to SR 3008. We manage this small portion of stream as a separate section because it is completely posted against public access. Because of the posting and short section length, we only electrofished for 180 m. This produced six species including 16 wild brown trout, two hatchery brown trout, and three hatchery brook trout. Posting of this section limits our management options. A private club stocks it with hatchery trout.

South Branch Roaring Creek, Section 05

Section 05 extends 5.0 km from SR 3008 downstream to T-355 (Jepko/Campground Road). The PFBC removed this section from the trout stocking program in favor of wild trout management beginning with the 1983 season. Wild brown trout biomass in the section has fluctuated from a low of 28.13 kg/ha in 1991 to a high of 47.17 kg/ha in 1977, though the 1977 estimate may have included hatchery fish. We found 30.53 kg/ha of wild brown trout during this work. The fish ranged from 25 to 374 mm in length, with 24% of the fish captured exceeding the minimum size limit (Figure 4).

South Branch Roaring Creek, Section 06 (Approved Trout Water)

Section 06 extends 5.0 km from T-355 (Jepko/Campground Road) downstream to the mouth. The PFBC manages this section with hatchery trout. It receives one preseason and one inseason stocking. Preseason species composition is 50% brook trout and 50% brown trout. Inseason species composition is 30% brook trout and 70% brown trout. Special remarks prohibit substitution of rainbow trout because of potentially acidic water chemistry. (Please explain this better or say it in a better way understandable to non PFBC or future PFBC employees and others).

Historic work in Section 06 (Daniels et al. 1977 and Daniels and Moase 1983) found small wild trout populations but we documented 31.26 kg/ha of wild brown trout with fish ranging up to and including the 425 mm length group. Whether this represented a temporary expansion of the population attributable to the consecutive cool summers we've experienced remained a question. We also found significant numbers of hatchery fish, with an estimated 56% and 25% of the total number of stocked brown and brook trout, respectively, remaining in the section. Future inseason plantings should include a higher percentage of brook trout to improve angler harvest, and inseason plants should be completed by the second week of May when there is still sufficient angler interest. This year, we stocked Section 02 during the week of May 17. Finally, the prohibition against substituting rainbow trout can be removed. Total alkalinity in this section was 14 mg/l during normal flow.

Mugser Run, Section 01

Section 01 extends 5.8 km from the headwaters downstream to T-315 at Fisherdale. Daniels et al. (1976a) did not find any wild trout in this section, but we documented a Class A wild brown trout biomass of 77.65 kg/ha. Fish ranged from 25 to 374 mm in length, with 56% exceeding the size limit (Figure 5).

Mugser Run, Section 02 (Approved Trout Water)

Section 02 extends 7.5 km from T-315 at Fisherdale downstream to the mouth. The PFBC manages this section with hatchery trout, but it only receives a light preseason stocking of browns and rainbows. Unlike Roaring Creek and the South Branch, few hatchery trout remained in Mugser Run during the summer of 2004. We estimated hatchery brown trout abundance at 17% of the total stocked and hatchery rainbow trout abundance at 5% of the total stocked.

Daniels et al. (1976a) found a small wild brown trout population in this section. Biomass was 7.61 kg/ha and the estimate probably included hatchery fish. In contrast, we documented 76.52 kg/ha of wild brown trout. Wild brown trout ranged from 25 to 399 mm in length, with 33% exceeding the size limit (Figure 5). This population developed despite the hatchery trout program and an excessive amount of siltation in the stream. At one of our stations, we noted an off-road four wheel drive operation that had caused severe erosion and sedimentation. We reported this situation to PFBC law enforcement.

We do not recommend removing Section 02 from the statewide trout stocking program at this time. It receives only a light preseason stocking that clearly has not hurt the wild brown trout population.

MANAGEMENT RECOMMENDATIONS

1. The Pennsylvania Fish and Boat Commission should continue to manage Roaring Creek, Sections 02 and 03; South Branch Roaring Creek, Section 06; and Mugser Run, Section 02 with hatchery trout under statewide angling regulations.

2. The Pennsylvania Fish and Boat Commission should add special stocking instructions to Roaring Creek, Sections 02 and 03, and the South Branch Roaring Creek, Section 06 that require inseason stockings to be completed prior to the third week of May.

3. The Pennsylvania Fish and Boat Commission should change the species composition of inseason stockings on Roaring Creek, Sections 02 and 03, to 70% rainbow trout, 30% brown trout.

4. The Pennsylvania Fish and Boat Commission should change the species composition of inseason stockings on Roaring Creek South Branch, Section 06, to 70% brook trout, 30% brown trout.

5. The Pennsylvania Fish and Boat Commission should remove special stocking instructions for the South Branch Roaring Creek, Section 06 that prohibit substitution of rainbow trout.

6. The Pennsylvania Fish and Boat Commission should continue to manage Sections 01, 02, and 03 of the South Branch Roaring Creek under catch-and-release regulations.

7. The Pennsylvania Fish and Boat Commission should add Mill Creek, Section 01, and Mugser Run, Section 01, to the list of Class A wild trout waters.

8. The Pennsylvania Department of Environmental Protection should upgrade the Chapter 93 water quality classification of Roaring Creek downstream from Lick Run from Trout Stocked Fishery to Coldwater Fishery.

9. The Pennsylvania Department of Environmental Protection should upgrade the Chapter 93 water quality classification of Lick Run from Coldwater Fishery to High Quality Coldwater Fishery.

10. The Columbia, Northumberland, and Montour County Conservation Districts should address siltation problems in the Roaring Creek watershed.

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Table 1. Named streams of the Roaring Creek basin (405E) listed in hierarchical order.

Roaring Creek Section 01
Mill Creek
Roaring Creek Section 02
Lick Run
South Branch Roaring Creek Section 01
South Branch Roaring Creek Section 02
South Branch Roaring Creek Section 03
South Branch Roaring Creek Section 04
South Branch Roaring Creek Section 05
South Branch Roaring Creek Section 06
Mugser Run Section 01
Mugser Run Section 02
Roaring Creek Section 03

Table 2. Station number, river mile, downstream limit, length electrofished, and voltage for stations sampled during 2003/2004 in the Roaring Creek basin (405E).

Stream	Station Number	River Mile	Downstream Limit	Length (m)	Volts
Roaring Creek	0201	13.14	Ideal Park Campground	300	200 AC
	0202	10.98	Route 42	300	150 AC
	0203	8.54	Covered Bridge	165	150 AC
	0204	6.02	Route 487	150	150 AC
	0205	4.04	Billmans Road	120	150 AC
	0301	1.39	See Topo	150	200 AC
Mill Creek	0101	1.30	Old Reading Road	300	200 AC
Lick Run	0101	2.24	Lick Run Road	300	200 DC
	0102	0.00	Mouth	300	200 DC
South Branch Roaring Creek	0101	15.40	See Topo	300	400 DC
	0201	13.90	300 m dnst foot bridge	300	400 DC
	0301	10.67	See Topo	300	400 DC
	0302	9.37	See Topo	300	400 DC
	0401	6.25	SR 3008	180	200 AC

	0501	4.02	Happy Valley Road	295	200 AC
	0601	1.50	180 m dnst Reeder Drive	305	150 AC
	0602	0.36	300 m dnst Krick Road	300	200 AC
Mugser Run	0101	5.40	150 m dnst Private Bridge	300	150 AC
	0201	3.23	150 m dnst Middle Road	300	150 AC
	0202	1.19	Bethel Road	300	150 AC

Table 3. Physical data for stream sections in the Roaring Creek basin (405E).

Stream (Section)	Length (km)	Width (m)	Gradient (m/km)	USGS Quadrangle(s)
Roaring Creek (01)	9.8	5.3	27.6	K34, K35
Roaring Creek (02)	19.4	12.3	4.6	K33, K34
Roaring Creek (03)	3.7	22.5	7.1	K33
Mill Creek (01)	5.1	4.2	29.8	K35
Lick Run (01)	7.1	3.8	13.8	K34, L34, L35
South Branch Roaring Creek (01)	3.4	3.9	3.8	L35
South Branch Roaring Creek (02)	2.6	6.2	2.4	L34, L35
South Branch Roaring Creek (03)	5.0	7.0	6.4	L34
South Branch Roaring Creek (04)	1.6	7.2	5.2	L33
South Branch Roaring Creek (05)	5.0	6.9	8.7	L33, L34
South Branch Roaring Creek (06)	5.0	9.2	12.6	L33, K33
Mugser Run (01)	5.8	2.6	10.9	L34
Mugser Run (02)	7.5	4.6	10.9	K34, L34

USGS Quadrangles: K33 = Danville; K34 = Catawissa; K35 = Shumans; L33 = Shamokin; L34 = Mount Carmel; L35 = Ashland.

Table 4. Social data for stream sections in the Roaring Creek basin (405E).

Stream (Section)	Road Access: % of Section Within: 100 m	300 m	500 m	Ownership: % Public Open	% Private Open	% Private Closed	2000 Human Population Density
Roaring Creek (01)	50	89	91	13	0	87	18
Roaring Creek (02)	28	87	100	0	100	0	22
Roaring Creek (03)	96	98	100	0	100	0	16
Mill Creek (01)	48	82	90	0	0	100	18
Lick Run (01)	56	97	100	0	70	30	30
South Branch Roaring Creek (01)	22	25	30	100	0	0	15
South Branch Roaring Creek (02)	50	87	100	100	0	0	15
South Branch Roaring Creek (03)	92	100	100	100	0	0	32
South Branch Roaring Creek (04)	100	100	100	0	0	100	87
South Branch Roaring Creek (05)	87	100	100	0	56	44	44
South Branch Roaring Creek (06)	87	100	100	0	100	0	35
Mugser Run (01)	66	83	100	0	0	100	23
Mugser Run (02)	61	75	100	0	93	7	38

Table 5. Physical-chemical data collected at sampling stations in the Roaring Creek basin (405E) during 2003/2004.

Stream	River Mile	Date	Time	Air Temp. °C	Water Temp. °C	pH	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Specific Conductance (umhos)
Roaring Creek	13.14	6/03/04	1125	26.0	15.0	7.0	13	30	85
	10.98	6/03/04	1045	24.0	14.7	7.0	14	33	98
	8.54	7/31/03	0925	17.0	18.0	7.2	24	44	117
	6.02	7/02/03	1317	30.0	19.4	7.2	14	32	95
	4.04	7/02/03	1205	28.0	18.9	7.2	14	28	94
	1.39	7/02/03	1025	23.0	18.2	7.2	14	30	88
Mill Creek	1.30	6/14/04	1425	24.0	14.8	6.6	8	20	49
Lick Run	2.24	7/31/03	1340	24.0	17.4	6.8	16	36	90
	0.00	7/31/03	1155	26.0	18.3	7.2	22	48	118
South Branch Roaring Creek	15.40	6/02/04	1210	23.0	12.5	5.7	2	11	31
	13.90	6/01/04	1505	25.0	17.3	6.2	4	12	37
	10.67	6/01/04	1350	24.0	19.3	6.4	5	10	36
	9.37	6/01/04	1205	24.0	17.0	6.6	8	8	38
	6.25	6/04/04	1435	27.0	16.9	6.7	5	11	45
	4.02	6/09/04	1305	29.0	19.6	6.6	5	16	54
	1.50	6/14/04	1130	21.0	16.4	7.1	14	29	104
	0.36	6/14/04	1305	22.0	17.3	7.0	14	30	104
Mugser Run	5.40	6/03/04	1225	27.0	16.1	6.8	14	35	120
	3.23	6/02/04	1330	24.0	16.2	7.0	14	36	114
	1.19	6/03/04	1350	27.0	17.0	7.0	14	36	109

Table 6. Scientific and common names of fish species captured in the Roaring Creek basin (405E) during the current and historic surveys.

Scientific name	Common name	Current	Historic
Oncorhynchus mykiss	Rainbow trout	(5)	X
Salmo trutta	Brown trout	(16)	X
Salvelinus fontinalis	Brook trout	(10)	X
Esox niger	Chain pickerel	(3)	X
Campostoma anomalum	Central stoneroller	(4)	X
Exoglossum maxillingua	Cutlips minnow	(13)	X
Clinostomus elongatus	Redside dace	(1)	
Notemigonus crysoleucas	Golden shiner		X
Luxilus cornutus	Common shiner	(10)	X
Notropis hudsonius	Spottail shiner	(1)	X
Notropis rubellus	Rosyface shiner	(3)	X
Pimephales notatus	Bluntnose minnow	(1)	X
Pimephales promelas	Fathead minnow	(1)	
Rhinichthys atratulus	Blacknose dace	(17)	X
Rhinichthys cataractae	Longnose dace	(14)	X
Semotilus atromaculatus	Creek chub	(10)	X
Semotilus corporalis	Fallfish		X
Nocomis micropogon	River chub	(9)	X
Catostomus commersoni	White sucker	(16)	X
Erimyzon oblongus	Creek chubsucker	(2)	
Hypentelium nigricans	Northern hog sucker	(7)	X
Ameiurus natalis	Yellow bullhead		X
Ameiurus nebulosus	Brown bullhead	(4)	X
Noturus insignis	Margined madtom	(10)	X
Anguilla rostrata	American eel		X
Ambloplites rupestris	Rock bass	(6)	X
Lepomis auritus	Redbreast sunfish	(1)	X
Lepomis cyanellus	Green sunfish	(1)	
Lepomis gibbosus	Pumpkinseed	(7)	X
Lepomis macrochirus	Bluegill	(12)	X
Micropterus dolomieu	Smallmouth bass	(5)	X
Micropterus salmoides	Largemouth bass	(2)	X
Etheostoma olmstedi	Tessellated darter	(11)	X
Etheostoma blennioides	Greenside darter		X
Percina peltata	Shield darter	(2)	X
Sander vitreus	Walleye		X
Cottus spp.	Sculpins	(5)	X
	Total Species:	31	33

(##) = Number of sites within the basin where each species was captured during the 2003/2004 survey.

Table 7. Fish species captured at electrofishing sites on Roaring Creek (405E) during 2003/2004.

Species	SECTION 02					SECTION 03
	RM 13.14	RM 10.98	RM 8.54	RM 6.02	RM 4.04	RM 1.39
Rainbow trout	X	X	X			
Brown trout	X	X	X	X	X	X
Brook trout	X	X	X			
Central stoneroller			X	X	X	
Cutlips minnow	X	X	X		X	X
Common shiner	X		X			
Spottail shiner				X		
Rosyface shiner				X		X
Bluntnose minnow				X		
Blacknose dace	X	X	X	X	X	
Longnose dace	X	X	X	X	X	X
Creek chub	X			X		
River chub	X	X	X	X	X	X
White sucker	X	X	X	X		
Northern hog sucker	X	X		X	X	X
Margined madtom			X	X	X	X
Rock bass	X	X	X		X	X
Redbreast sunfish					X	
Pumpkinseed			X		X	
Bluegill			X		X	
Smallmouth bass		X	X		X	X
Tessellated darter		X	X	X		
Shield darter			X	X		
Sculpins	X	X	X			
Total Species:	13	13	18	14	13	9

RM = River Mile.

Table 8. Fish species captured at electrofishing sites on the South Branch Roaring Creek (405E) during 2004.

Species	SECTION							
	01	02	03		04	05	06	
	RM 15.40	RM 13.90	RM 10.67	RM 9.37	RM 6.25	RM 4.02	RM 1.50	RM 0.36
Rainbow trout								X
Brown trout					X	X	X	X
Brook trout			X	X	X		X	X
Chain pickerel	X	X	X					
Central stoneroller								X
Cutlips minnow						X	X	X
Redside dace						X		
Common shiner						X	X	X
Rosyface shiner							X	
Blacknose dace			X	X	X	X	X	X
Longnose dace						X	X	X
Creek chub						X	X	
River chub							X	X
White sucker			X	X	X	X	X	X
Creek chubsucker	X	X						
Northern hog sucker							X	
Brown bullhead	X	X	X					
Margined madtom			X			X	X	X
Rock bass							X	
Green sunfish				X				
Pumpkinseed	X	X	X	X			X	
Bluegill		X	X	X	X	X		
Smallmouth bass							X	
Largemouth bass					X			
Tessellated darter			X	X		X	X	
Total Species:	4	5	9	7	6	11	16	11

RM = River Mile.

Table 9. Fish species captured at electrofishing sites on Mill Creek, Lick Run, and Mugser Run (405E) during 2003/2004.

Species	Mill Creek	Lick Run		Mugser Run		
	RM 1.30	RM 2.24	RM 0.00	RM 5.40	RM 3.23	RM 1.19
Rainbow trout				X		
Brown trout	X	X	X	X	X	X
Brook trout	X	X				
Cutlips minnow		X	X	X	X	X
Common shiner		X	X	X	X	X
Fathead minnow				X		
Blacknose dace	X	X	X	X	X	X
Longnose dace		X	X	X	X	X
Creek chub	X	X	X	X	X	X
River chub			X			
White sucker	X	X	X	X	X	X
Northern hog sucker			X			
Brown bullhead			X			
Margined madtom			X			X
Bluegill		X	X	X	X	X
Largemouth bass						X
Tessellated darter		X	X	X	X	
Sculpins			X		X	
Total Species:	5	10	14	11	10	10

RM = River Mile.

Table 10. Estimates of the number of hatchery trout remaining in stocked stream sections of the Roaring Creek basin (405E) in 2004.

	Rainbow trout		Brown trout		Brook trout	
Stream (Section)	Estimate	Number Stocked	Estimate	Number Stocked	Estimate	Number Stocked
Roaring Creek (02)	698	4,050	2,832	2,100	194	1,350
Roaring Creek South Branch (06)	10	0	420	750	135	550
Mugser Run (02)	22	420	30	180	0	0

Table 11. Wild brown trout biomass estimates for Roaring Creek (405E).

Section	Year	Biomass (Kg/Ha)	Number/Km	Number/Ha	Number of Legals/Km	Number of Legals in Section
02	2004/2003	9.53	141	143	42	815
02	1990	13.42	157	156	74	1,436
02	1977*	23.41	226	259	101	1,959
03	2003	0.15	7	4	0	0
03	1990	0.86	25	10	20	74
03	1977*	1.45	35	12	26	96

* Estimate may include hatchery fish.

Table 12. Wild brown and brook trout biomass estimates for Mill Creek (405E) Section 01 in 2004. Estimates are based on marking run data only.

Species	Biomass (Kg/Ha)	Number Per Km	Number Per Ha	Number of Legals/Km	Number of Legals In Section
Brown	48.28	441	1,050	110	561
Brook	23.88	292	698	83	423
Totals	72.16	733	1,748	193	984

Table 13. Wild brown trout biomass estimates for Lick Run (405E) Section 01.

Year	Biomass (Kg/Ha)	Number/Km	Number/Ha	Number of Legals/Km	Number of Legals In Section
2003	47.43	136	418	64	454
1990	68.63	349	973	112	795
1982*	20.73	42	126	39	277
1976*	46.57	300	1,114	51	362

* Estimate may include hatchery fish.

Table 14. Wild brown trout biomass estimates for Sections 05 and 06 of the South Branch Roaring Creek (405E).

Section	Year	Biomass (Kg/Ha)	Number Per Km	Number Per Ha	Number of Legals/Km	Number of Legals In Section
05	2004	30.53	520	524	106	530
05	1991	28.13	250	330	90	450
05	1982*	33.56	587	1,148	121	605
05	1977*	47.17	532	1,110	113	565
06	2004	31.20	463	437	180	900
06	1983*	12.46	258	355	46	230
06	1977*	3.29	36	37	18	90

* Estimate may include hatchery fish.

Table 15. Wild brown trout biomass estimates for Sections 01 and 02 of Mugser Run (405E).

Section	Year	Biomass (Kg/Ha)	Number Per Km	Number Per Ha	Number of Legals/Km	Number of Legals In Section
01	2004	77.65	240	799	133	771
01	1976	0.00	0	0	0	0
02	2004	76.54	625	1,356	169	1,268
02	1976*	7.61	47	111	13	98

* Estimate may include hatchery fish.

Table 16. Pennsylvania Fish and Boat Commission (PFBC) and Pennsylvania Department of Environmental Protection (DEP) classifications with recommended DEP upgrades and PFBC management programs for stream sections in the Roaring Creek basin (405E).

Stream (Section)	Classification		Recommended DEP Upgrade	Recommended PFBC Management Program
	PFBC	DEP		
Roaring Creek (01)	ALR3	HQ-CWF	None	Wild Trout Waters
Roaring Creek (02)	DGR2	TSF	CWF	Hatchery Trout
Roaring Creek (03)	DGR15	TSF	CWF	Hatchery Trout
Mill Creek (01)	ALR3	HQ-CWF	None	Wild Trout Waters
Lick Run (01)	ALR4	CWF	HQ-CWF	Wild Trout Waters
South Branch Roaring Creek (01)	DR4	HQ-CWF	None	Catch and Release
South Branch Roaring Creek (02)	D R3	HQ-CWF	None	Catch and Release
South Branch Roaring Creek (03)	D R3	HQ-CWF	None	Catch and Release
South Branch Roaring Creek (04)	CLS3	HQ-CWF	None	Natural Yield
South Branch Roaring Creek (05)	BLS3	HQ-CWF	None	Natural Yield
South Branch Roaring Creek (06)	BGR3	HQ-CWF	None	Hatchery Trout
Mugser Run (01)	A R4	HQ-CWF	None	Wild Trout Waters
Mugser Run (02)	AGR3	HQ-CWF	None	Hatchery Trout

TSF = Trout Stocked Fishery; CWF = Coldwater Fishery; HQ-CWF = High-Quality Coldwater Fishery.

Figure 1. Roaring Creek basin (405E).

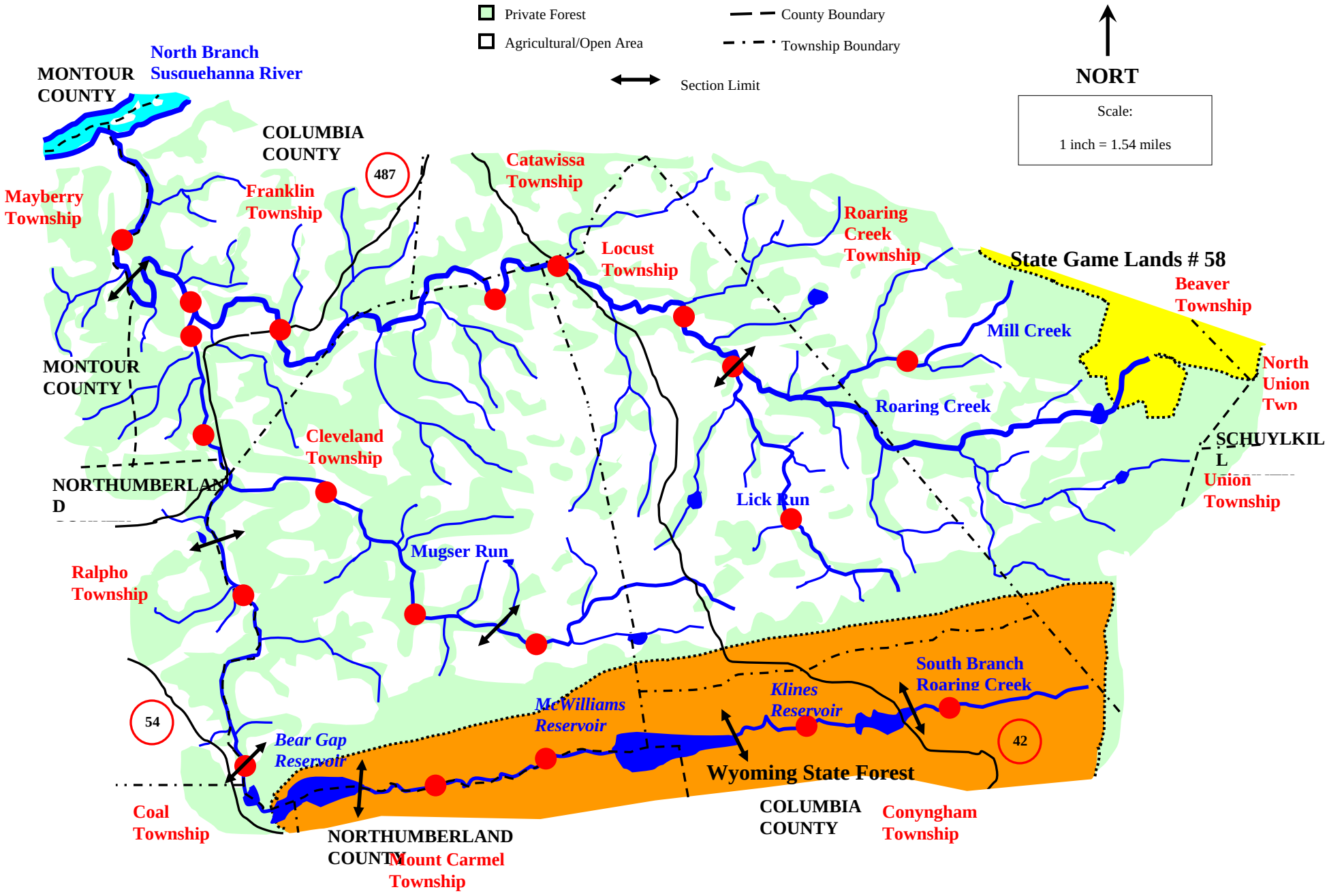


Figure 2. Length-frequency distribution (M+C-R) of wild brown trout captured in Roaring Creek (405E) Section 02 during 2003 and 2004.

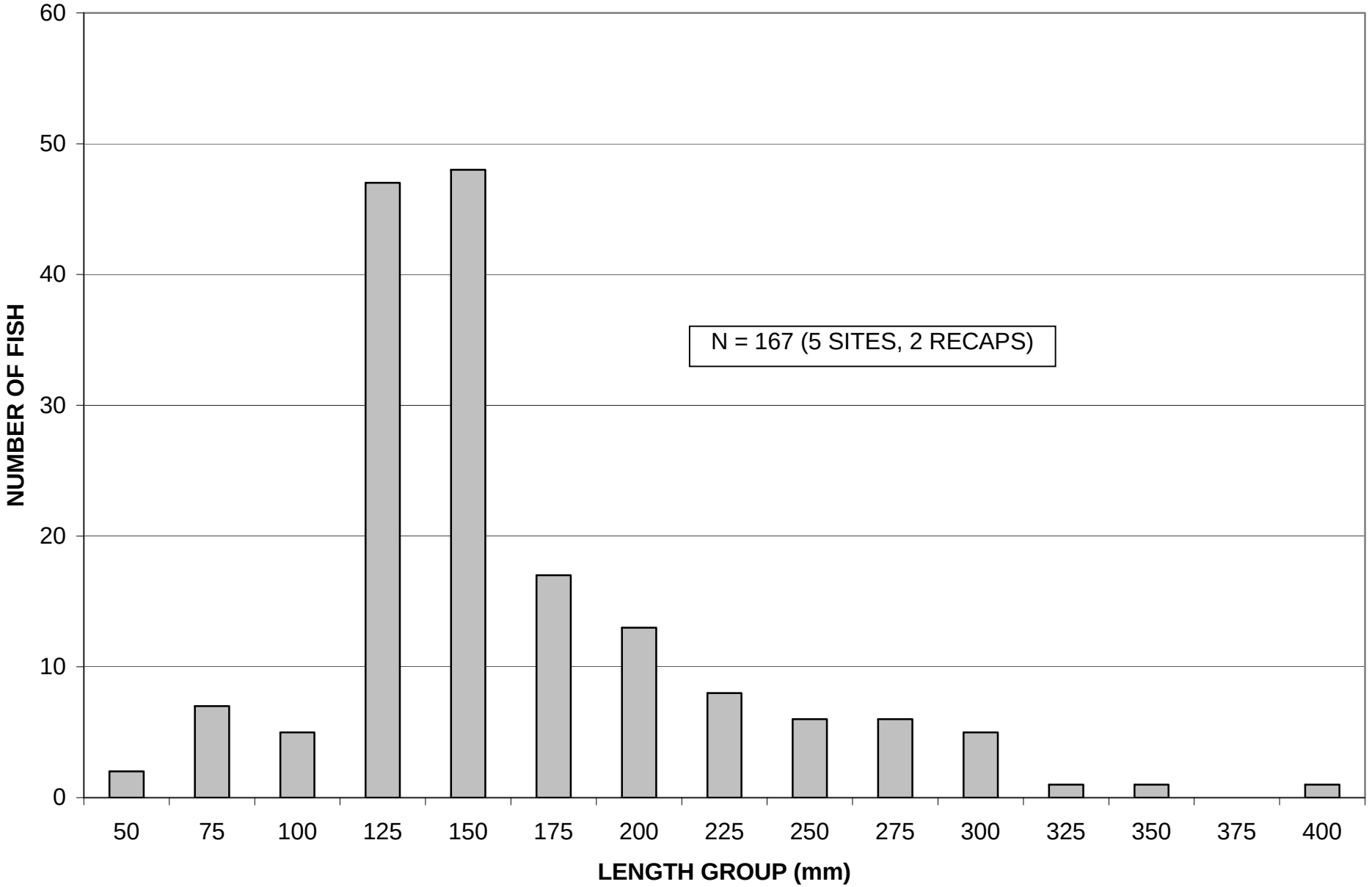


Figure 3. Length-frequency distributions (M+C-R) of wild brook and brown trout captured in Mill Creek and Lick Run (405E) during 2003/2004.

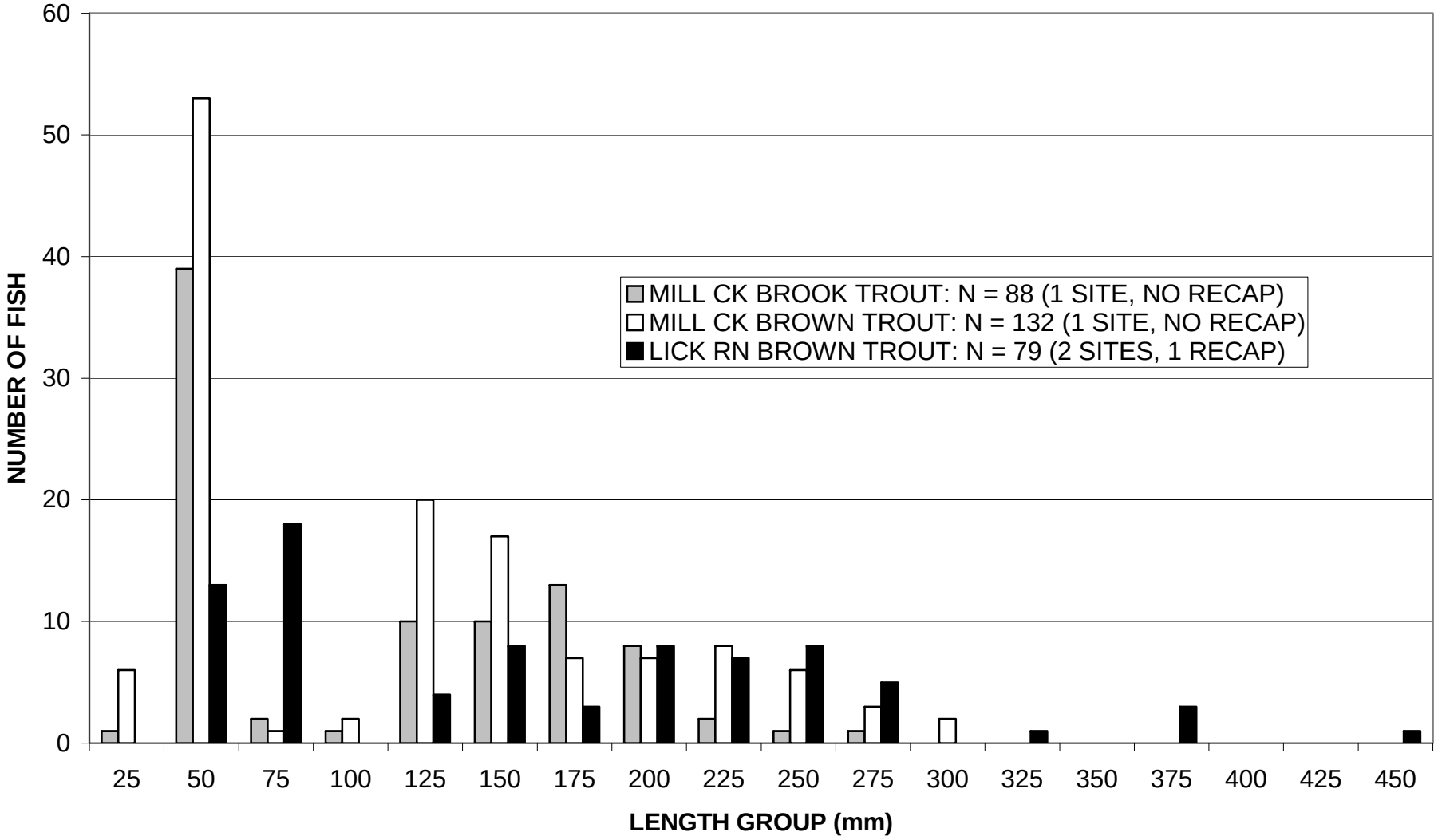


Figure 4. Length-frequency distributions (M+C-R) of wild brown trout captured in the South Branch Roaring Creek (405E) Sections 05 and 06 during 2004.

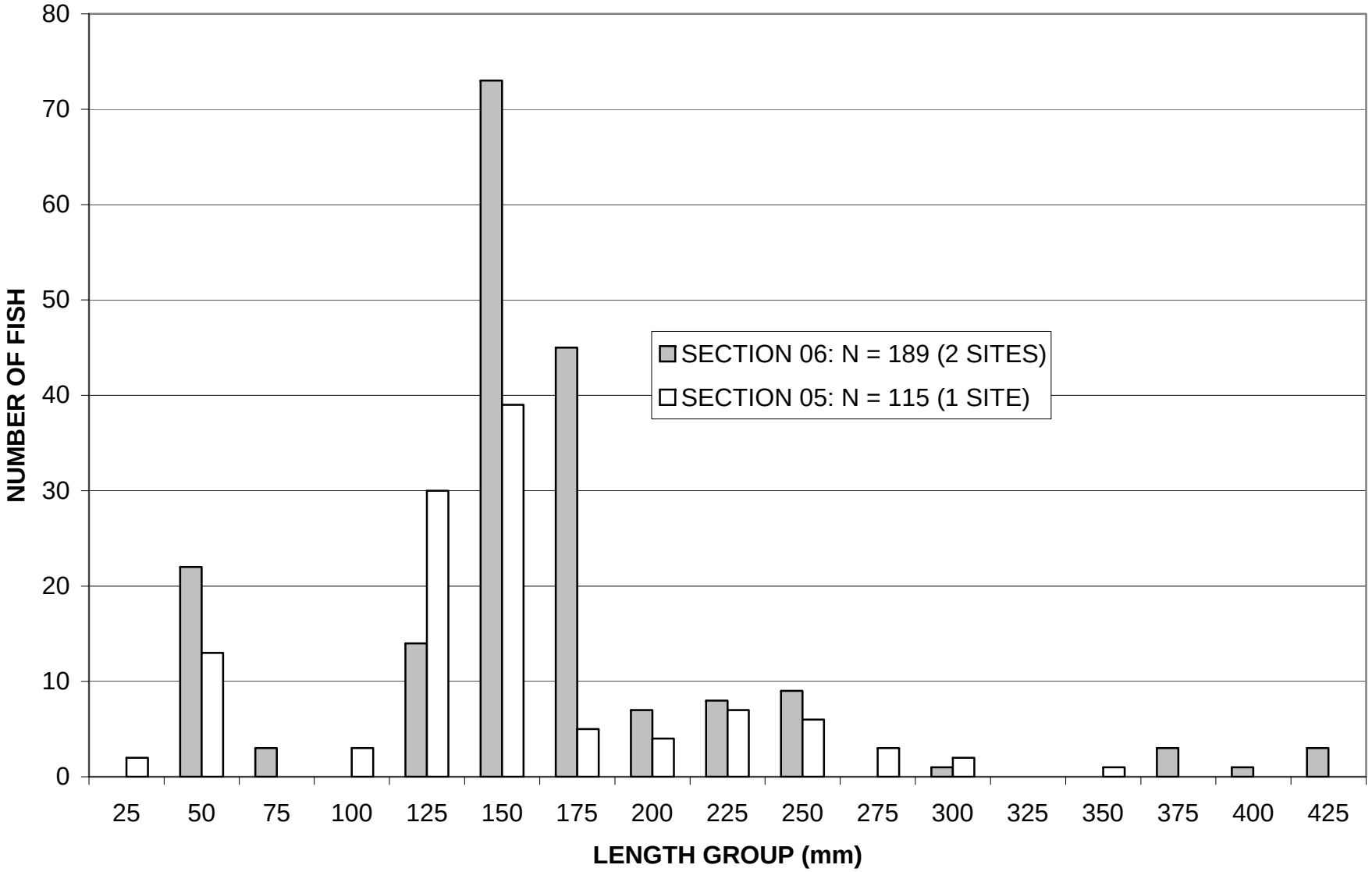
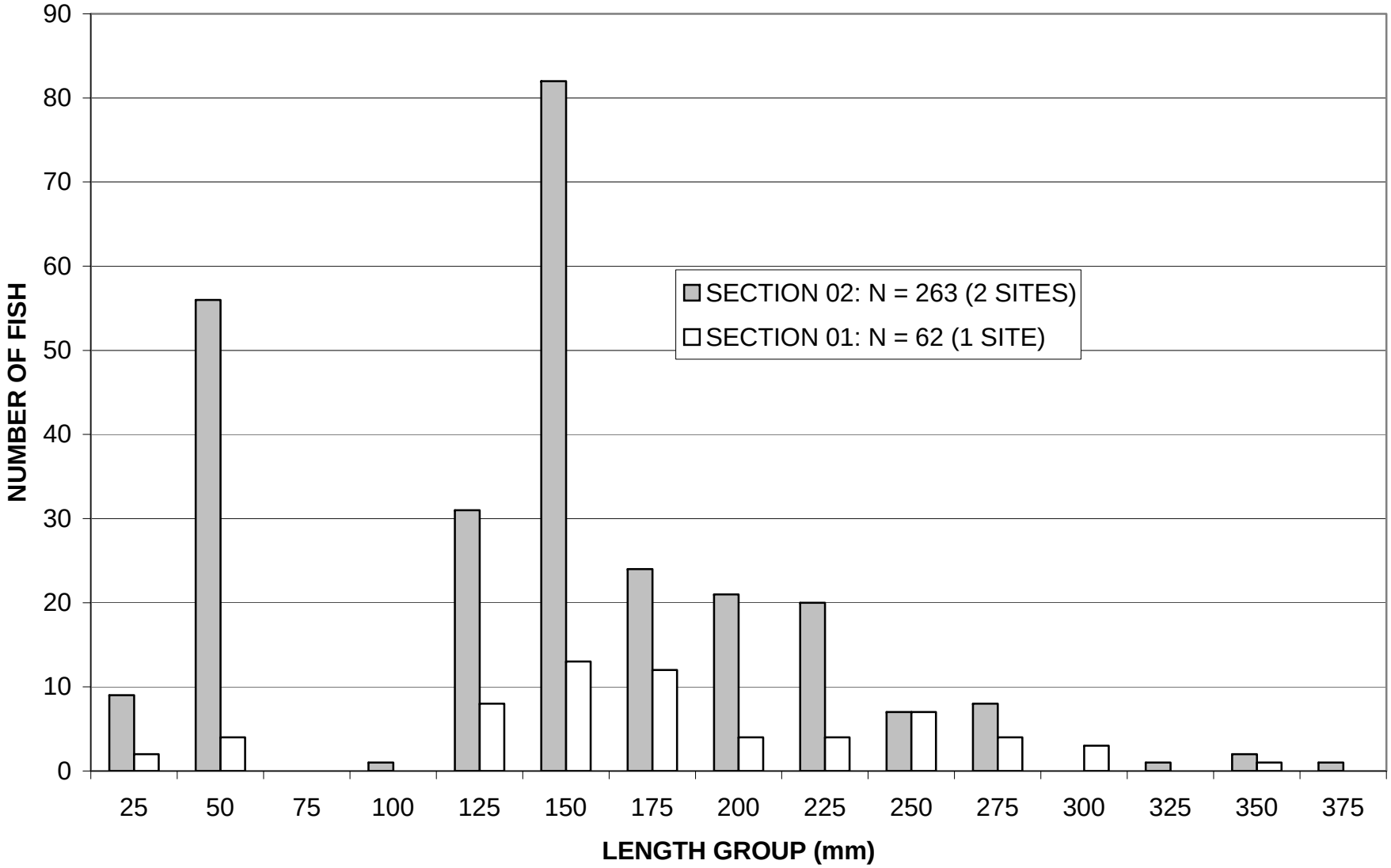


Figure 5. Length-frequency distributions (M+C-R) of wild brown trout captured in Sections 01 and 02 of Mugser Run (405E) during 2004.



DISTRIBUTION

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Water	Database Name	Lat/Long of the mouth
Roaring Creek	Roaring Ck	40-56-21 // 76-31-44
Mill Creek	Mill Ck	40-53-36 // 76-22-22
Lick Run	Lick Rn	40-53-50 // 76-23-18
South Branch Roaring Creek	Roaring Ck S Br	40-54-27 // 76-30-39
Mugser Run	Mugser Rn	40-52-40 // 76-30-13