Table 1. Summary of electrofishing data at four stations on Cherry Creek sampled on 22 and 28 September 2000. A slash (-) indicates species was absent.
KEY: A = Abundant (>25 individuals); C = Common (10-25);
P = Present (5-10); R = Rare (<5).

STATION		#1 (Hatchery)	#2 (Church	#3 (Rt. 191)	#4 (DWG)
Length	(feet)	335	380	380	790
Avg. width	(feet)	15	20	28	31
Area – acres		0.12	0.17	0.25	0.55
Hectares		0.05	0.07	0.10	0.22

		RELATIVE ABUNDANCE			
FISH SPECIES					
Brown trout	***Salmo trutta***	A	A	A	C
Rainbow trout	***Oncorhynchus mykiss***	R	-	-	-
Brook trout	***Salvelinus fontinalis***	R	-	-	-
White sucker	***Catostomus commersoni***	C	C	A	P
American eel	***Anguilla rostrata***	P	P	A	A
Blacknose dace	***Rhinichthys atratulus***	P	P	A	-
Common shiner	***Luxilus cornutus***	P	P	A	-
Cutlips minnow	***Exoglossum maxillingua***	-	P	P	P
Tessellated darter	***Etheostoma olmstedi***	A	P	P	R
Fallfish	***Semotilus corporalis***	-	P	-	-
Pumpkinseed	***Lepomis gibbosus***	-	R	-	R
Rock bass	***Ambloplites rupestris***	R	-	-	R
Redfin pickerel	***Esox americanus***	-	R	R	-
Slimy sculpin	***Cottus cognatus***	R	-	-	-
Longnose dace	***Rhinichthys cataractae***	-	-	R	-

Table 2. Classification of fish species collected from Cherry Creek on 22 and 28 September 2000.

	CRITERIA			
SPECIES	Distribution	Temp.	Trophic Class	Tolerance
Brown trout	S	C	TC	I
Rainbow trout	S	C	TC	I
Brook trout	B,L	C	TC	I
White sucker	S,L	CW	GF	T
American eel	S,L	W	TC	T
Blacknose dace	B,S	CW	GF	T
Common shiner	S,L	CW	GF	M
Cutlips minnow	S,L	W	BI	I
Tessellated darter	S,L	CW	BI	M
Fallfish	S,L	CW	GF	M
Pumpkinseed	S,L	W	GF	M
Rock bass	S,L	CW	TC	M
Redfin pickerel	S,L	W	TC	M
Slimy sculpin	B,L	C	BI	I
Longnose dace	B,S	CW	BI	M

KEY

Distribution: **B = brooks (flowing waters < 5 m wide); S = streams (flowing waters 5-10 m wide); L = lakes (includes ponds & reservoirs).**

Temperature: **C = coldwater; W = warmwater; CW = inhabits both types (coolwater).**

Trophic Class: **GF = generalist feeder (omnivore); BI = benthic insectivore; TC = top carnivore.**

Tolerance (to environmental perturbation): T = Tolerant; I = Intolerant; M = Intermediate

Table 3. Number, population and biomass estimates, and average condition factors (K) of wild brown trout collected at four stations on Cherry Creek on 22 and 28 September 2000.

BROWN TROUT	#1 (Hatchery)	#2 (Church)	#3 (Rt. 191)	#4 (DWG)
Age Group	NUMBER COLLECTED			
0+ (young of year)	50	26	12	3
1+ (yearlings)	9	30	9	7
2+ (adults < 320 mm)	6	16	8	5
3+ (adults > 320 mm)	13	7	1	0
1				
Age Group	POPULATION ESTIMATE			
0+ (young of year)	63	26	15	3
1+ (yearlings)	9	34	10	7
2+ (adults < 320 mm)	6	16	9	5
3+ (adults > 320 mm)	13	7	1	0
	ESTIMATED BIOMASS			
kilograms/hectare	278	138	26	10
pounds/acre	312	154	30	11
			2	
Age Group	AVG. CONDITION FACTOR			
0+ (young of year)	0.80	0.95	-	0.87
1+ (yearlings)	0.86	0.95	-	0.90
2+ (adults < 320 mm)	0.94	0.94	-	0.95
3+ (adults > 320 mm)	0.94	0.96	-	-

1- Based upon the length-frequency distribution, age of trout was related to size and growth rate. This varied among stream areas sampled. For example, young-of-year trout were less than 120 mm at station #1 but somewhat larger (<160 mm) at station #4 because of faster growth, presumably due to warmer temperatures.

2 - Weights and condition factors of trout were not measured at station #3 because of equipment malfunction.

BACKGROUND

On 22 and 28 September 2000, Aquatic Resource Consulting conducted an inventory of the fish community of Cherry Creek (Monroe County, PA). The survey was requested by the Brodhead Watershed Association for the purpose of establishing a database to characterize the ecosystem. The presence and abundance of trout species was of particular interest because members of this family are considered good indicators of water quality. Future surveys would then permit the monitoring of changes in the fishery that might be related to land use in the watershed. Poorly regulated discharges and non-point source runoff from anthropogenic stresses (agriculture, land development, and contaminants) have the potential to degrade or pollute surface water quality and to adversely impact the biotic community – aquatic macroinvertebrates and fish. A survey of the benthic macroinvertebrate community was also conducted in 2000 at the same locations in Cherry Creek that were electrofished. That information is available in a separate report.

SITE DESCRIPTION

Cherry Creek at the sample locations is a second order valley stream located at the base of Kittattinny Mountain in southeastern Monroe County (Figure 1). It originates from springs near Saylorsburg, PA, and meanders approximately 15 miles through a relatively narrow, steep-sided valley before emptying into the Delaware River at Delaware Water Gap, PA. Elevation change from source to mouth is only 340 feet. Along its course, numerous tributaries erupting from Kittatinny Mountain feed Cherry Creek. Substrate material is primarily gravel, sand and silt, with scattered cobble and boulders in higher gradient riffle areas where scouring occurs. Riparian vegetation is well established and stable, alternating between trees that provide a thick canopy on the upper and lower stream to woody shrubs which create an impenetrable bankside overhang, particularly in the mid-valley area. Underlying geology is a complex of limestone, shale and siltstone overlain with unconsolidated glacial deposits of silt, sand, and gravel in the valley (Carswell and Lloyd 1979). As a consequence of the limestone formations, Cherry Creek has a much higher pH, alkalinity, and total dissolved solids than most Pocono area streams, which tend to be acidic with a low mineral content (Monroe County Water Quality Survey 1995).

Land use within Cherry Valley is limited to residential development with scattered commercial enterprises near the headwater area at Saylorsburg and at the mouth in Delaware Water Gap, PA. The entire watershed is heavily forested. Agriculture is limited to drier portions of the floodplain extending back to the base of the mountains, primarily in the upper and mid-valley region. Three golf courses are located in or near Delaware Water Gap. The only point source discharge is from Instrument Specialties, a tool and die manufacturer located in Delaware Water Gap. Cherry Creek is classified as a High Quality Coldwater Fishery by the PA Department of Environmental Protection.

METHODS

The fish community of Cherry Creek was sampled using a Coffelt BP1C variable voltage backpack electrofishing unit with hand held electrodes and 1/8 inch mesh nets. Three consecutive runs were made in an upstream direction. All trout were collected in each run and kept in separate containers, then enumerated, weighed, measured, and released. Quantitative estimates of population and biomass were made only for trout using the depletion removal technique (Zippin 1958). Other fish species were collected for identification on the first run from which relative abundance was estimated.

Four stations on Cherry Creek were sampled, located as follows (Figure 1):

(1) Hatchery – below the discharge from the Cherry Valley Hatchery (length = 335 feet).
(2) Church – below the Kemmerville Road bridge adjacent the Cherry Valley Methodist Church (length = 380 feet).
(3) Rt. 191 – at a private residence approximately ½ mile upstream from the Cherry Valley Road/Rt. 191 intersection (length = 380 feet).
(4) Delaware Water Gap (DWG) – just upstream from the trolley station in Delaware Water Gap, PA (length = 790 feet).

RESULTS AND DISCUSSION

Fish Community

Fifteen fish species were collected at the four sampling stations on Cherry Creek (Table 1). The number of taxa declined in a downstream direction, with sites #1 and #2 each supporting ten species, nine at site #3, and only seven at station #4 (Delaware Water Gap). The fish community of Cherry Creek included a diverse mix of coldwater and coolwater species, but also a few fish classified as warmwater species because of a preference for temperatures exceeding 22 degrees C (72 degrees F) – see Table 2. Coldwater taxa intolerant to environmental perturbation – primarily brown trout (***Salmo trutta***) – predominated at the two upstream stations. Cool and warmwater species less sensitive to degraded conditions, such as white sucker (***Catostomus commersoni***), American eel (***Anguilla rostrata***), and blacknose dace (***Rhinichthys atratulus***) were more numerous on the lower stream areas. Stocked trout or hatchery escapees, including brown, brook (***Salvelinus fontinalis***), and rainbow (***Oncorhynchus mykiss***), were found only at the Hatchery station (site #1). Distinction between wild and hatchery fish was based on external coloration and the condition of fins; hatchery trout recently released tend to be less colorful and to display fin erosion caused by crowding and abrasion.

Only three species were recovered at all four stations: wild brown trout, white sucker, and American eel (Table 1). Both brown trout and white suckers have a widespread distribution in colder streams in the Northeastern U.S., and both spawn at relatively cold temperatures (< 10 degrees C [<50 degrees F]) – trout in the fall and suckers in the spring. The primary forage of trout is aquatic macroinvertebrates, many of which, like trout, demand high water quality. White suckers, however, are indiscriminate bottom feeders more tolerant of warm temperatures and degraded stream conditions caused by siltation and contaminants. Eels are common in tributary streams to the Delaware River, even those with obstructions to flow and fish movement; the ability of eels to bypass man-made dams is legendary. Eels are catadromous – the adults descend streams in the fall to spawn in the ocean, primarily in the Sargasso Sea near Bermuda. The small eels (elvers) soon ascend freshwater streams along the Atlantic coast where they remain until they reach adulthood.

The fish community at each station reflected not only the temperature regime, but also the quality of habitat. In a freshwater ecosystem, habitat - an organism's living area – includes the substrate (stream bottom material), channel configuration (pools, riffles, runs, flats) as influenced by the flow rate and stream gradient, instream structure (boulders, deadfalls, organic debris), and bankside vegetation. Each fish species has specific habitat needs to reproduce, grow and survive, such as suitable spawning areas, forage, and refuge sites. These features affect taxa distribution and abundance.

Trout, both wild and hatchery fish, predominated at station #1 below the outfall from the Cherry Valley Trout Hatchery (Table 1). Brown trout predominated, but two brook trout, one wild and one of hatchery origin, were also found. The wild individual may have drifted downstream from a headwater tributary since brook trout are known to require upwelling groundwater (springs) to reproduce. In addition, a total of nine rainbow trout were collected – three wild fish and six hatchery fish. Based upon their size, all the wild rainbows were probably yearling fish or older, so these may have been fingerling rainbows that escaped from the hatchery in previous years and survived rather than the product of natural reproduction in Cherry Creek. In addition to white suckers and American eels, several slimy sculpin (***Cottus cognatus***), a few common shiners (***Luxilus cornutus***), and one rock bass (***Ambloplites rupestris***) were also netted. Slimy sculpins are restricted to colder, unpolluted headwater streams; their habit of depositing eggs on the underside of rocks limits their distribution to waterways with minimal siltation and a cobble, boulder substrate. Common shiners are a small minnow with a moderate tolerance to stream degradation and omnivorous foraging habits, i.e., feeds on both algae and macroinvertebrates. Origin of the rock bass is uncertain, since its distribution is normally limited to larger streams and lakes rather than colder, headwater brooks. Habitat features at the Hatchery sampling location were good, with alternating pools and riffles, overhanging vegetation, and scattered boulders on a gravel/sand substrate.

Wild brown trout were also the most numerous species at site #2, followed by white sucker. Six additional species absent at site #1 were also collected – blacknose dace (***Rhinichthys atratulus***), cutlips minnow (***Exoglossum maxillingua***), tessellated darter (***Etheostoma olmstedi***), fallfish (***Semotilus corporalis***), pumpkinseed (***Lepomis gibbosus***), and redfin pickerel (***Esox americanus***). Most prefer a coolwater thermal range (20-22 degrees C [68-72 degrees F]). Spawning occurs when a certain minimum temperature is reached, usually in late spring or early summer. The pumpkinseed and pickerel probably

dispersed from impoundments in the Cherry Creek drainage, since both species usually inhabit warmer lakes or bogs rather than streams. The tessellated darter and the other minnow species – blacknose dace, cutlips minnow, and fallfish – are extremely adaptable and fairly small species which can subsist on tiny macroinvertebrates and algae. The stream area at station #2 was characterized by significant sediment deposits, primarily sand and gravel, lateral scour pools on outside bends, and thick, overhanging bankside vegetation, mostly speckled alder (***Alnus incana***).

Suckers, eel, dace, and shiners were numerically as abundant as brown trout at station #3, where pool areas were limited, velocity diminished, and sand/gravel flats predominated – not prime trout habitat. Almost all fish were collected in deeper cuts adjacent brush-lined banks. Cutlips minnow and tessellated darter were also present, with one redfin pickerel and one longnose dace, a close relative to blacknose dace (Table 1). Longnose dace are associated with swift flows, which apparently provide essential spawning or refuge features; if present, generally only a few individuals are found.

Blacknose dace and eels were the most abundant species at the Delaware Water Gap site, followed by suckers and cutlips minnow (Table 1). Only 15 wild brown trout were collected, even though as much stream area was sampled at this location as the three other sites combined. A few tessellated darters, pumpkinseed, and rock bass were also present. The species representation here reflected not only the warmer temperature regime and habitat features at this most downstream stretch but also the resident fish community in the Delaware River. Dispersal of fish to and from the Delaware probably influenced the species composition near the mouth of Cherry Creek since there is no obstruction to fish passage. Physical characteristics may also affect fish distribution. The wider channel creates sluggish flows and increased sediment deposition. Sand and gravel was the primary substrate material – the least productive for aquatic macroinvertebrates, which are the primary forage item for many of these fish species, including trout. Large portions of the stream were barren flats of uniform depth with little instream structure (deadfalls, debris piles, and boulders) where fish can find refuge or foraging sites. Furthermore, overhanging bankside vegetation that provided cover on the upper stream sites was minimal.

Trout Population

Cherry Creek has a reproducing wild trout population from the upper sampling station below the Cherry Valley Hatchery to the mouth in Delaware Water Gap. However, numerical abundance, biomass (weight of fish per area of stream), and size distribution (relative numbers of each age group represented in the population) varied at each location. Numbers of trout were significantly lower at the two lower stations, just above and at Delaware Water Gap. Decline in habitat quality was probably the cause, but this decrease may also be attributable in part to warmer temperatures. A few brook and rainbow trout, both wild and of hatchery origin, were found at the most upstream station below the Hatchery; some may have escaped from the Cherry Valley Hatchery in 2000 or prior years

Approximately the same number of brown trout were collected at sites #1 and #2 (Table 3). However, far more fingerling (young-of-year, or 0+ age) and larger trout were taken at the upper station just below the Cherry Valley Hatchery. This suggests that spawning success was much higher at this stream area. Also, many of the larger trout at this station (ten fish exceeded 15 inches in length) may have been fish which escaped from Hatchery ponds. After a year or two in the stream, these fish are indistinguishable from those produced by spawning activity; they are "wild" fish. Actually, the trout population at site #2 was more balanced and probably more stable, with a more even representation by yearling and older fish. Numbers of trout declined significantly at sites #3 and #4, particularly for the smallest and largest size groups. This indicated poor spawning success and/or survival after hatching, as well as low production and/or high mortality of adult brown trout.

Good statistical regressions allowed precise estimates of the wild brown trout population, both numbers and biomass, at each station. Population estimates were calculated for each size group of brown trout. Each size group corresponded to a particular age group, or cohort, of fish. A length-frequency (L-F) distribution was prepared for all trout collected at the four stations on Cherry Creek (Figure 2). The peaks in this graph represent the average size of an age class; the valleys occur between age cohorts. The 0+ age group is easily identified – those fish less than 130 mm (5 inches). The sizes of older age groups are more difficult to distinguish when fish from all four sample locations are considered. This is because the growth rate increases as we move downstream in response to higher average temperatures during the warmer months. Temperature regulates growth in exothermic [cold-blooded] animals. However, when separate L-F distributions

were prepared for wild brown trout at each station, the average size of yearling (1+) trout at the sampling time at sites #1 to #4 was determined to be 160 mm (6.3 inches), 180 mm (7.1 inches), 210 mm (8.3 inches), and 230 mm (9.1 inches), respectively. These values are similar to those obtained on many area Pocono streams. Estimating age of fish beyond 10 inches using the L-F distribution is not recommended because of overlap in size of year classes. For example, the largest yearlings may be the same size as the smallest two-year-olds because of differences in growth between individual fish. Therefore, the size limit boundary chosen in this study for 2+ and 3+ year-old brown trout (320 mm, or 12.6 inches), may be somewhat arbitrary. However, few fish collected exceeded this length. In addition, population estimates for the largest fish are considered more accurate because sampling efficiency for this group is quite high, approaching 100%. The largest brown trout collected, taken below the Cherry Valley Hatchery, measured 483 mm (19.0 inches) and weighed 965 grams (2.1 pounds).

Estimated biomass of wild brown trout at sites #1 and #2 far exceeded the PA Fish & Boat Commission's standard for Class A trout streams (40 kg/hectare [44 pounds/acre]). Biomass below the Cherry Valley Hatchery was calculated as 278 kg/hectare (312 pounds/acre), while the value at site #2 was approximately half that value (Table 3). Values on most "freestone" Pocono streams – those with low dissolved solids – rarely exceed 100 kg/hectare and usually average 25-50 kg/hectare. The high carrying capacity for brown trout on Cherry Creek may be related to the higher dissolved mineral content or nutrient levels that increases the production of aquatic macroinvertebrates, the primary forage of trout and many other fish species. Numerous studies have shown a higher production of fish and invertebrates on such "limestone" streams. Of course, the large number of larger trout collected below the Cherry Valley Hatchery, some of which may have originated in the Hatchery, could have artificially elevated the biomass at this location. The biomass downstream at the Church site, however, would be unaffected by fish from the Hatchery and was probably the best estimate of carrying capacity on upper Cherry Creek. Biomass at the lower stream stations was much lower because few larger trout were present (Table 3).

The condition factor (K) for most groups of trout at the four stations on Cherry Creek was generally good (Table 3). Condition is a statistical calculation comparing weight to length; more robust fish have a higher condition. Wild trout generally display values between 0.90 and 1.10; lower values may indicate lack of forage, poor feeding, or stress from crowding or disease. Almost all age groups on

Cherry Creek were within the normal range. Young-of-year and yearling trout at the Hatchery site displayed somewhat lower condition values, but the condition of large trout at that location improved. Condition was not calculated for fish at site #3 because the weigh scale malfunctioned and weights of trout were not measured.

SUMMARY

Cherry Creek is a low gradient stream of moderate alkalinity located in a relatively undeveloped valley in Monroe County, PA. Four stream areas were electrofished between the headwaters area near Saylorsburg, PA, and the juncture with the Delaware River. The stream supports a diverse fish community consisting of 15 species. Wild brown trout (***Salmo trutta***), a coldwater species intolerant to environmental degradation, predominated at the two upstream sampling stations but was also found at the two lower sites as well. White suckers (***Catostomus commersoni***) and American eel (***Anguilla rostrata***), two intolerant species preferring warmer temperatures, were also collected at all four locations. A mix of dace, minnows and darters adapted to both cool and warmwater ecosystems were also found at each station. Their numbers increased in a downstream direction, reflecting not only the warmer temperature regime but also physical instream features.

Biomass of wild brown trout at the two upper valley sample areas was 3 to 6 times the PA Fish & Boat Commission's standard (40 kg/hectare) for Class A trout streams. The presence of young-of-year (0+ age) brown trout provided evidence of natural reproduction at all sample locations. However, numbers and weight of trout declined significantly at the two locations nearer the Delaware River, probably in response to habitat degradation. This decrease can be attributed to the lack of pools, the scarcity of boulders and cobbles to support aquatic macroinvertebrates, sand-gravel deposition causing the proliferation of low-velocity flats, and the paucity of instream refuge and foraging sites for trout of all sizes. Wild and hatchery-bred brown, brook, and rainbow trout were found together only at the most upstream station – just below the Cherry Valley Hatchery. Escape of fish from the hatchery ponds may explain the presence of rainbow trout, but brook trout were probably the product of natural reproduction in Cherry Creek or an upstream tributary.

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FISHERY SURVEY

OF CHERRY CREEK

September 2000

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Prepared for

Brodhead Watershed Association

Jim Hartzler
Aquatic Biologist

February 2001

9 February 2001

Mr. Charles Baughman
Executive Director
Brodhead Watershed Assoc.
Box 339
Henryville, PA 18332

Dear Charlie,

Enclosed is the final report documenting the electrofishing survey of Cherry Creek last September. Don Baylor is handling the billing; he wasn't sure when I spoke to him if BWA had already paid for this or not.

From what I have seen and read, you are doing a great job. Hope you can stay for a while – a lot is happening in the county.

If you have any questions, please call.

Sincerely,

Jim Hartzler