Electrofishing Survey Of Bushkill Creek

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Prepared for

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Forks of the Delaware Chapter
Of Trout Unlimited
and
Bushkill Stream Conservancy

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January 2011

BACKGROUND

In September, 2010, Aquatic Resource Consulting conducted an electrofishing survey of the Bushkill Creek in Tatamy and Easton (Northhampton County), PA. The investigation was requested by the Forks of the Delaware Chapter of Trout Unlimited and the Bushkill Stream Conservancy. The primary objective was to assess the wild trout population in this suburban/urban area stream.

The Bushkill Creek is a third-order tributary that originates from several smaller tributaries draining from Kittatinny Mountain and the Lehigh Valley. It flows overland for approximately 15 miles through farmland and residential properties before entering the Delaware River in Easton, PA. Commercial businesses become more numerous as the stream enters the Easton city limits.

Extensive limestone deposits in the watershed create a moderate to highly alkaline water chemistry in the stream. According to members of the local Trout Unlimited chapter, springs entering the stream along its course moderate water temperatures in summer and winter. Runoff during precipitation events may have a significant impact on stream temperature and water quality because of the large amount of impervious surfaces (roadways, parking areas, roofs) within the watershed.

The Bushkill Creek at the sample areas is classified as a High Quality Coldwater Fishery according to PA Department of Environmental Protection regulations. The PA Fish & Boat Commission manages the upper sampled area of the stream as a wild trout fishery – no stocking – while the lower stream sampling site is stocked with catchable-size trout annually. The stream areas sampled have open regulations, while a 1.1 mile portion between the two stations are managed for catch-and-release (no kill).

METHODS

The fish community of the Bushkill Creek was sampled using a Model LR-24 backpack electrofishing unit. Two consecutive runs were made at each sampling location to permit estimation of the total number and biomass of trout

using the depletion removal method. All trout netted were collected, weighed, measured, and released. Relative abundance of other fish species was recorded as abundant (>20 individuals), present (5-20), or rare (<5).

SAMPLING LOCATIONS

Two stream areas on Bushkill Creek were chosen for the survey, located as follows (see Figure 1):

(1) Upper site – approximately 1½ miles downstream from the community park on Bushkill Drive at Tatamy (Figure 2).
(2) Lower site – approximately 1 ½ miles upstream from the confluence of Bushkill Creek with the Delaware River in Easton, adjacent Bushkill Drive, just upstream from the old railroad tressel (Figure 3).

RESULTS AND DISCUSSION

Fish Community

The Bushkill Creek supports a diverse fish community with wild brown trout as the dominant species. A total of 11 fish species representing six different families were collected at the two sampling areas. These included two salmonids (trout), one cottid (sculpin), one catostomid (sucker), four minnow species, one eel species, and two centrarchids (sunfish) (Table 1). All are common to streams in the Lehigh Valley and Pocono Mountain region. The relative abundance of these species varied somewhat at the two sampling areas. These results may reflect both habitat features and sampling conditions. For example, the upper station was relatively shallow with low water velocity and extensive bedrock formations – ideal sampling conditions. On the other hand, the lower site was deeper with swift current and limited visibility, which made netting fish very difficult. Fewer fish were collected at the downstream location although it appeared to have better trout habitat, including a cobble-boulder substrate.

Two species – brown trout and slimy sculpin – are classified as coldwater taxa that are intolerant to prolonged periods of high water temperature, siltation,

Table 1. Species composition of the fish community on the Bushkill Creek in September, 2010, with temperature preference, pollution tolerance, and trophic classification. **A** = abundant (>20); **P** = present (5-20); **R** = rare (<5); -- = absent.

	LOCATION			Pollution	Trophic
SPECIES	Upper	Lower	Temp.	Tolerance	Class
brown trout ***Salmo trutta***	A	A	C	I	TC
slimy sculpin ***Cottus cognatus***	A	P	C	I	BI
white sucker ***Catostomus commersoni***	A	P	CW	T	GF
blacknose dace ***Rhinichthys atratulus***	A	P	CW	T	GF
cutlips minnow ***Exoglossum maxillingua***	P	P	W	I	BI
longnose dace ***Rhinichthys cataractae***	P	P	CW	M	BI
American eel ***Anguilla rostrata***	P	P	W	T	TC
pumpkinseed ***Lepomis gibbosus***	R	--	W	M	GF
common shiner ***Luxilus cornutus***	--	R	CW	M	GF
largemouth bass ***Micropterus salmoides***	--	R	W	M	TC

KEY: Temperature: C = coldwater; W = warmwater; CW = both cold & warmwater
Tolerance (to environmental perturbation): I = intolerant; T = tolerant; M = intermediate
Trophic class: TC = top carnivore; BI = benthic invertivore; GF = generalist feeder

low oxygen conditions, and various pollutants. Hence, their presence is an indication of fairly high water quality. In fact, the sculpin may be a better indicator than brown trout because this member of the family Cottidae, which rarely exceeds four inches in length, is often the only taxa associated with wild brook trout, Pennsylvania's only native salmonid, in undisturbed headwater streams. Like brook trout, it cannot tolerate even minor sedimentation. While brook trout excavate a depression in the substrate, then cover their eggs with gravel after spawning, sculpins have the peculiar habit of depositing eggs on the underside of rocks where accumulated fines would smother them.

Four other fish species collected in the Bushkill Creek – white sucker, American eel, blacknose dace, and longnose dace – are common cohabitants of brown trout in cooler streams in the northeastern U.S. All these taxa can tolerate higher temperatures than trout and so are also found in warmer ecosystems. Suckers have long been labeled as "trash" fish that compete with and are considered detrimental to wild trout, but little evidence exists to support this notion. American eel are widespread in waterways in the Atlantic coast drainage. This catadromous species reproduces in the ocean, then the tiny "elvers" swim up the coastline and ascend freshwater streams where they grow to adulthood. After several years, mature eels descend to their historic spawning grounds near Bermuda. Eels are voracious predators that probably consume large numbers of small fish, including trout. Blacknose dace are the most numerous and widespread minnow in streams in the Northeast; their distribution is limited only by the minimum temperature that allows them to spawn – approximately 70 degrees F. They rarely exceed 3 inches in length and are frequently observed schooling in shallow shoreline areas. Longnose dace are somewhat larger than blacknose dace, are solitary, and prefer the torrential flows in riffles and runs, so are almost never seen.

Two other minnows that inhabit the warmer, lowland reaches of area streams were collected in the the Bushkill Creek. Cutlips minnow are classified as intolerant to environmental disturbances, possibly because they feed primarily on aquatic macroinvertebrates that cannot tolerate extensive siltation of the stream substrate. Common shiners are generalist feeders, consuming whatever is available – aquatic insects, algae, and detritus. Their distribution in streams is more limited than other minnow species; only a few were recovered at the lower sampling station.

The pumpkinseed (sunfish) and largemouth bass collected in the Bushkill Creek were probably escapees from upstream impoundments, or perhaps migrants from the Delaware River. These species are classified as pond and lake taxa, although they also inhabit sluggish areas on larger streams where they may spawn in quiet backwater shoreline areas.

Trout Population

Bushkill Creek supports a reproducing wild brown trout population with at least three age groups represented but with a relatively low biomass in the stream areas sampled (Table 2). The numbers of fish in the various size (age) groups was more balanced at the upper station than at the lower stream area, where no trout over 12 inches were netted. Trout ranging in size from 73 mm to 477 mm (3.7-18.8 inches) were collected by electrofishing a total of 875 feet of stream at the two sampling locations. One stocked rainbow trout (***Oncorhynchus mykiss***), measuring 350 mm (13.8 inches) was netted at the upper stream area. Trout were more numerous at this location. However, the numbers may reflect in part higher sampling efficiency at this location due to the shallow water and low velocity, in contrast to the swift, deeper lower stretch where netting fish was extremely difficult.

Wild brown trout displayed excellent growth, based upon estimates from the length-frequency (L-F) distribution of all trout sampled. Figure 4 is a graph showing the number of fish in each size group; peaks in the graph represent the average size of each age class. The L-F distribution is a fairly reliable method for estimating the age of smaller fish – young-of-year and yearlings – but not larger, older trout because growth becomes less uniform as fish age. It appears that at least three ages were represented in the Bushkill Creek population: 0+ (young-of-year), 1+ (yearling), and 2+ year old. In September 2010, young-of-year trout averaged 4+ inches and yearlings ranged in size from 9 to 12 inches. Beyond this size, an insufficient number of trout were collected to estimate age. Only the microscopic examination of boney parts (scales, otoliths) of individual fish would give an accurate estimate of age. In addition, some catchable-size (stocked trout will survive and continue to grow which can confound growth estimates. Growth rate of fish is controlled primarily by the yearly water temperature regime, so the

Table 2. Number of wild brown trout collected, and estimated population, biomass and coefficient of condition at two locations on the Bushkill Creek in September, 2010.

LOCATION	**Upper**	**Lower**
Length (feet)	400	475
Avg. width (feet)	48	39
Area – acres	0.51	0.43
Hectares	0.21	0.17
Brown trout – collected		
Size: < 180 mm (<7.1 in.)	45	11
180-320 mm (7.1-12.6 in.)	9	14
320-440 mm (12.6-17.3 in.)	5	0
>440 mm (>17.3 in.)	2	0
Total	61	25
Brown trout – population estimate		
Size: < 180 mm (<7.1 in.)	81	16
180-320 mm (7.1-12.6 in.)	12	20
320-440 mm (12.6-17.3 in.)	5	0
>440 mm (>17.3 in.)	2	0
Brown trout – biomass		
Kilograms/hectare	23.1	20.1
Pounds/acre	20.6	17.9
Average condition factor (K)		
Size: < 180 mm (<7.1 in.)	0.63	0.93
180-320 mm (7.1-12.6 in.)	0.64	0.96
320-440 mm (12.6-17.3 in.)	0.68	--
>440 mm (>17.3 in.)	0.57	--

average size of each age group normally varies little from year to year. It's possible that the unusually dry conditions and warm stream temperatures in 2010 increased growth slightly higher than the norm. However, there are no data from prior years to compare with our information.

Young-of-year brown trout were collected at both sample stations on Bushkill Creek, indicative of spawning at or near those locations. However, 0+ year-old fish were far more numerous at the upper station (Table 2). Redds (spawning beds) are constructed where there is intra-substrate flow through suitably sized material (gravel, small cobble) that keeps the eggs and developing fry supplied with dissolved oxygen. The exact location of spawning areas can only be determined by a visual survey during the fall spawning period. Emerging fry normally stay close to these spawning grounds for some time if satisfactory feeding and refuge sites are available. However, high flows can cause downstream drift. In addition, territorial behavior drives trout to seek more favorable lies.

Approximately the same number of larger (>8 inch) brown trout were collected at both sampling locations. Population estimates for this size group were also similar (Table 2). However, the seven largest fish, which ranged in size from 325 mm to 477 mm (12.8 to 18.8 inches) were all taken at the upper electrofishing site. Members of the Trout Unlimited chapter informed us that the lower stream area located within the Easton city limits in a park area received heavy fishing pressure while the upper area is utilized primarily by fly fishermen who release most fish. This difference in angling use and harvest may explain the discrepancy in larger trout among the two stream areas. However, some larger trout may have been missed while sampling at the deeper, faster lower station; collection efficiency at the shallower upper station was obviously much higher.

Total estimated biomass of wild brown trout was similar at both electrofishing stations on Bushkill Creek – just over 20 kg/hectare (Table 2). This is significantly less than the 44 kg/hectare (40 pounds/acre) standard of the PA Fish and Boat Commission (PAF&BC) for Class A wild trout waters. PAF&BC sampled the Catch-and-Release regulations section of the Bushkill Creek, located just upstream from our lower electrofishing station, in July 2010. They reported a total estimated biomass for brown trout of 67 kg/hectare – three times greater than our estimate. However, their estimate for the number of trout per mile over 14

in length (72) was comparable to our finding (66) at the upper electrofishing station; we collected no trout over 12 inches at the lower station. Angler harvest in this heavily fished open regulations stream area within the borough of Easton may explain the paucity of larger fish.

One disturbing feature of the trout population at the upper stream area was the low condition of fish in all size groups, corresponding to age classes. PA F&BC reported the same phenomenon ("thin appearance" of large brown trout) in the report for their 2010 survey. Condition measures robustness – weight relative to length – and is considered one measure of fish health. Numerous studies peg the value for coefficient of condition (K) in the 0.90-1.10 range for most wild trout. The average condition of trout for the four size groups at the upper station on Bushkill Creek ranged from 0.57 to 0.68 (Table 2). This may be normal for this wild trout population but data from other years were not available. Perhaps higher stream temperatures during the summer drought raised fish metabolism to high levels, depleting fat reserves and body tissue. Or forage, primarily aquatic insects, may not have been adequate to maintain body weight through the summer. Crowding due to territoriality has been shown to cause stress, and this may also have been a factor in weight loss. However, low condition was not apparent at the lower electrofishing site, where K values for 0+ and 1+ year-old brown trout (0.93 and 0.96, respectively) fell within the normal range.