Technical Memorandum

Blackstone River Watershed 2003
Fish Population
Monitoring and Assessment

Robert J. Maietta

Massachusetts Department of Environmental Protection
Division of Watershed Management

27 April 2006

CN 240.4

Introduction

Fish population surveys were conducted at thirteen stations using techniques similar to Rapid Bioassessment Protocol V as described originally by Plafkin et al. (1989) and later by Barbour et al. (1999) (See Figure 1). Standard Operating Procedures are described in MassDEP Method CN 075.1 *Fish Population SOP*. Surveys also included a habitat assessment component modified from that described in the aforementioned document (Barbour et al 1999).

Fish populations were sampled by electrofishing using a Smith Root Model 12 battery powered backpack electrofisher. A reach of between 80m and 100m was sampled by passing a pole mounted anode ring, side to side through the stream channel and in and around likely fish holding cover. All fish shocked were netted and held in buckets. Sampling proceeded from an obstruction or constriction, upstream to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle. Following completion of a sampling run, all fish were identified to species, measured, and released. Results of the fish population surveys can be found in Table 1. It should be noted that young of the year (yoy) fish from most species (with the exception of salmonids) are not targeted for collection. Young of the year fishes that are collected, either on purpose or inadvertently, are noted in Table 1.

Habitat Assessment

An evaluation of physical habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sample reach during the 2003 Blackstone River watershed fish population surveys, habitat qualities were scored using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and riparian area. Most parameters evaluated are instream physical attributes often related to overall land use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follows: instream cover for fish, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and when appropriate compared to a reference station to provide relative habitat ranking (See Table 2).

Fish Sample Processing and Analysis

The RBP V protocol (Plafkin et al. 1989 and Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). Since no formal IBI for Massachusetts currently exists, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of the overall abundance (number of species and individuals) and species composition classifications listed below.

1. Tolerance Classification - Classification of tolerance to environmental stressors similar to that provided in Plafkin et al. (1989), Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes are those provided by Halliwell et al. (1999).

2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain (1996) modified regionally following discussions between MassDEP and MA Division of Fish and Game (DFG) fishery biologists.

3. Trophic Classes- Classification which utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al.(1999).

Station Habitat Descriptions and Results

Laurel Brook upstream of West Street in Uxbridge

The reach of this first order stream was of low gradient and contained a mix of riffles and runs as well as a few small pools. Eight of the nine habitat parameters scored in the "optimal" category. Epifaunal substrate was not scored. Velocity depth combinations scored "sub-optimal" due to the scarcity of pools and the absence of fast deep water. Channel flow status scored "optimal", however, it should be noted that the watershed received heavy rains on the previous day. The final habitat score was 158 (of a possible 180). Fish sampling efficiency in Laurel Brook was rated as excellent. A Stowaway continuous temperature data logger was placed within this reach of Laurel Brook on July 25, 2003 and retrieved on September 22nd 2003. Results of the temperature survey will be found in DWM Technical Memorandum (CN 135.0), *Continuous Temperature Data at Four Locations in the Blackstone River Watershed (August-September, 2003* (In publication).

The fish sample included white sucker *Catostomus commersoni*, two age classes of brook trout *Salvelinus fontinalis*, and largemouth bass *Micropterus salmoides*. It should be noted that the Laurel Brook Club stocks parts of Laurel Brook with brook trout fry and there is a possibility that these fish are the result of those stockings. The source of immature largemouth bass is most likely one or both of the small ponds located upstream. The sampling station was located in the upper one third of the sub-watershed and within a reach that the Laurel Brook Club has reported as being totally dewatered on a number of occasions since the construction of Blissful Meadows Country Club. Their contention is that water use and management at the golf course is having a direct impact on flows within Laurel Brook. MassDEPs Central Regional Office is working with the Blissful Meadows to assess water use and to investigate the allegations.

The presence of brook trout and white sucker, two fluvial specialist/dependant species, suggests a stable flow regime. It should be noted, however, that the vast majority of fish present at this location were young of the year (yoy). This section of Laurel Brook is obviously serving as nursery habitat for white sucker, but the presence of yoy white sucker is not necessarily an indication of a stable flow regime. Additional biomonitoring that includes macroinvertebrate assessment should be conducted in Laurel Brook.

Scadden Brook upstream from West Street in Uxbridge.

The sampled reach of this small second order stream is of moderate gradient and contained a mix of riffles and runs. The riparian zone was completely forested. Seven of the ten habitat parameters scored in the "optimal" category. Instream cover for fish and epifaunal substrate scored "sub-optimal". Velocity depth combinations scored "marginal" due to the scarcity of pools and the absence of fast deep water. Channel flow status scored "optimal" however, it should be noted that the watershed received heavy rains on the previous day. The final habitat score was 168 (of a possible 200). Fish sampling efficiency in Scadden Brook was rated as excellent. A Stowaway continuous temperature data logger was placed within this reach of Scadden Brook on July 25, 2003 and retrieved on September 22nd 2003. Results of the temperature survey can be found in DWM Technical Memorandum (CN 135.0).
Fish species captured in order of abundance included blacknose dace *Rhinichthys atratulus*, white sucker, and largemouth bass. Many young of the year (yoy) blacknose dace were also noted on the field sheet. Blacknose dace are classified as moderately tolerant fluvial specialist whereas white sucker are classified as a tolerant fluvial dependant. The dominance of these two species seem to indicate a stable flow regime, however the "sub-optimal" instream cover for fish may account for the relatively low numbers of fish collected from this reach. The source of immature largemouth bass is most likely Lee Reservoir (Uxbridge Rod and Gun Club's pond) which is located a short distance downstream from the sampling location. The presence of largemouth bass (a top-level predator) may also be having a significant effect on overall numbers of fish observed. Although trout were not collected or observed, many local sportsmen from the Uxbridge Rod and Gun Club report native brook trout in Scadden Brook. The watershed is a mostly forested, with a small amount of low density residential, commercial, and industrial land-use mixed in. Much of the local residential development has taken place in the last 5 to 10 years. Future biomonitoring should include a more thorough search for native brook trout and a benthic macoinvertebrate component.

Emerson Brook upstream from Rte 146 (South) off ramp at Chocolog Road in Uxbridge

This third order stream is the combined flow of Scadden and Laurel brooks. The sampled reach is just downstream of the confluence of Emerson and Happy Hollow brooks and was of moderate to high gradient with a diverse mix of riffle, run, and pool habitats. Eight of the ten habitat parameters scored in the "optimal" category. Channel flow status and bank stability scored "sub-optimal". It should be noted that the watershed received heavy rains on the day prior to the survey. The final habitat score was 178 (out of 200). Fish sampling efficiency at Emerson Brook was rated as good. A Stowaway continuous temperature data logger was placed within this reach of Emerson Brook on July 25, 2003 and retrieved on September 22nd 2003. Results of the temperature survey can be found in DWM Technical Memorandum (CN 135.0).

Fish species captured in order of abundance included blacknose dace, fallfish *Semotilus corporalis*, common shiner *Luxilus cornutus*, longnose dace *Rhinichthys cataractae*, white sucker, brook trout, and largemouth bass. The brook trout appeared to be a native fish as evidenced by the excellent fin quality, however, historic trout stocking in the upper watershed by both the Laurel Brook Club and the Uxbridge Rod and Gun Club make this determination very difficult. It should be noted that the Laurel Brook Club also stocks fry which could certainly develop into adults with excellent fin quality. The presence of six fluvial specialist/dependant species and two intolerant species (longnose dace and brook trout) is indicative of excellent water and habitat quality. The Emerson Brook watershed (including Laurel and Scadden Brooks is largely undeveloped. Two large landowners (Laurel Brook and Uxbridge Rod and Gun Clubs) account for much of the undeveloped area. It should be noted that there are a number of impoundments on these two properties.. In addition both clubs have stocked and fished for trout within this watershed for years. The effect of extensive stocking (and fishing) and the impoundments is unclear at this time. Future biomonitoring work on Emerson Brook should include more intensive sampling of Emerson Brook as well as macroinvertebrate monitoring.

Coal Mine Brook upstream of Lake Avenue in Worcester

A first order tributary to Lake Quinsigamond, Coal Mine Brook is of moderate to high gradient and contained a diverse mix of riffles, runs and pools. Six of ten habitat parameters scored in the "optimal" category. Instream cover for fish and sediment deposition scored "sub-optimal". Channel flow status and bank stability scored "marginal" and "poor" respectively. The final habitat score was 157 of a possible 200. Although the flow was extremely low on the date of the sampling it appears that this brook experiences extreme high flow conditions as well. This observation was based on the erosional areas on the streambank and the presence of debris caught in tree branches well above the normal water line. Much of the upper watershed is developed both residentially and commercially. There is also a large shopping plaza and a major six lane highway (Route 290) which drain to this sub-watershed. Recent re-construction of the shopping plaza included best management practices such as stormwater detention/infiltration basins as a part of the permitting process to try and minimize the negative effects of fluctuating flows and temperatures related to storm events. It is unclear if these BMPs have been successful in mitigating the effects of stormwater. A Stowaway continuous temperature data logger was placed within this reach of Coal Mine Brook on July 25, 2003 and retrieved on September 22nd 2003. Results of the temperature survey can be found in DWM Technical Memorandum (CN 135.0), *Continuous Temperature Data at Four Locations in the Blackstone River Watershed (August-September, 2003).*

The survey resulted in the collection of only two golden shiner *Notemigonus crysoleucas*, a macrohabitat generalist which is commonly sold and used as bait by fishermen and women targeting larger freshwater fish. It is possible that the shiners captured were bait bucket releases. Although the instream cover for fish was rated as "sub-optimal" it was scored 15 which is the highest score within the category and is described as "50% of area with a mix of stable habitat; adequate habitat for maintainence of populations". It is unclear if the lack of fish in Coal Mine Brook is a result of historic conditions or if the water quality and flow regime of this brook remain unsuitable to support a balanced and indigenous fish community. Future monitoring should include benthic macroinvertebrates, water quality, and thermal components.

Cedar Swamp Brook downstream of Southwest Main Street (Douglas Pike) in Douglas

The sampled reach of this first order stream was a diverse mix of riffles, runs, and pools. Eight habitat parameters scored in the "optimal" category. Only epifaunal substrate and channel flow status scored "sub-optimal", and both of these scored 15, which is the maximum for this category. The final habitat score was 181 (of a possible 200). Although

no fish were collected or observed in this reach, fish sampling efficiency at this location was rated as excellent because frogs and invertebrates were being shocked and no fish were observed escaping.

The absence of fish from Cedar Swamp Brook may be due to low flow issues during drought years or naturally occurring low pH. The water color was red and the temperature on the date of the survey was 16.5 C. The brook drains Cedar Swamp, a large forested wetland associated with Chocolog and Cedar Swamp ponds in Uxbridge which are located a short distance upstream. The watershed near the ponds and swamp is mostly undeveloped, however, there is a new residential development just upstream from the sampled reach. Future biomonitoring work on Cedar Swamp Brook should include more intensive sampling of the brook as well as macroinvertebrate monitoring.

Tinkerville Brook upstream of Hemlock Street in Douglas

The sampled reach was of moderate gradient and contained mostly riffle/run habitat. Pools were lacking. Although four habitat parameters scored in the "optimal" category, three of these only scored "optimal" on one bank. Channel flow status, instream cover for fish, embeddedness, and channel alteration all scored "sub-optimal". Velocity depth combinations scored "marginal" due to the the absence of deep water habitats. Riparian vegetative zone width scored "poor" due to the presence of a road along the right bank of the reach. The final habitat score was 141 (of a possible 200). Fish sampling efficiency was rated as good .

Fish species captured included redfin pickerel *Esox americanus* and brook trout. While the presence of what appeared to be 2-year-old brook trout is indicative of excellent water and habitat quality, the total number of fish collected (or observed) was very low for the amount of habitat available. The habitat field sheets note "evidence of road runoff (sand) instream".

Tinkerville Brook and it's major tributary Hemlock Brook both appear to originate in forested wetlands. Development within the Tinkerville Brook sub-watershed is relatively light and mostly residential. The low number of fish is likely related to water quantity and possibly naturally occurring low pH. Additional biomonitoring should be conducted in an effort to document the extent of the brook trout fishery in this sub-basin. This monitoring should include a benthic macroinvertebrate component.`

Greene Brook downstream from Perry Street in Douglas

A first order tributary to the aforementioned Cedar Swamp Brook (downstream of our sampled reach), Greene Brook was of moderate gradient and contained riffles, runs and pools. Six habitat parameters; instream cover for fish, embeddedness, channel alteration, bank vegetative protection, bank stability, and riparian vegetative zone scored in the "optimal" category and four habitat parameters; sediment deposition, epifaunal substrate, velocity-depth combinations and channel flow status scored in the "sub-optimal" category. The presence of a dirt road crossing upstream was noted as the cause for the sediment deposition and embeddedness problems. Still these problems were not extreme. The presence of a beaver dam upstream may have been contributing to low flows. The final habitat score was 169 (of a possible 200). Fish sampling efficiency was rated as good to excellent.

The survey resulted in the collection of only nine redfin pickerel *Esox americanus*, one golden shiner, and one brown bullhead *Ameiurus nebulosus* . All three are classified as tolerant macrohabitat generalists. In light of the "optimal" instream cover for fish, the low numbers of fish and the absence of fluvial species leads one to believe that the flow regime may be compromised by the upstream beaver activity. Additional monitoring (especially upstream of the beaver dam) would be helpful in more thoroughly documenting the fish community within Greene Brook. Future biological monitoring should also include a benthic macroinvertebrate component.

Cook Allen Brook downstream of Mendon Road in Sutton

This first or second order stream is the outlet of Reservoir 5, which is owned by the Town of Northbridge and operated by their Water Department. The brook is of moderate to high gradient with a diverse mix of riffles, runs, and pools. Eight of ten habitat parameters scored in the optimal category. Velocity depth combinations scored "sub-optimal" due to a lack of deep fast water and channel flow status scored "marginal" due to very low flows. The final

habitat score was 170 (of a possible 200). Although no fish were collected or observed in this reach, fish sampling efficiency was rated excellent as frogs and invertebrates were observed being shocked and no fish were observed escaping.

The absence of fish from Cook Allen Brook may be due to flow regulation by the Northbridge Water Department. A town employee who was interviewed on the day of the sampling, verbally confirmed that the Reservoir was on occasion managed in such a way that all flow was cut off from this segment. The watershed upstream of the sampling station is completely undeveloped and appears to be mostly, if not entirely, owned or managed by the Town of Northbridge Water Department. Minimum flow from the reservoirs is a necessity to support any stream fish community which might be established in Cook Allen Brook. Re-establishment of lotic fishes to this section might require re-stocking due to this segment's isolation from other lotic environments.

Taft Pond Brook downstream of sand pit access road at end of South Street in Upton.

The sampled reach of this second order stream was of low gradient and contained a mix of riffles and runs and pools. Five of the ten habitat parameters scored in the "optimal" category. Bank vegetative protection and bank stability scored "optimal on the left bank and "sub –optimal" on the right bank. Velocity depth combinations and sediment deposition scored "sub-optimal" and channel flow status scored only "marginal". The final habitat score was 166 (of 200). Fish sampling efficiency in Taft Pond Brook was rated as good.

Fish species captured in order of abundance included redfin pickerel, brown trout *Salmo trutta*, yellow bullhead *Ameiurus natalis*, largemouth bass, pumpkinseed *Lepomis gibbosus* and chain pickerel *Esox niger*. The presence of two small brown trout suggests a reproducing trout population. Even the largest brown trout, which was of a size that is regularly stocked by MassWildlife had excellent fin quality which suggests it is a wild fish. The presence of brown trout, an intolerant fluvial species is indicative of excellent water and habitat quality and a stable flow regime, however the overall low numbers of fish and the fact that all other species observed were macrohabitat generalists suggests potential problems in Taft Pond Brook. These problems may be flow-related. Taft Pond, which is located upstream, is most likely the source of not only the young of the year largemouth bass, but the pumpkinseed, chain pickerel and bullhead as well. Sedimentation is noted as a slight problem within this reach Future monitoring should include macroinvertebrates and be expanded to better document the presence and extent of the reproducing brown trout population.

Miscoe Brook upstream from Oak Drive in Upton.

Miscoe Brook originates on the south side of Miscoe Hill and flows through a very high gradient reach before leveling out in a low gradient flat prior to joining with Taft Pond Brook just upstream from the former brooks confluence with West River. Although we originally planned to begin the sample in the low gradient portion and continue into a high gradient segment, flows were so low and habitat was so limited within the high gradient segment that sampling was impossible. It was obvious that the majority of the fish which may have inhabited the high gradient mostly dewatered section of the brook, had either dropped back into the low gradient areas or perished. Six of the ten habitat parameters scored in the "optimal" category. Sediment deposition scored "sub-optimal" and velocity depth combinations and epifaunal substrate scored "marginal" due to a total lack of flowing water and, in turn, a scarcity of riffles or submerged rocky substrates. Channel flow status scored "poor" as most water was in standing pools. The fine organic component of the stream bottom in pools made sampling difficult at times due to particulate organic matter getting disturbed and suspended into the water column and there by reducing visibility. The final habitat score was 149 (of a possible 200)

The fish community included large numbers (n=40) of brook trout as well as redfin pickerel. Brook trout made up 80% of the sample. The presence of multiple age classes of reproducing brook trout is indicative of excellent water and habitat quality. It was obvious that large portions of Miscoe Brook were un-inhabitable due to very low water conditions. Efforts to stabilize flows in Miscoe Brook are crucial to protecting this excellent cold-water fishery resource. Future monitoring should include macroinvertebrates and be expanded to document the extent of this cold-water fishery. It is unclear what effect, if any, local authorized water withdrawal of 0.06 million gallons per day by Miscoe Springs Inc. Well # 1 may be having on this brook and cold-water fishery resource.

Spring Brook downstream of Providence Street in Mendon.

Spring Brook is a second order stream which flows into Muddy Brook in Mendon. The sampled reach was of moderate to high gradient and contained mostly run and pool habitat. Riffles were present although low flows resulted in a large amount of exposed substrate. Seven of the ten habitat parameters scored in the "optimal" category. Epifaunal substrate and velocity depth combinations scored in the "sub-optimal" category mostly due to low flow conditions. Channel flow status scored "marginal. The final habitat score was 165 (of a possible 200). Fish sampling efficiency was rated as fair .

Fish species captured in order of abundance included tessellated darter *Etheostoma olmstedi*, white sucker, and multiple age classes of brook trout. All species collected from Spring Brook are considered fluvial specialists or dependants. Brook trout are classified as being intolerant to environmental stressors and the presence of multiple age classes suggests successful reproduction and is indicative of excellent water and habitat quality. Although flows were very low on the date of the survey, the presence of three fluvial species is indicative of a stable flow regime. Future monitoring should include macroinvertebrates and be expanded to document the extent of this cold-water fishery

Center Brook upstream of Mendon Street in Upton

This third order stream is the combined flow of no less than eight small un-named tributaries which either flow into Pratt Pond or Center Brook upstream of the sampling location. The sampled reach was of moderate gradient with a mix of riffle, run, and pool habitats. Only two (instream cover for fish and channel flow status) of the ten habitat parameters scored in the "optimal" category. Riparian vegetative zone width scored "marginal" and "poor" on the right and left banks, respectively. All other habitat parameters scored high in the "sub-optimal" category. The final habitat score was 146 (out of 200). Unfortunately fish sampling efficiency at Center Brook was rated poor due to deep pools and muddy conditions.

Fish species captured in order of abundance included tessellated darter, yellow bullhead , brook trout, redfin pickerel, largemouth bass, and brown bullhead *Ameiurus nebulosus*. At least 50 percent of the brook trout appeared to be a native fish as evidenced by their small size and excellent fin quality. The presence of tessellated darter and brook trout, both fluvial species, is indicative of a stable flow regime and excellent water quality. The presence of four species of macrohabitat generalists and young of the year largemouth bass and brown bullhead is probably best explained by the large pools within the sampled reach and the presence of a number of ponds located upstream. Sedimentation and a less than ideal riparian buffer within this reach of Center Brook pose the greatest threats to this cold-water fishery. Future monitoring should include expanded fish population monitoring to better document the extent of the brook trout population and should include a macroinvertebrate component as well.

Miscoe Brook downstream of Merriam Road in Grafton.

The sampled reach of this second order stream was a low gradient mix of shallow riffles and runs. Only four of the ten habitat parameters scored in the "optimal" category. Instream cover for fish, epifaunal substrate, channel flow status, and bank stability scored "sub-optimal". Velocity depth combinations scored only "marginal" due to the low flows and the absence of deep water habitat. Although riparian vegetative zone width scored "optimal"on the right bank, it scored "poor" on the left bank due to lawns which came right down to the waters edge. There was a small pond or impoundment both a short distance upstream and just downstream of the sampled reach. The final habitat score was 151 (of a possible 200). Fish sampling efficiency was rated as excellent.

Fish species captured in order of abundance included redfin pickerel, brook trout, pumpkinseed *Lepomis gibbosus*, and chain pickerel. All of the brook trout appeared to be native fish as evidenced by their small size and excellent fin quality. The presence of brook trout, a fluvial dependant species is indicative of a stable flow regime and excellent water quality. The other species are all considered tolerant macrohabitat generalists and are most likely present as a result of the low gradient nature of this reach and it's proximity to the small ponds. Threats to this cold-water fishery include residential development and associated activities (i.e., such as fertilizer and pesticide use), and flow augmentation (i.e. pond construction). Future monitoring should include expanded fish population surveys to better document the extent of the brook trout population. Biomonitoring surveys should include a macroinvertebrate component as well. In addition, due to discrepancies between USGS Quadrangle Maps and aerial photographs with regard to the size of the downstream pond/impoundment, review of aerial photographs to investigate potential wetlands violations should be conducted .

References

Bain, M. B., and M. S. Meixler. 2000. Defining a target fish community for planning and evaluating enhancement of the Quinebaug River in Massachusetts and Connecticut. Final report by the New York Cooperative Fish and Wildlife Research Unit, Cornell University, Ithaca, NY to the New England Interstate Water Pollution Control Commission, Lowell, MA. 51 p.

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition. EPA 841-B-99-002. Office of Water, US Environmental Protection Agency, Washington, DC. 151 p. + appendices

Halliwell, D.B, Langdon, R.W., Daniels, R.A., Kurtenbach, J.P., and R.A. Jacobson. 1999. Classification of Freshwater Fish Species of the Northeastern United States for Use in the Development of Indices of Biological Integrity, with Regional Applications. pp. 301-338 in T. P. Simon (ed.). Assessing the Sustainability and Biological Integrity of water Resources Using Fish Communities. CRC Press, Boca Raton, FL. 671 p.

Hartel, K. E., D.B. Halliwell, and A. E. Launer. 2002. Inland fishes of Massachusetts. Massachusetts Audubon Society. Lincoln, Massachusetts.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant, and I. J. Schlosser. 1986. Assessing Biological Integrity in Running Waters: A Method and Its Rationale. Special Publication 5. Illinois Natural History Survey. Champaign, IL. 28 p.

Maietta, R. J. 2006 Draft DWM Technical Memorandum (CN 135.0)Continuous Temperature Data at Four Locations in the Blackstone River Watershed (August-September, 2003). MassDEP Division of Watershed Management, Worcester.

Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society. Special Publication 29, Bethesda, Maryland

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/440/4-89-001. Office of Water, US Environmental Protection Agency, Washington, DC.

Tetra Tech, Inc. 1995. Massachusetts DEP Preliminary Biological Monitoring and Assessment Protocols for Wadeable Rivers and Streams. Method 003: Preliminary biological monitoring and assessment protocols for pulsed DC electrofishing. Prepared for Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 7 p.

US EPA. 1995. Generic Quality Assurance Project Plan Guidance for Programs Using Community Level Biological Assessment in Wadeable Streams and Rivers. U.S. Environmental Protection Agency, Office of Water. 71 p.

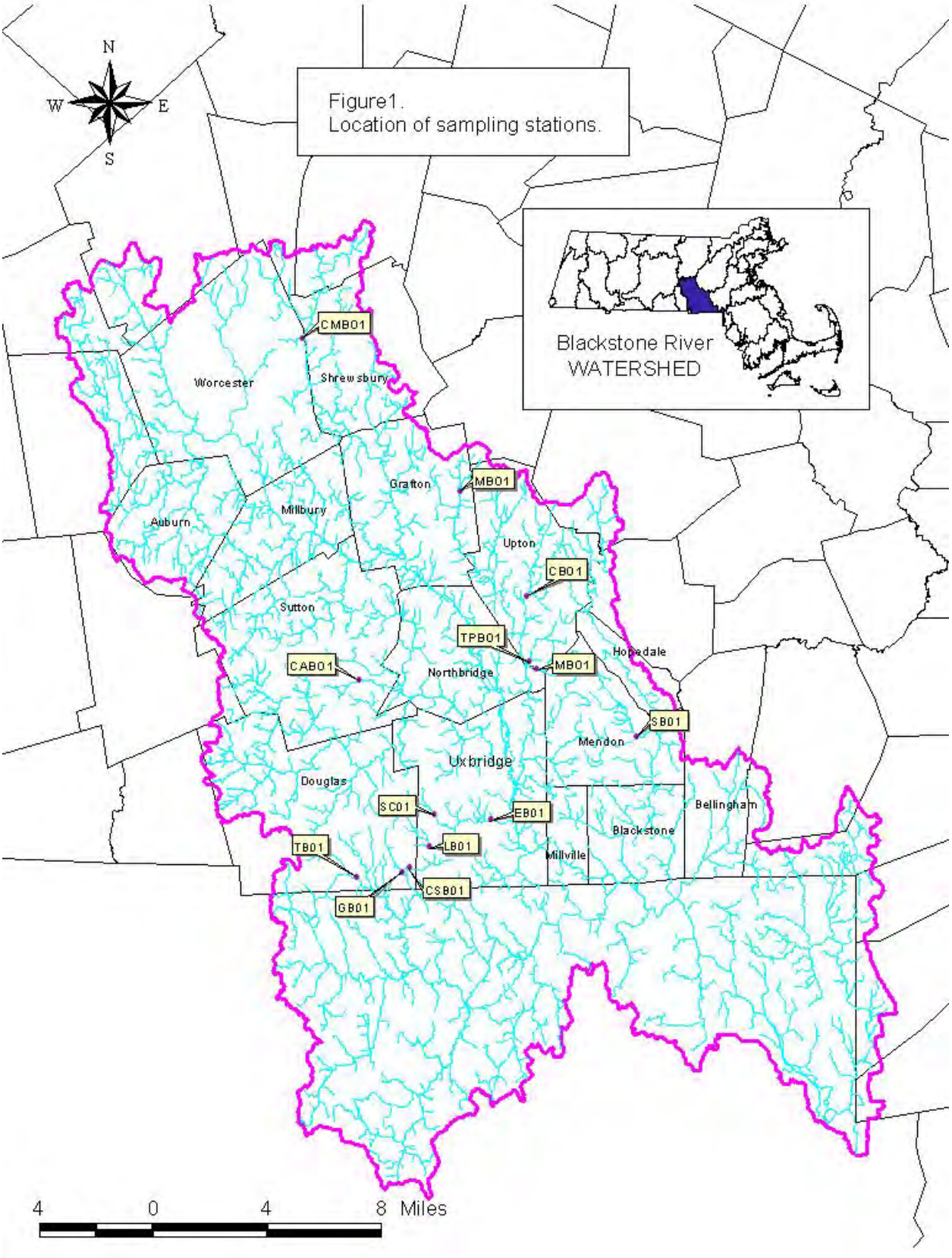
N
W
E
S
Figure1.
Location of sampling stations.
Blackstone River
WATERSHED
CMB01
Worcester
Shrewsbury
Grafton
MB01
Millbury
Auburn
Upton
CB01
Sutton
TPB01
Hopedale
CAB01
Northbridge
MB01
SB01
Mendon
Uxbridge
Douglas
SC01
EB01
Bellingham
Blackstone
TB01
LB01
Millville
CSB01
GB01
4 0 4 8 Miles

Table 1. List of fish population survey station locations and results from the 2003 Blackstone River Watershed survey.

Station Description	Date	Species Code[1]															Comments
		FF	CP	BB	CS	WS	EBT	LMB	LND	TD	RFP	YB	BT	GS	P	BND	
LB01, Laurel Brook, Uxbridge, reach beginning 20 m upstream from West Steet.	3 Sept 2003	-	-	-	-	21(2)	3	1(1)	-	-	-	-	-	-	-	-	EBT fry and adults are stocked privately in this sub-basin. WS less than 80 mm counted as yoy. Estimated pick-up >70%
SC01, Scadden Brook, Uxbridge, reach beginning approximately 20 m upstream of West Street	3 Sept. 2003	-	-	-	-	4(2)	-	(3)	-	-	-	-	-	-	-	18	WS and LMB less than 80 mm counted as yoy
EB01, Emerson Brook, Uxbridge, reach beginning approximately 10m upstream from Rte 146 (South) off ramp at Chocolog Road.	3 Sept. 2003	21	-	-	13	6	1	(1)	12	-	-	-	-	-	-	33	Estimated pick-up >60% visibility affected efficiency.
CMB01, Coal Mine Brook, Worcester, reach beginning 20 m upstream of Lake Ave. North	3 Sept 2003	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	One other fish observed but not captured. Pick-up is estimated at 66%.
CSB01, Cedar Swamp Brook, Douglas, reach beginning 200 m downstream of Southwest Main Street (Douglas Pike).	5 Sept. 2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No fish. Possibly low pH.
TB01, Tinkerville Brook, Douglas, reach beginning 10 m upstream of Hemlock Street	5 Sept. 2003	-	-	-	-	-	4	-	-	-	4	-	-	-	-	-	Estimated pick-up >70%
GB01, Greene Brook, Douglas, reach beginning approximately 300m downstream of Perry Street.	5 Sept 2003	-	-	1	-	-	-	-	-	-	9	-	-	1	-	-	Estimated pick-up >70%
CAB01, Cook Allen Brook, Sutton, reach beginning 150 m downstream of Mendon Road	5 Sept 2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No fish. Possible flow issues between Reservoirs # 5 and # 4 .
TPB01, Taft Pond Brook, Upton, reach beginning 100 m downstream of sand pit access road located at end of South Street.	11 Sept. 2003	-	1	-	-	-	-	(2)	-	-	24	2	3	-	1	-	LMB less than 86 mm counted as yoy

Table 1 Continued.

Station Description	Date	Species Code[1]															Comments
		FF	CP	BB	CS	WS	EBT	LMB	LND	TD	RFP	YB	BT	GS	P	BND	
MB01 Miscoe Brook, Northbridge, Mendon, and Upton, reach beginning 20 m upstream from Oak Drive in Upton	11 Sept. 2003	-	-	-	-	-	29 (11)	-	-	-	10	-	-	-	-	-	EBT less than 97 mm counted as yoy
SB01, Spring Brook, Mendon, reach beginning 130m downstream of Providence Street	11 Sept 2003	-	-	-	-	3(3)	3(2)	-	-	11	-	-	-	-	-	-	WS and EBT less than 80 mm counted as yoy. Very low flows.
CB01, Center Brook, Upton, upstream of Mendon Road	18 Sept 2003	-	-	(1)	-	-	8	(3)	-	11	5	10	-	-	-	-	Shocking efficiency poor. Estimated pick-up 50%. LMB less than 60 mm considered (yoy). BB less than 70mm considered yoy.
MB01, Miscoe Brook, Grafton, reach beginning approximately 150 meters downstream of Merriam Road	18 Sept 2003		3				8				9				7		Estimated pick-up greater than 80%

[1]SPECIES CODE | COMMON NAME | SCIENTIFIC NAME

FF	fallfish	*Semotilis corporalis*
CP	chain pickerel	*Esox niger*
BB	brown bullhead	*Ameiurus nebulosus*
CS	common shiner	*Luxilus cornutus*
WS	white sucker	*Catostomus commersoni*
EBT	brook trout	*Salvelinus fontinalis*
LMB	largemouth bass	*Micropterus salmoides*
LND	longnose dace	*Rhinichthys cataractae*
TD	tessellated darter	*Etheostoma olmstedi*
RFP	redfin pickerel	*Esox americanus*
YB	yellow bullhead	*Ameuirus natalis*
BT	brown trout	*Salmo trutta*
GS	golden shiner	*Notemigonus crysoleucas*
P	pumpkinseed	*Lepomis gibbosus*
BND	blacknose dace	*Rhinichthys atratulus*

[2] number in parentheses indicate young-of-the-year

Table 2. Habitat assessment summary for fish population stations sampled during the 2003 Blackstone River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a listing and description of sampling stations.

Stations	Laurel Brook	Scadden Brook	Emerson Brook	Coal Mine Brook	Cedar Swamp Brook	Tinkerville Brook	Greene Brook	Cook Allen Brook	Taft Pond Brook	Miscoe Brook	Spring Brook	Center Brook	Miscoe Brook
Primary Habitat Parameters	**Score (0-20)**												
INSTREAM COVER (for Fish)	16	15	18	15	18	13	17	19	18	13	16	16	16
EPIFAUNAL SUBSTRATE	N/A	14	17	19	15	16	15	17	16	15	13	15	10
EMBEDDEDNESS	17	18	19	18	16	12	16	16	18	18	19	15	18
CHANNEL ALTERATION	20	20	17	16	20	14	20	19	19	18	19	15	19
SEDIMENT DEPOSITION	18	19	19	14	19	16	14	18	15	17	18	15	15
VELOCITY-DEPTH COMBINATIONS	11	7	17	18	18	10	15	15	15	10	14	15	10
CHANNEL FLOW STATUS	18	17	15	7	15	15	12	6	10	13	7	17	3
Secondary Habitat Parameters	**Score (0-10)**												
BANK VEGETATIVE PROTECTION left	10	10	10	9	10	10	10	10	10	9	10	6	10
BANK VEGETATIVE PROTECTION right	10	10	10	9	10	8	10	10	8	9	10	9	10
BANK STABILITY left	9	9	8	2	10	9	10	10	10	8	9	8	9
BANK STABILITY right	9	9	8	2	10	7	10	10	8	8	10	8	9
RIPARIAN VEGETATIVE ZONE WIDTH left	10	10	10	9	10	9	10	10	10	2	10	2	10
RIPARIAN VEGETATIVE ZONE WIDTH right	10	10	10	9	10	2	10	10	9	9	10	5	10
Total Score	**158***	**166**	**178**	**147**	**181**	**141**	**169**	**170**	**166**	**149**	**165**	**146**	**149**

N/A not assessed
• of a possible 180