The Effects of a Lampricide Treatment of TFM on Non-target Fish and Macroinvertebrates In Trout Brook, Milton, Vermont - September, 1995

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Agency of Natural Resources
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Introduction

In August, 1995 the Department of Environmental Conservation was notified by the Department of Fish and Wildlife (F&WL) of its intention to treat Trout Brook with the lampricide, TFM during early September, 1995 in accordance with permit (C90-01) issued in March, 1990. The initial treatment (of two scheduled) was cancelled in 1991 due to the inability of the applicant to fulfill the permit conditions relating to the American brook lamprey mitigation plan.

The original treatment plan outlined in Permit C90-01 would have treated 6,800 feet of Trout brook. The latest request by the Applicant shortened the reach to be treated to 2,200 feet by moving the application point (AP) downstream. Consequently, the original non-target impact assessment study plan completed and submitted as condition 31 of C90-01, was modified accordingly.

The short term effects of the treatment on the aquatic community are evaluated herein based on sampling of the non-target macroinvertebrate and fish communities during 1995. Long term effects would be addressed by sampling once during early September of 1996 and 1997.

Methods

Macroinvertebrate Population

Trout Brook is a relatively low gradient stream that winds through alders and brush. The stream bottom is sand, silt, and clay. The primary habitat for invertebrates in this type of stream are the numerous debris dams in the stream. This habitat was targeted as the primary sampling habitat for this study. The specific stream reach monitored during this study was approximately 1700 feet below the application point as shown in figure 1.

The short term effects of treatment were evaluated by sampling the stream six days before treatment on September 5, 1995 and again, four days after treatment. The pretreatment samples were collected from a length of stream immediately below the length of stream sampled post treatment.

Three replicate samples were collected on each sampling date, using the VTDEC Kick Net sampling method, preserved in the field and processed in the laboratory using the methods outlined in the VTDEC Field Methods Manual (1989). This sampling method employed a timed unit effort for each replicate, and the samples are then subsampled in the laboratory by picking one quarter of a sample plus a minimum of 300 animals if not realized in the one quarter subsample. The final percent of each sample processed is then recorded to determine the relative abundance of the population. All animals were identified to their lowest possible taxonomic level, usually genus/species. A macroinvertebrate-based habitat evaluation was conducted during each sampling event.

Fish Population

The sample design of the fish impact assessment effort is simple, owing to the relative small stream size and short distance of stream to be treated. The sampled section under study was representative of the lower reaches of Trout Brook: low gradient (primarily pool-run), narrow (average width - 2.1m), close riparian vegetation providing good canopy and a substrate of primarily clay and sand with occasional woody debris cover. Fish were sampled, pre and post treatment, from a single, 89 meter section located approximately 1700 ft. downstream from the AP and approximately 200m upstream from the mouth.

The section was isolated with block nets prior to sampling. Two upstream passes were made with a DC backpack electrofishing unit. Fish were placed in live cages until both passes had been completed. Any fish, stressed or killed by the sampling effort were noted. With the exception of lampreys, all fish were identified to species, noting external anomalies, and then released evenly throughout the section. A general physical habitat assessment of the section fished was also made. In addition to the above macroinvertebrate and fish community sampling, water temperature, specific conductance, pH and alkalinity were measured, using methods outlined in the VTDEC Quality Assurance Plan (1992), at the time of sampling.

RESULTS AND DISCUSSION

Water quality data taken during pre and post treatment biological sampling is presented in Table 1. Physico-chemical data taken during the treatment was supplied by the applicant (VTDF&WL 1996). During the treatment, stream discharge was measured at 0.67 cfs. Alkalinity ranged from 123.0-137.5 ppm and pH from 7.96-8.17. Water temperatures were 12 c^{o} at the initiation of the treatment, reaching a maximum of 14.2 then falling to 7.0 at the end of the treatment.

The target TFM concentration was 1.5 x MLC (4.0 ppm), = 6.0 ppm. Actual instream concentrations at the AP approached 7 ppm for the first 1/2 hour but fell to 6 ppm within 1.5 hours and remained at or just below that level for the remainder of the 12 hour treatment.

Table 1. Water chemistry data during pre and post treatment biological sampling.

	Water Temperature (^{o}c)	Specific Conductance (umhos)	Alkalinity (ppm)	pH (std.units)
Pre - Sept 5, 1995	15.0	286	130	7.61
Post - Sept 15, 1995	12.0	314	139	7.81

Macroinvertebrate Population

The macroinvertebrate community structural and functional attributes are summarized in the following tables. The macroinvertebrate community biometrics are presented in Table 2. The percent composition of the major orders and that of the functional groups is presented in Tables 3 and 4. The dominant macroinvertebrate taxa are presented in Table 5. The raw count data for each taxa, by replicate, is located in Appendix 1.

The macroinvertebrate community biometrics presented in Table 2 show no adverse impact from the TFM treatment. The biometrics of density, richness, and EPT Index were all slightly greater after the treatment although none of the changes were statistically significant, $p<.05$, Mann-Whitney-U Rank Sum Test. The ratio of EPT/Richness, and EPT/EPT&C and the Bio Index value were virtually unchanged showing that no shifts in the community occurred between water quality sensitive species (EPT species) and the more tolerant species in the community.

Comparing the Biometrics from Trout Brook to the VT DEC database for wadable streams shows it to be moderately productive, with a good Bio Index value and a moderate density. The overall species richness is good, however the number of EPT species is low and the stream is dominated by other major taxa in terms of the number of species as expressed in the EPT/Richness ratio. The low number of EPT species found may be due, in part, to the small stream size, habitat type (low gradient w/debris dams) and the ecoregion location. However, the density of EPT species as a group, relative to that of the generally more water quality tolerant Chironomidae species (EPT/EPT&C), indicates good water quality . The dominant taxon both before and after treatment was in fact an Ephemeropteran (mayfly), *Stenonema sp*.

Table 2. The macroinvertebrate community biometrics before and after TFM treatment of Trout Brook, Milton Vt. data represent the means and percent standard error of the mean ( ) of selected metrics from three replicate KN samples.

	Density	Richness	EPT	EPT /Richness	Bio Index	EPT /EPT&C	% Dominant Taxa
Before 9/5/95	861 (44%)	32.5 (9%)	5.4 (26%)	.16	2.61 (<1%)	.55 (1.8%)	27 *Stenonema*
After 9/15/95	1260 (14%)	41.7 (6%)	6.3 (19%)	.15	2.40 (<1%)	.67 (3.9%)	24 *Stenonema*

The percent composition of the major groups presented in Table 3 shows that there were virtually no shifts in percent composition before and after the TFM treatment. The community from Trout brook is strongly dominated by the order Diptera and Ephemeroptera, with the Diptera representing about 50 percent of the

community composition and the Ephemeroptera about 40 percent. All the other groups composed less then five percent of the community.

The percent composition of the functional groups is presented in Table 4. No adverse changes were measured in the functional composition of the macroinvertebrate community. The community was represented by all the functional groups. The collector-gatherer and filterer groups and the predator and scraper functional groups dominated the community. The shredders of detritus and herbivores represented less then 5 percent of the community.

Table 3. The percent composition of the major groups of macroinvertebrates before and after TFM treatment of Trout Brook.

	Coleoptera	Diptera	Ephem	Trichop	Plecop	Odonata	Other
Before 9/5/95	1	54	41	<1	1	2	4
After 9/15/95	2	51	38	2	2	3	5

Table 4. The percent composition of the macroinvertebrate functional groups before and after TFM treatment of Trout Brook, Milton Vt.

	Collector Gatherer	Collector Filterer	Predator	Shredder Detritus	Shredder Herbivore	Scraper
Before 9/5/95	36	12	18	<1	5	27
After 9/15/95	25	17	16	5	2	26

The Pinkham-Pearson Coefficient of Similarity of the dominant taxa (genera) percent composition before and after TFM treatment was 0.49 (values are from 0-totally dissimilar to 1.0 totally similar). This level of similarity generally indicates minor shifting in the densities of the dominant taxa but no losses of the dominant taxa present before the treatment, and no major increases in dominance of previously minor taxa. All the dominant taxa were either in the Order Diptera (6) or Ephemeroptera (3) (Table 5).

Table 5. The Percent Composition Dominant Macroinvertebrate taxa (genera) from Trout Brook before and after a TFM treatment.

	Before - 9/5/95	After - 9/15/95
Diptera: *Atherix sp*	10	6
Cricotopus sp	5	2
Parametrionemous sp	13	6
Simulium spp	7	14
Chrysops sp	2	4
Tipula sp	<1	5
Ephemeroptera: *Baetis spp*	11	6
Stenonema sp	27	24
Leptophlebiidae imm.	2	4

The habitat conditions at the two sample sites during the sampling events were evaluated as similar. A high flow event did occur between the two sampling events, however the debris dams remained intact and the available habitat appeared to be similar.

In summary, no biologically significant changes were observed in any macroinvertebrate community biometrics. The taxonomic and functional percent composition remained similar after the TFM treatment. Since no short term adverse impacts were documented, long term monitoring of the Trout Brook macroinvertebrate population is not necessary.

Fish Population

The fish population of Trout Brook has been sampled at four upstream locations in conjunction with the original treatment scheme which had the AP located at the Cataract Rd. Bridge. The fish community upstream is relatively diverse, comprised of up to 11 species. The Vermont Index of Biotic Integrity (VTIBI), a measure of community health, scored 29 ("fair") to 33 ("Good") at these sites, located 1.0 to 1.3 miles from the mouth.

The pre-treatment sample was collected on September 5, 1995 at the study section, below the revised AP, six days prior to the September 11 treatment. The sample yielded 15 fish species, a relatively high number considering the small stream size (Table 6). The high richness can be explained by the close proximity of Trout Brook to Lake Champlain which serves as a diverse source of species. The total fish density, (using first run raw numbers) was moderately high at 173/100m^2. This value, however is generally typical of small, minimally impacted streams of this ecoregion. The sum of the population estimates from each species (using Carle and Strub-1978 modification of Zippen estimator) was 292.7/100m^2 (241.7 - 361.7 -95% CI). Silvery minnows,

pumkinseeds, and creek chubs comprised 74% of the total collected in the pre-treatment sample. Three unidentified lampreys were also collected.

Since a major portion of the community is made up of generalist feeders, many which are pollution-tolerant, the VT Index of Biotic Integrity (VTIBI) scored a 31 out of a possible 45. This score denotes a condition of fair to good and rests on the margin of compliance with the Vermont Water Quality Standard for Class B waters. Significant pollution is not suspected in this watershed however, since much of it is forested, with minor portions made up of mixed agricultural activities. The relatively low VT IBI score probably reflects more the physical nature of the site which favors pool species, many of which are also tolerant.

The post-treatment sample was collected four days following the treatment on the 15th of September. This sample reflected an overall decline in site total density (first run raw numbers) to 97/100m^2 and population estimate of 132.2 (122.6-158.1 - 95% C.I.). Species richness remained at 15. Both, one-run densities and population estimates from individual species were lower in the post-treatment sample, with the exception of white sucker which increased in density between collection dates. Brown bullhead and banded killifish, present in very low numbers in the first collection, were not recorded in the second collection. This minor loss was reversed by the appearance of fathead minnow and blacknose dace in the post-treatment sample. The dominant species changed places among each other between samples. The trophic make-up of the post-treatment assemblage was quite similar to the pre-treatment, being dominated by mostly tolerant generalists. Eight of the nine population metrics which cumulatively comprise the VTIBI were similar between the two samples, resulting in an identical post-treatment VTIBI score of 31.

The observed decrease in fish numbers between pre and post-treatment collections is strongly suspected to be a result of mortalities caused by intense electrofishing conducted the day before treatment by the applicant, rather than from any toxic effects of TFM. The applicant had been directed by permit condition to remove as many American brook lamprey as possible out of the treatment reach prior to treatment. In accordance with the mitigation plan they were to hold these individuals live and release them back into the stream following the treatmement. Since lampreys are more resistant to the effects of electric current than are other fish species, collecting them requires a more extensive application of electricity. As a result, this method incurs significant mortality of non-lamprey species due to their lower resistance to the current. A collection of electrofishing mortalities from this effort was conducted by the applicant just prior to the TFM treatment in a section from the first stream crossing to the mouth, a distance of about 100 m. A total of 111 fish were collected in this reach; 96% of which were silvery minnow. Since no electrofishing mortality counts were taken upstream of the first bridge crossing, no accurate estimate of mortality can be made over the entire treated section from this source. Consequently, mortality cannot be accurately partitioned betweenthe causes of electrofishing and TFM treatment.

Table 6. Population estimates and per cent composition of fish species collected pre and post- treatment in trout brook, September, 1995.

Species	Before Treatment		After Treatment	
	% of Total	Population Estimate[1]	% of Total	Population Estimate

Silvery Minnow	28	72 (+6, -5)	11	14 (+2, -1)
Pumpkinseed	25	87 (+33, -28)	10	13 (+3, -1)
Creek Chub	22	68 (+16, -14)	38	50 (+4, -2)
Tesselated Darter	6	19 (+9, -4)	8	10 (+-, -1)
Longnose Dace	4	10 (+1, -0)	6	7 (+1,-0)
Bluntnose Minnow	4	10 (+1, -0)	4	5 (+1, -0)
White Sucker	4	10 (+2, -1)	14	19 (+4, -2)
No. Redbelly Dace	2	4 (+-0)	<1	<1 (+0, -0)
Golden Shiner	1	3 (+-0)	<1	<1(+2, -1)
Brown Bullhead	1	3 (+1,-0)	0	0
Brook Stickleback	1	3 (+1, -0)	<1	<1 (+0,- 0)
Lamprey sp.	1	3 (+1, -0)	1	<1(+2, -0)
Banded Killifish	1	<1 (+1, -0)	0	0
Common Shiner	<1	<1(+2, -0)	5	5 (+7, -1)
Mottled Sculpin	<1	<1 (+2, -0)	<1	<1 (+0, -0)
Blacknose Dace	0	0	<1	<1 (+0, -0)
Fathead Minnow	0	0	4	5 (+5, -0)
Total[2]		293 (242-362)		132 (158-123)

1. denotes 95% confidence limits as determined by the removal depletion method of Carle and Strub 19???
2. from sum of individual estimates

One day after treatment, the applicant conducted a second collection of target and non-target fish mortalities over the entire 2,200 foot reach. Of the 151 non-target mortalities recorded, 92 were American brook lamprey. An evaluation of the success of the mitigation plan designed to mitigate American brook lamprey losses will be evaluated by the Scientific Advisory Group on Fish of the State Endangered Species Committee following the eight year experimental period of the permit and will be addressed by the VTDEC pending that review.

The remaining 59 non-lamprey mortalities observed from the 2,200 foot reach were made up of 35 silvery minnows, 17 brown bullhead, four white suckers and one each of tesselated darter, logperch and blacknose dace. A portion of the silvery minnows observed from the post treatment count may have been electroshocking

mortalities not recorded during the previous count which covered only the first 100m of stream up from the mouth. Extrapolating from the sum of individual population estimates from the sample section to the total treated 2,200 foot reach yields a minimum and maximum pretreatment reach population of 5,975-8,941 non-lamprey fish respectively. Based on the estimated population size, non-lamprey mortalities from the treatment comprised from 0.6 to 1.0 percent of the non-lamprey population in the treated reach (59 / 5975, 59 / 8,941). It is concluded that any direct mortality of non-target, non-lamprey fish from the TFM treatment was not significant and was eclipsed by the effects from the electrofishing collections for non-target lamprey conducted the day before the treatment.

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