Report on:

The effect of the 2002 Lewis Creek 3-Trifluoromethyl-4-Nitrolphenol (TFM) treatment on two insect larvae *Hexagenia limbata*, and *Phylocentropus sp* in Lower Lewis Creek, Ferrisburg, VT.

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Summary

Populations of the mayfly, Ephemeroptera *Hexagenia limbata*, and the caddis fly, Trichoptera *Phylocentropus sp*, were monitored before and after the 2002 TFM treatment of Lewis Creek. The data show that the TFM treatment had no significant effect on either of the species populations. While the 2002 TFM treatment was permitted at a concentration of 1.1 x MLC for 12 hours, the actual treatment in lower Lewis Creek (at the F&W access site) averaged 2.1 x MLC for 9 hours, with a 1.1 x MLC maintained at the site for 13hrs (Chipman B.D.). Monitoring of an earlier (1990) TFM treatment of Lewis Creek using very limited monitoring data at the F&W access site indicate this treatment may actually have only averaged 0.8 x MLC (based on new pH chart), but lasted for 16hrs (Anderson, J.K 1990). During this treatment *Hexagenia limbata* suffered high mortality rates after treatment (Langdon and Fiske 1991). Stream temperature was significantly different between the two treatments, with the 1990 treatment about 10^0 C warmer. Based on the above differences between the two treatments both temperature and duration of exposure likely explain why the *Hexagenia limbata* suffered high mortality rates after the 1990 treatment, and not after the 2002 treatment. In conclusion TFM treatments will likely have the least amount of impact on non-target insects if they are done at low temperatures, for as short duration as possible.

Methods

Samples were collected the day before treatment (October 21,2002), and the day after the TFM block passed thru the lower Lewis Creek F & W access area (October 24). An Ekman dredge ($0.02m^2$) w/ five-foot extension handle was used to collect 10 replicate samples from random points along a 20m reach of stream bank, at a depth of about 0.5 meters. The stream bank habitat of silt, and clay is the primary habitat for these animals to create burrows, within which they filter feed. Samples were sieved using a standard #30 sieve bucket (mesh size 560u), and then spread out on a white enamel pan. Animals were enumerated in the field, with live animals distinguished from dead by placing them in water and looking for movement. By enumerating both live and dead animals after the treatment, two estimates of percent mortality were computed. The first, more traditional estimate of mortality, was computed by comparing the mean densities

between the before and after treatment samples. Determining the percentage of dead larvae in the post treatment samples made a second estimate possible.

Results

Table 1 shows the density of both insect larvae before and after the treatment, as well as the density of dead larvae after treatment. The *H.limbata* population was estimated to decrease only 8% after treatment. This difference, however, was not statistically significant (p=0.60, non-parametric rank sum test). The percentage of dead larvae in the samples collected after treatment was estimated at 16% of the population. The *Phylocentropus sp*. population was estimated to decrease 18 %. This difference was also not statistically significant (p=0.47, non-parametric rank sum test). The percentage of dead larvae in the samples collected after treatment was estimated at 10 % of the population.

Table 1: Shows the density/ per m^2 of both insect larvae before and after the treatment, as well as the density per m^2 of dead larvae after treatment.

Date	10/21/02 Before	10/24/02 After		10/21/02 Before	10/24/02 After	
	Hexagenia .limbata			*Phylocentropus* sp.		
#/Rep m^2	live	live	dead	live	live	dead
1	450	350	200	200	100	0
2	350	200	0	100	150	50
3	150	550	0	0	100	0
4	350	350	50	200	150	0
5	200	600	150	150	100	50
6	550	400	50	250	0	0
7	650	350	50	100	150	0
8	550	450	150	100	150	0
9	700	350	50	50	50	0
10	450	450	50	200	150	0
Average #/ m^2	440 ±129	405 ±82	75	135 ±56	110 ±37	10
Estimate of % mortality	1- decrease of 8 % in population (NS, p=0.60) 2- 16% of larvae were dead post treatment			1- decrease of 18 % in population (NS, p=0.47) 2- 10 % of larvae were dead post treatment		

Discussion

The mayfly *Hexagenia limbata* is important in the food web and is heavily utilized by fish in the food chain. It is considered relatively sensitive to TFM (Bills 1985), and has been impacted (60% mortality) during past TFM treatments of Lewis Creek (Langdon and Fiske 1991). Long-term monitoring has shown that the populations can recover within a year after such impacts to pretreatment densities (VTDEC 1994). The lower mile of Lewis Creek is almost lake level. As a result with, certain conditions of flow and weather, the discharge into Lake Champlain can be inhibited for periods of time. The Aquatic Nuisance Control Permit #2002-C02 issued by the VTDEC increased the allowable concentration of TFM by about 10% from past treatments, in the lower section of Lewis Creek. The VTDEC found that it would be beneficial to document the impact of the 2002 treatment to these sensitive species because of the increase in concentration allowed, and the somewhat unpredictable discharge pattern of lower Lewis Creek, in addition to documented past impacts to the *H. limbata* population.

The density of *H. limbata* in 2002 is the highest recorded, ($440/m^2$) compared to previous years of monitoring from 1988 to 1993 ($85\text{-}273/m^2$). The consistent low flow levels over the past two years may have beneficially influenced the population. Surprisingly the 2002 TFM treatment had no significant effect on the *H. limbata* population with a decrease of only 8 % of the population recorded. Even though there was no statistically significant impact on the population itself about 16 percent of the larvae collected after the treatment were dead. Compared to the 1990 treatment when there was a 60 % decrease in density, the 2002 treatment had very little impact on the *H.limbata* population. In 1990 many of the *H. limbata* had abandoned their burrows and were observed littering the bottom of Lewis Creek. In 2002 no dead *H. limbata* were observed on the stream bottom.

The density of *Phylocentropus sp*, in 2002 was in the midrange compared to the six years of monitoring between 1988 and 1993. The 2002 TFM treatment had no significant effect on the *Phylocentropus sp* population with a decrease of 18% of the population recorded. Even though there was no statistically significant impact on the population itself, about 10 percent of the larvae collected after the treatment were recorded as dead. The 1990 treatment also recorded no statistically significant change in the *Phylocentropus sp* population, with a 4% increase in population estimate after the treatment.

The environmental conditions between the 1990 and 2002 treatments were considerably different, and are likely the reason why less impact was documented in 2002. Limited monitoring data from the 1990 TFM treatment of Lewis Creek (permitted at 1.0 x MLC, as adjusted using bioassay), show this treatment to have averaged 0.8 x MLC (based on an updated pH chart), and lasted for 16 hrs, with water temperatures ranging from 13-15 degrees centigrade (Anderson, J.K. 1990). During this treatment *Hexagenia limbata* suffered high mortality rates after treatment (Langdon and Fiske 1991). The 2002 TFM treatment was permitted at a concentration of 1.1 x MLC for 12 hours, the actual treatment in lower Lewis Creek (at the F&W access site) averaged 2.1 x MLC for 9 hours, with greater then 1.1 x MLC maintained at the site for 13 hours, with water temperatures averaging between 5 and 6 degrees centigrade (Chipman, B.D. 2003). Based on the environmental differences between the two treatments, a longer exposure time and or a higher water temperature during treatment can have a substantial influence on the toxicity of a TFM treatment to the *Hexagenia limbata* population. The results of this monitoring also draws into question the assumed 1:1 relationship between the MLC for sea lamprey, and that of non-target species under different environmental conditions of pH, temperature, and duration of exposure.

References

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