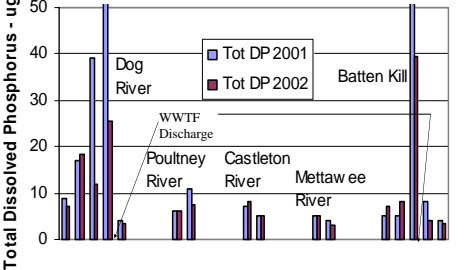


Introduction: The Batten Kill located in Bennington County of southwestern Vermont has long been recognized as one of this state's top trout fishing streams and has been grouped with other important trout fisheries of the United States. Prior to the introduction of brown trout to the river around 1900, the only salmonid inhabiting the river was the native brook trout. Following the initial releases of brown trout, the species established itself as a self-sustaining wild population around which the sport fishery developed further and built upon the river's reputation as Vermont's pre-eminent trout stream. All stocking was phased out by 1976 and since then the river's fishery has been entirely dependent on wild fish production. In 1991 the river was designated by the Vermont Water Resources Board as the state's first Outstanding Resource Water. Both creel and electroshocking surveys by the Vermont Department of Fish and Wildlife (F&W) have shown a decline in the wild trout populations in the Batten Kill during the 1990's.

Goals and Objectives: The goal of this project was to collect and analyze representative macroinvertebrate assemblage and water chemistry samples from the Batten Kill and four other high quality self-sustaining trout (brown trout to the extent feasible) fisheries. Data would be evaluated for the purposes of making inter-stream comparison, and comparison to a larger State-wide reference quality database of similar type streams (VTDEC). The results would be used to provide information relative to the potential role of secondary productivity and overall biological integrity on the salmonid fishery.

Methods: Grab samples for water quality analysis were collected eight times at sixteen sites on five rivers over a two year period (2001-2002). Standard analytical methods were used to measure concentrations of a suite of basic water quality parameters. Benthic macroinvertebrate samples were collected during the fall of 2002 at all sixteen sites using standardized DEC protocols (VTDEC,2004).

Figure 2: Median dissolved phosphorus concentrations at all sites for 2001 and 2002. Note the effect of low flow (less available dilution) on 2001 concentrations in the Dog River and the Batten Kill. (upstream to downstream=right to left)

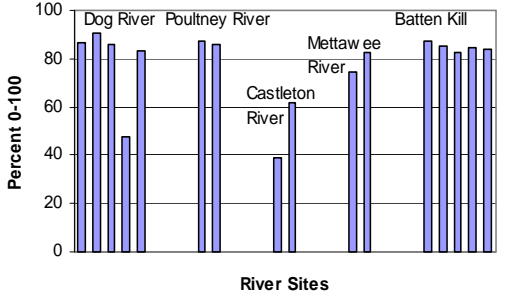


A Comparative Assessment of the Water Quality and Macroinvertebrate Assemblage Characteristics of the Batten Kill with Several Other Wild Trout Streams in Vermont

Vermont Department of Environmental Conservation
 Biomonitoring and Aquatic Studies Section
 October, 2005



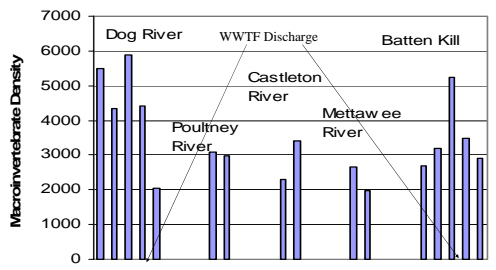
Figure 1: Percent similarity of the macroinvertebrate community to the reference condition. (upstream to downstream=right to left)



Similarity to Reference Conditions: The reference condition is representative of what conditions are expected to be when the site is virtually or only minimally disturbed. **Figure 1** emphasizes the degree of effect from the Northfield WWTF as the taxonomic structure has been significantly altered from what would be expected at a site with no adverse impacts. Likewise the Castleton River sites are somewhat altered from expectations. At site 1, this is primarily due to habitat uniqueness. Similarity values greater than 80% generally indicate a lack of adverse impact to the overall taxonomic structure of the macroinvertebrate community.

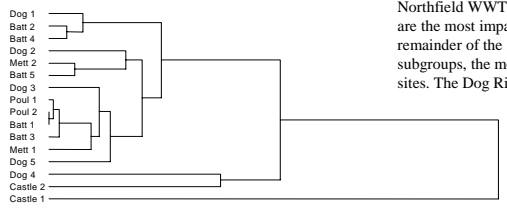
Effects of Municipal Wastewater Treatment Discharges: Discharges of treated municipal wastes into the Batten Kill and the Dog River strongly affect nitrogen and phosphorus concentrations in the receiving water. The effect appeared to be more extreme and persistent in the Dog River than in the Batten Kill, likely due to differences in available dilution in the lower reaches of receiving water. General low flow conditions during the 2001 sampling period may represent "worst case conditions" for these parameters. Maximum total phosphorus concentrations of 208 and 542 ug/l P were observed in the Batten Kill and Dog River respectively. **Figure 2** shows median dissolved phosphorus at all sites for both 2001 and 2002. **Figure 3** shows that enrichment effect on benthic organism density. The density of benthic organisms increases as the environment becomes more enriched. Again, the effect is more significant and sustained in the Dog River than in the Batten Kill. With the exception of the treatment plant effects, background phosphorus concentrations were similar (less than 10 ug/l) at all sites.

Figure 3: Macroinvertebrate abundance (number of organisms per sample) at all sites. Note the effect of treatment plant discharge of density in the Dog River and the Batten Kill. (upstream to downstream=right to left)



The following dendrogram (**Figure 4**) depicts the clustering of 2002 median chemistry values at all 16 sites. The most upstream station on the Dog River (Sta.5) is the most different from all the other sites. This site represents "background" condition in the Dog River watershed. The other 4 Dog River sites form another grouping that is highly separated from the other sites. These groupings support observations that the basic chemistry of the Dog River is different from the other streams, most probably related to geological factors. The most upstream Batten Kill site (Sta. 5) also stands alone as a "group", representing a condition less disturbed than the sites further downstream. The remainder of the sites fall into one major grouping, with sub-groupings of: a) the 2 lower Batten Kill sites and the lower Mettawee site; b) the two mid-reach Batten Kill sites (Stas. 3 and 4); c) the upper Mettawee and lower Castleton sites; d) the two Poultney River sites (very similar) and the upper Castleton site.

Figure 5: Macroinvertebrate Order % Composition



There appeared to be no effect from the wastewater discharges on the taxa richness of the sensitive EPT taxa nor on their overall taxonomic richness of the macroinvertebrate assemblage. **Figure 6** shows relatively even numbers of total taxa and EPT taxa across all sites, although there is some indication that enrichment from the wastewater discharges may enhance the total number of taxa present due to increases in tolerant taxa without loss of sensitive EPT taxa.

Summary of Findings:

1. Water chemistry and aquatic macroinvertebrate community structure and function were assessed at 16 sites on 5 rivers. The five rivers are managed as naturally-reproducing salmonid fisheries. The intent of the assessments was to evaluate differences in chemical and biological factors between the rivers and the potential for any observed differences to be indicative of possible differences in fishery productivity between the rivers.
2. Chemistry sampling indicated that the base chemistry of the Dog River was different from the other 4 rivers. This difference was most likely due to differences in geologically-derived constituents. The Batten Kill and Dog River were affected by discharges from the Manchester and Northfield Wastewater Treatment Facilities respectively. The major effect was the elevation of phosphorus and nitrogen concentrations in the receiving waters. The effect was more detrimental to biologic integrity in the Dog River than in the Batten Kill.
3. Macroinvertebrate communities showed good to excellent biological integrity at 14 of the 16 sites sampled. Two sites, the Dog River site 4 (directly below the Northfield WWTF) and the Castleton River site 2 indicated a greater than moderate enrichment impact on biological integrity. While the impact below the Northfield WWTF was expected due to high nutrient concentration observations, elevated nutrient concentrations were not observed in the Castleton River. A biological effect was observed below the Manchester WWTF in response to elevated nutrients, but the effect was clearly less dramatic and adverse than in the Dog River. There were biological similarities between the rivers. Differences between sites, often on the same river, were more significant than biological differences between rivers.
4. There were no obvious chemical or biological factors that were evaluated that would account for differences in salmonid fishery production between the 5 rivers. The elevated phosphorus and nitrogen in the water chemistry of the Batten Kill below the Manchester WWTF and observed responses in the macroinvertebrate community are of a magnitude that would be unlikely to have adverse effects on fishery productivity.

Acknowledgements: Special thanks to Ken Cox and Scott Covington of the Vermont Fish and Wildlife Department for collecting water chemistry samples. Also, thanks to the United States Forest Service for the financial and administrative support of this project.

References: Vermont DEC. 2004. Wadeable Stream Biocriteria Development and Implementation Methods for Fish and Macroinvertebrate Assemblages in Vermont Wadeable Streams and Rivers.



Figure 4: Median Chemistry 2002

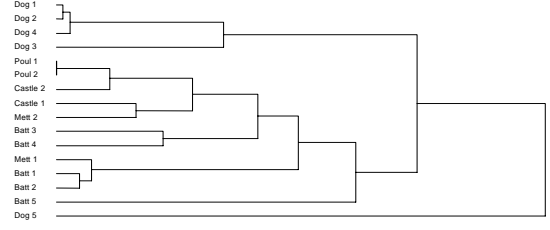


Figure 5 is a dendrogram representing the grouping of sites based on the percent composition of the major macroinvertebrate orders identified from each site. The most obvious characteristics of the dendrogram are: a) the separation of the lower Castleton River site from all other sites, most probably as a result of its unique habitat characteristics; b) the grouping of the Dog River site 4 site (immediately below the Northfield WWTF) and Castleton River site 2 as a distinctive pair. These latter two sites are the most impacted and share characteristics typical of nutrient enrichment. The remainder of the sites fall into a major grouping with several subgroups. Within the subgroups, the most similarity is shown among the Batten Kill, Poultney and Mettawee sites. The Dog River sites consistently separate themselves within the subgroups.

Figure 6: Total and Sensitive Taxa Richness at All Sites. Sensitive taxa primarily stoneflies, mayflies and caddisflies. (upstream to downstream=right to left)

