Lye Brook Wilderness Study of Surface Waters Executive Summary

Introduction

The Vermont Department of Environmental Conservation (VTDEC) has monitored water quality in and around the Lye Brook Wilderness Area (LBW) since 1980 in an effort to document the effects of acid deposition on sensitive lakes. In 1993, the Vermont Monitoring Cooperative (VMC), working with the Green Mountain National Forest (GMNF) and the VTDEC, established a southern Vermont monitoring site in the LBW. VTDEC and GMNF subsequently entered into three consecutive cooperative agreements to jointly conduct expanded surface water monitoring activities in response to mandates under the Clean Air Act to protect Air Quality Related Values (AQRV) in Class I wilderness areas such as the LBW. The following monitoring activities were conducted by the Vermont Department of Environmental Conservation under the conditions of these agreements from 1993 through 1995:

- Fish and aquatic macroinvertebrate communities were sampled at seven stream sites in and around the LBW.
- Quantitative and qualitative benthic macroinvertebrate samples were collected at four lakes and ponds in and around the LBW.
- Sediments were collected from two lakes and analyzed for selected organic and inorganic contaminants.
- Water chemistry was monitored at all stream and lake sites where biological sampling was conducted.
- Fish were collected from four lakes; edible portions of tissue were analyzed for selected organic and inorganic contaminants.

The study area is highly susceptible to surface water acidification primarily due to the fact that the waterbodies are situated in geologic areas resistant to chemical weathering. Much of the surface water in the study area is affected by organic acids and is tannic/brown in color. This region of Vermont has in addition, some of the highest levels of sulfate deposition and ozone in the State (R. Poirot - Personal Communication). Long distance transport of atmospheric pollutant is the suspected cause of these air quality related issues.

Results

Lake Water Chemistry: Water chemistry was sampled three times a year in all years at Branch and Bourn Pond. Both ponds are considered to be acidified, with average Calcite Saturation Indices (CSI) greater than 6. The pH of Branch Pond is consistently

less than 5.00 standard units while Bourn Pond is in the 5.00-5.50 range on a consistent basis. Both lakes are relatively high in organic carbon and aluminum. It is likely that the organic carbon ameliorates the potential toxic effects of aluminum to aquatic biota in these lakes. Little Mud Pond was sampled twice in 1993 and Lye Brook Meadows was sampled once in 1995. Both waterbodies are acidic and highly colored and support significant sphagnum mats. Ionic concentrations were lower in Little Mud Pond than in the other lakes and ponds sampled in the study area. Both waterbodies are considered to be acidified. Branch and Bourn Ponds both exhibit thermal stratification. Although no dissolved oxygen samples were collected, biological analyses indicate severe oxygen depletion in the hypolimnion of these lakes. Long-term monitoring data collected from acid sensitive lakes and ponds by VTDEC since 1981 suggest a trend of decreasing calcium, magnesium, and sulfate in ponded surface waters Statewide, with a lake-specific trend of decreasing sulfate described for Bourn Pond (Stoddard and Kellogg, 1993).

Lake Sediments: Sediments from Bourn and Branch Ponds were collected from deep areas of the lakes. No chlorinated pesticides or poly-chlorinated biphenyls (PCB's) were detected. Three polycyclic aromatic hydrocarbons (PAH) were detected. Flouranthene and pyrene were detected at very low levels in sediments from both lakes; phenanthrene was detected in sediment from Branch Pond. All PAH concentrations were well below concentrations known to threaten the well-being of aquatic life. Lead and mercury were detected at levels indicating potential low-level risk to aquatic biota. It is likely that the source of these contaminants is atmospheric deposition.

Lake Benthos: Benthic macroinvertebrates were sampled from different habitats in Branch, Bourn, and Little Mud Ponds in May, 1993 and Lye Brook Meadows in July, 1995. Ekman dredge samples were collected from both profundal and sub-littoral areas of Branch and Bourn Ponds and from sub-littoral only at Little Mud Pond. Qualitative littoral sampling was conducted at all four ponds. Total taxa richness from the Ekman dredge sampling ranged from six in the profundal zones of Branch and Bourn Ponds, to 18 in Little Mud Pond. Sub-littoral samples were generally more diverse than profundal samples. Dipterans, primarily of the Chaoboridae and Chironomidae families dominated the profundus of both lakes, with the profundal community of Bourn Pond made up of 96 percent Chaoboridae. Communities in both profundal zones were indicative of severe oxygen stress. No taxa of the acid-sensitive groups mollusca/crustacea/ephemeroptera were observed in any of the profundal and sublittoral Ekman dredge samples. Qualitative shoreline sampling produced more taxa. Taxa richness in Little Mud, Bourn, and Branch Ponds averaged about 60 taxa while Lye Brook Meadow produced 40 taxa. No crustacea (eg. crayfish) were observed in any of the four waterbodies. No acid-sensitive mayflies or mollusca were observed in Lye Brook Meadows. Little Mud Pond contained one mayfly species but no mollusca. Branch and Bourn Ponds both contained three mayfly and two molluscan taxa.

Fish Tissue Contaminants: During 1994 and 1995, fish for contaminant analysis of edible tissue were collected from Branch, Bourn, Stratton, and Grout Pond by angling and gill nets. Only brook trout were collected from Branch, Bourn, and Stratton Ponds.

Brown bullhead, chain pickerel, and smallmouth bass were collected from Grout Pond. Concentrations of PCBs and chlorinated pesticides were below detection limits in all brook trout samples. Metabolites of DDT, up to 0.12 ppm DDE in smallmouth bass, were detected in all samples from Grout Pond. Mercury was detected in all samples. Concentrations ranged from 0.08 ppm in brook trout from Stratton Pond to 1.45 ppm in one smallmouth bass from Grout Pond. Of five smallmouth bass tested from Grout Pond, four had concentrations of mercury in excess of 1.00 ppm, the FDA action level for mercury in fish.

Stream Chemistry: Stream chemistry was sampled at two sites each on Bourn and Lye Brook, and one site each on Branch Pond Brook and Winhall River. Considerable spatial and temporal variability was observed in stream chemistry parameters. All streams sampled underwent a reduction in pH, alkalinity, and calcium in response to snowmelt and spring runoff. Lack of significant spring runoff followed by drought conditions in 1995 resulted in higher pHs throughout most of the 1995 sampling period than in the previous two years. Differences in stream chemistry were observed between upstream and downstream sites on Bourn and Lye Brooks. All stream sites are considered to be acidified, with the exception of the downstream site on Lye Brook. Stream chemistry at this site is influenced by dolomitic outcroppings which increase pH and alkalinity. A maximum alkalinity of 10.5 mg/l was observed at this site in the fall of 1995, compared with an alkalinity of less than one mg/l at the upstream site at the same time. Concentrations of aluminum were highest during periods of runoff. Aluminum was observed at concentrations that, depending on the duration of exposure, would be potentially toxic to aquatic biota.

Stream Fish Populations: Stream fish populations were sampled by electroshocking at six sites on four streams - two sites each on Lye and Bourn Brooks and one site each on Branch Pond Brook and the Winhall River. All four streams are characterized as small cold-water streams. No fish were observed at the most upstream site on Lye Brook. Only brook trout at relatively low densities were found at the upstream Bourn Brook site and the Branch Pond Brook site. Three and four species were found at the lower Lye and Bourn Brook sites respectively. A total of eight species, including three Salmonids, were found at the Winhall River site. Salmonid species observed were brook and brown trout, and Atlantic salmon; non-salmonids included slimy sculpin, longnose and blacknose dace, white sucker, and creek chub.

Stream Macroinvertebrate Populations: Stream macroinvertebrates were sampled at seven sites on four streams. Substrate composition at all sites was dominated by boulder and cobble. Most sites were sampled annually for the three years of the project. Sampling was conducted in the fall using standardized kick-net sampling techniques consistent with VTDEC field protocols. In addition to an estimate of the abundance per unit sampling effort, a number of community-based metrics were calculated, including: total number of taxa present (taxa richness), the total number of stonefly, mayfly, and caddisfly taxa present (EPT richness), a bio-index indicative of overall productivity (Bio-

Index or BI), a diversity index, the relative dominance of an individual taxon (% Dom Tax), and the percent composition of various taxonomic and functional components of the macroinvertebrate community. The upstream Lye Brook sites exhibited poor biological integrity and were the most biologically depauperate and least diverse of the sites sampled. The uppermost site was dominated by dipterans and had no mayfly or stonefly taxa, which were abundant at all other sites. The upper Lye Brook site was unique among the sites sampled in that it was characterized as enriched and had a significant periphytic blue-green algal growth at the time of sampling. The Branch Pond Brook and upper Bourn Brook sites exhibited some biological impairment in 1994, a year when stream pH's were generally lower than in 1993 or 1995. It is likely that the reduced biological integrity at these sites is at least in part a result of episodic exposures to high acidity and to high levels of aluminum. The Winhall River and lower Bourn Brook sites had the most diverse and well-balanced benthic communities of the sites sampled. These two sites, along with the lowest Lye Brook site, were all rated as having good to excellent biological integrity.

Recommendations: Recommendations are made in this report relative to maintaining a continued long-term monitoring presence in the Lye Brook Wilderness area. It is recommended that stream and lake chemical monitoring should continue at the intensity conducted during these studies; and that biological monitoring should be repeated on a regular basis at five-year intervals.