The St. John, Aroostook, and Meduxnekeag River basins have received a low level of sampling effort relative to their importance, their size and the amount of detrimental activities in the region.

Introduction

Geography

The St. John River is the largest river basin in Maine, covering 7,286 square miles within the State. About two thirds of the St. John drainage basin is in Maine with the balance in Quebec and New Brunswick, Canada. The river begins at Fifth St. John Pond, and flows through northern Maine, parallel to the Quebec boundary, through an extensive semi-wilderness area, for about 117 miles. It then turns east, to the Allagash River headwaters, where it ultimately forms the boundary of Maine and New Brunswick, Canada. The river passes through the developed areas of Fort Kent, Madawaska, and Van Buren, Maine. It exits Maine near Hamlin, eventually discharging into tidewaters of New Brunwick, Canada at St. John Bay. The total length of the river in Maine, from Fourth St. John Pond to Hamlin is approximately 214 miles.

The Aroostook River basin is the largest tributary of the St. John River and covers 2,301 square miles. The Aroostook is formed by the union of Munsungan and Millinocket Streams in township of T8R8, approximately 21 miles northeast of the headwaters of the East Branch of the Penobscot River. It follows a winding path to the northeast mostly through undeveloped areas prior to reaching the Presque Isle region in Aroostook County. It passes through the municipalities of Masardis, Ashland, Presque Isle, Caribou, and Fort Fairfield before emptying into the St. John River in New Brunswick. The total length of the mainstem, ending at the Maine/New Brunswick border is approximately 104 miles.

The Meduxnekeag River basin drains about 200 square miles in Maine, much of which is agricultural crop and pasture land. The Meduxnekeag River originates on Meduxnekeag Lake just west of New Limerick, and flows east through the developed areas of New Limerick and Houlton, before turning north for approximately 8 miles, exiting Maine's eastern border east of Littleton. The South Branch of the Meduxnekeag begins in

Cary, about 9 miles south of Houlton and flows north through agricultural areas and the town of Hodgdon before joining the mainstem. The Meduxnekeag North Branch flows from an area approximately 17 miles northwest of Houlton, through the town of Monticello, and joins the mainstem in Canada. Total length of the mainstem ending at the Maine/New Brunswick border is about 20 miles.

The Allagash and the Fish Rivers contribute the remaining flow volume to the St. John River. The Biomonitoring Program has no aquatic life sampling stations on these tributaries. Water quality of the Allagash is expected to be good because of the protected status conferred by the Allagash Wilderness waterway. The Fish River drainage is characterized by many large lakes. The upper drainage is largely forested while the lower drainage flows through more developed areas and shows impacts of agricultural non-point.

Basin Summary Statistics

Biomonitoring Activities in the Basin	**Period of Record**: 1983-1994 **Waterbodies Sampled**: Total of 23 waterbodies (St. John R. mainstem: 5; Aroostook R. basin: 15; Meduxnekeag R. basin: 3) **Established Stations**: Total of 40 stations for all basins combined **Number of Sampling Events**: St. John R.: 7; Aroostook R. basin: 36; Meduxnekeag R. basin: 9;
Wastewater Discharges	**St. John R. Basin**--1 paper mill in the United States, 1 pulp mill in Canada; 6 municipal treatment plants serving a population of approx. 16,100 in the U.S. **Aroostook R. Basin**-- 7 municipal treatment plants serving a Population of approximately 37,200; 2 food processors and 2 minor industrial discharges. **Meduxnekeag R. Basin**--1 food processor and 2 municipal treatment plants serving a population of approx. 8,700.
Other Sources	Extensive agricultural and forest harvesting land use in the entire St. John River basin.
Flow Regulation ***(Total Capacity)	**Aroostook R. Basin**--Water levels controlled by approx. 27 dams including 3 FERC hydro-electric projects: 2 are <2000 KW*; 1 peaking-power and storage project. **St. John R. Basin**—Water level controlled by 3 dams: No FERC regulated hydro-projects.

Meduxnekeag R. Basin—Water level controlled by 14 dams: No FERC regulated hydro-projects.

Quality

Variable, with outstanding water quality and ecological resources in the upper St. John River and Allagash River watersheds, to fair to poor in some parts of the Meduxnekeag and Aroostook basins, due to non-point and point source impacts.

Drainage area	Average Annual Discharge	Wastewater Flow Volume (Major Industrial and all Municipal Discharges Only)	Mainstem Average Dilution
St. John R: 8236 mi^2 (near Hamlin)	St. John R.: 9740 cfs (at Ft. Kent)	St. John R. 27.2 mgd (42.2 cfs)	St. John R: 335:1 (pro-rated for Hamlin)
Aroostook R.: 2301 mi^2 (at Ft. Fairfield)	Aroostook R: 2665 cfs (at Washburn)	Aroostook R.: 10.8 mgd (16.8 cfs)	Aroostook R.: 221:1 (pro-rated for Ft. Fairfield)
Meduxnekeag R: 175 mi^2 in Maine (near Houlton)	Meduxnekeag R: 301 cfs (near Houlton)	Meduxnekeag R.: 2.2 mgd (3.4 cfs)	Meduxnekeag R.: 88:1 (pro-rated for Houlton)

Overview of Biological Monitoring Activities

The Aroostook County region was sampled in the 1999 field season, in preparation for the next round of NPDES licensing activities in 2000. The St. John, Aroostook and Meduxnekeag basins have received a low level of sampling effort relative to their importance, size and amount of detrimental activities in the region. The Fish River basin was not sampled until 1999 and the Allagash River basin has received no sampling effort. Only a few stations in the region have been sampled more than once. The Houlton Band of Maliseet Indians has recently entered into a partnership with the MDEP Biological Monitoring Program to collect biological data from the Meduxnekeag River basin. Similar to the arrangement with the Penobscot Indian Nation on the Penobscot River (Part II Basin Chapter 3, p. 71) the Maliseets collect and analyze biological and water quality data following recommended DEP protocols and utilizing the same taxonomic experts. Five new stations were established on the

Meduxnekeag, by the Maliseets, in 1998 and one was established on the Mattawamkeag (not mapped), for collection of benthic macroinvertebrate and periphyton data.

Of 40 stations in the three combined basins, 4 do not attain the aquatic life standards of their assigned class (Basin Table 1, p. 133; Basin Map 1, p. 161). All are in the Aroostook sub-basin. The existing monitoring effort has uncovered no stations that fail to attain at least Class C standards. Seven stations (two or three in each basin) exhibit aquatic communities that exceed the standards of their assigned class. To date most of the monitoring effort has focused on assessment of municipal and industrial point source impacts in the region. There is a need to refine assessment methods and establish new biological monitoring stations in order to better detect impacts of agricultural and forest harvesting activities. New methods for detection of non-point source impacts to small streams will be applied in this region during the summer of 1999 (Part I Chapter 2, p. 27). Additionally, the Biological Monitoring Program has begun development of algal indicators of nutrient enrichment. The Meduxnekeag River has been chosen as one site to pilot this work. Algal indicators will provide new and supporting information about stream condition to complement the existing benthic macroinvertebrate program. They have the potential to provide a more sensitive tool for problem identification (nutrient enrichment; aesthetic problems, etc.) and evaluation of management success. Algal biomass measures are better correlated with public perceptions of problems than actual nutrient concentrations in streams. Algae has been shown to respond more quickly to certain types of stressors than the macroinvertebrate community and in some cases may show a response where macroinvertebrates show no response. Algal indicators are expected to be a useful tool for development of nutrient Total Maximum Daily Loads (TMDLs). Modeling for improvements and assessing community response in the instream algal condition may be a more successful and direct approach than modeling for changes in nutrient concentrations.

Case Study 3

Suspected Toxic Impacts of Agriculture, Dudley Brook

Dudley Brook (Sta. 215) exhibits community characteristics suggestive of toxic impacts from agricultural activities when compared to Pattee Brook (Sta. 212) another Aroostook County stream of similar size and physical habitat structure. The Dudley Brook watershed is 60-75% cropland in a potato and grain (oats and/or barley) rotation. Management of these crops involves the application of large amounts of herbicides and pesticides. Dudley Brook is managed as Class B but biomonitoring results indicate it is only attaining Class C standards for aquatic life. Pattee Brook also has agricultural activity within the watershed but to a lesser extent than Dudley. Pattee Brook is the water supply for Fort Fairfield and attains aquatic life standards for Class B.

Presented in Figure 12 is a graphical representation of three measures of pollution sensitive organisms, placing Pattee Brook and Dudley Brook within the context of the overall Maine Biological Monitoring Program database. Appendix 2 provides an explanation of the distribution information presented in box plots. The four "boxes" represent the distributions of all the sites falling within a given class in the Biomonitoring database. Variables displayed are: *Generic Richness*, a measure of the overall number of different types of organisms in the sample; *EPT*, a measure of the number of genera within the three pollution-sensitive orders, **E**phemeroptera (mayflies), **P**lecoptera (stoneflies), and **T**richoptera (caddisflies); and *EPT Index*, a measure of numbers of mayfly plus stonefly genera, relative to the maximum number occurring at clean water reference sites in the baseline database.

In comparison to Pattee Brook, Dudley has only half the overall number of genera and 55% the number of genera of pollution sensitive taxa (Figure 12). Toxic impacts frequently result in depressed production across all groups of organisms. Dudley Brook had 1/3 the total number of individuals that occurred in Pattee Brook. For these reasons it is concluded that the Dudley Brook benthic macroinvertebrate community is exhibiting evidence of detrimental toxic impacts causing it to fail to attain its assigned water quality classification.

The effects of agricultural run-off

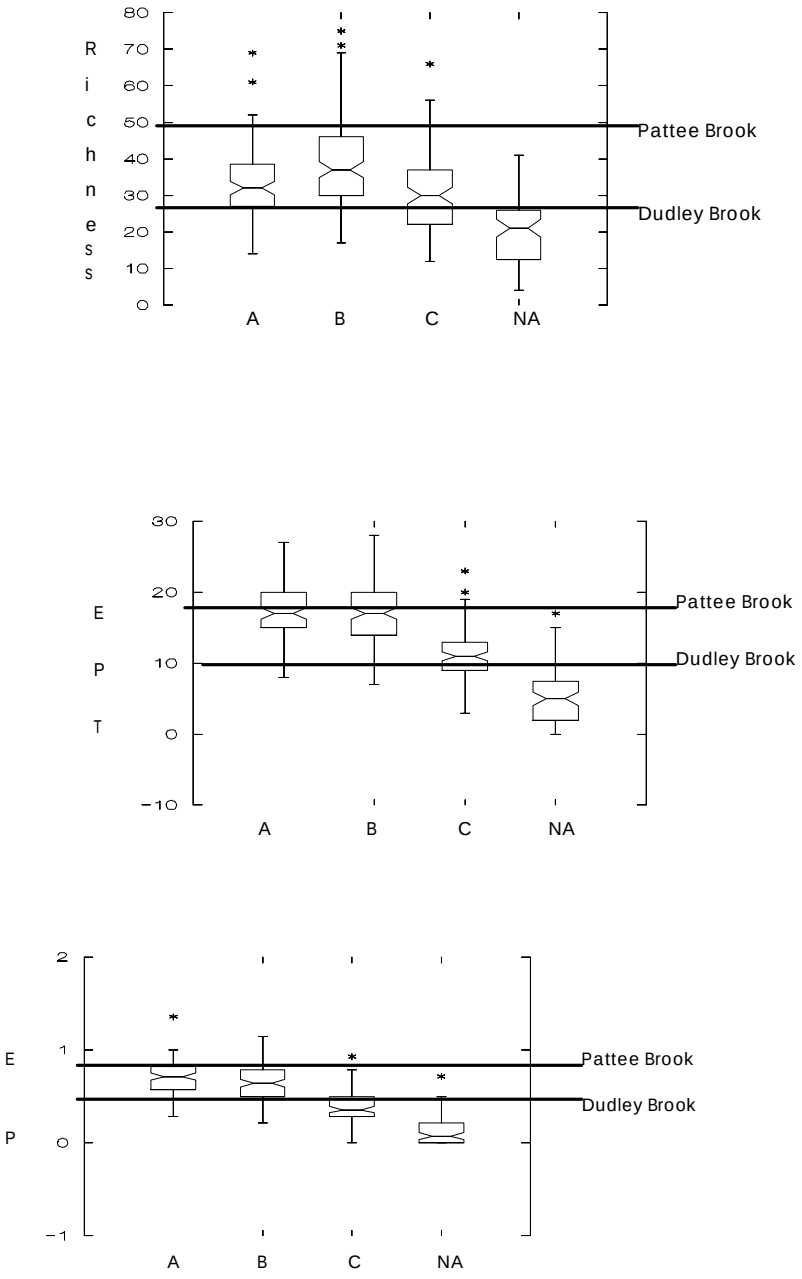

Figure 12 Box plots showing values of the variables Richness, EPT and EP for Pattee Brook and Dudley Brook as compared to the distribution of all values for all sites within a given class in the Maine DEP Biological Monitoring Program database.

N=414, $n\text{-}_{\text{Class A}}$=99; $n\text{-}_{\text{Class B}}$=133; $n\text{-}_{\text{Class C}}$=103; $n\text{-}_{\text{Non-Attainment}}$=79