The Androscoggin River is the fourth largest river in Maine, draining 3,450 square miles or about 10% of the state. In comparison to the other three rivers, available dilution on the Androscoggin mainstem is fairly low.

Introduction

Geography

The Androscoggin River originates at the outlet of Umbagog Lake near Errol, New Hampshire where it flows for the first fifty miles before entering the State of Maine through Gilead. The river traverses the developed and industrial towns and cities of Rumford, Dixfield, Jay, Livermore Falls, Lewiston-Auburn and Brunswick before emptying into Merrymeeting Bay. The total length of the mainstem from Umbagog Lake to Brunswick is approximately 162 miles. There are also 22 other sampled streams of the Androscoggin River basin listed in Basin Table 5.

Basin Summary Statistics

Biomonitoring Activities in the Basin	Period of Record: 1983 – 1998 Waterbodies Sampled: 23 Established Stations: 70 Number of Sampling Events: 126 (34 sampling events in 1998) (Note: 1998 data not yet available)
Major Discharges	2 paper mills and 1 textile manufacturer in Maine, 1 paper mill in New Hampshire, and 12 municipal treatment plants serving a human population of about 100,000.
Other Sources	Miscellaneous industrial waste discharges; agriculture and animal waste from livestock and egg farms; combined sewer overflows (CSO's); urban runoff.
Flow Regulation	Basin hydrology is highly altered by the existence of 104 dams; the mainstem has 15 FERC licensed dams for hydropower generation or storage, impounding approximately 37 miles of river.

Quality

Characterized by high water quality and sparse human disturbance in the upper watershed. Water quality declines as the river flows south through the state because of urban development and industrial discharges.

Drainage area (near Auburn)	Average Annual Discharge (near Auburn)	Wastewater Flow Volume (Major Industrials and all Municipal Discharges)	Mainstem Average Dilution
3,263 mi^2	6,156 cfs	110.9 mgd (171.9 cfs)	36:1

Overview of Biological Monitoring Activities

The Biological Monitoring Program has established 70 discrete monitoring stations on 23 different waterbodies draining to the Androscoggin River Basin, since 1983. The basin was intensively sampled in 1998 to prepare for National Pollutant Discharge Elimination System (NPDES) relicensing activities. Stations newly established in 1998 are recorded on Basin Table 5, p. 146 and Basin Map 5, p. 166, but data work-up is incomplete. The Androscoggin will next be due for basin-wide sampling in 2003, in preparation for license renewals in 2004. Stations within the basin have been sampled sporadically since 1983 with the greatest sampling emphasis directed to higher-risk waterbodies. The majority of sampling events (sixty four percent) occur on waters of statutory Class C. The upper mainstem, in the vicinity of the Rumford and Jay pulp and paper mills, has received a proportionately greater emphasis, with 13 locations accounting for 24% of all sampling events in the basin. Much of the data on the mainstem near Jay has been collected and submitted to the Department by the International Paper Company and their biological monitoring contractor, EcoAnalysts of Bath, Maine. Other locations of significance include Thompson Lake Outlet Stream, site of long-standing toxicity problems downstream of a textile mill; several small streams in Turner receiving groundwater leachate from a major egg farm; and the upper Little Androscoggin River, site of a former tannery.

Historical Perspective

Milestone Events in the Basin

YEAR	WATERBODY	AFFECTED STATIONS	EVENT
1985	Little Androscoggin, So. Paris	43, 44, 45, 46, 79	Closure of A.C Lawrence Tanning Co.
1984-90	Thompson L. Outlet, Oxford	76, 77, 78	Toxicity reduction efforts at Robinson Mfg.
1992	Gulf Island Pond on the mainstem		MDEP orders IP to correct low dissolved oxygen in GIP by an oxygen diffuser at Twin Bridges, Turner
1989	Martin Stream, Turner Lively Brook, Turner House Brook, Turner	104, 105, 184, 185, 189 188	MDEP takes enforcement action Decoster Egg Farm for water quality violations
1995-1997	Mainstem, Canton to Livermore Falls	61, 82, 222, 233, 244, 260, 261, 263, 264, 265	Relicensing of Riley-Jay-Livermore and Otis Hydroelectric dams

Within the period of record, non-attainment of applicable aquatic life standards has occurred at 15 stations in the Androscoggin River Basin with 9 stations in non-attainment as of the most recent available data (Basin Table 5). In the early to mid 1980s several inadequately treated point sources contributed significantly to non-attainment of standards. These include the South Paris Utilities District, the Robinson Manufacturing Company and the mainstem pulp and paper mills. In addition, groundwater contamination and agricultural runoff from the Decoster Egg Farm has had long-standing detrimental impacts to two small streams in Turner (Case Study 6).

Mainstem impoundments in the vicinity of the International Paper Company mill in Jay have also contributed to persistent non-attainment of standards. However, in spite of some lingering problems, water quality in the Androscoggin River basin has improved markedly over the past 10 years. Discharges of oxygen consuming wastes and organic solids, in the mainstem especially, have decreased by as much as 90% since the early 1990's due to improvements in wastewater treatment at the major industries. Ten years of toxicity reduction efforts at Robinson Manufacturing are finally bringing positive results for the Thompson Lake Outlet Stream in Oxford (Case Study 7) and with the closure of A.C. Lawrence Tanning Company in 1985, the problems on the Little Androscoggin River in South Paris are resolved (Case Study 8).

CASE STUDY 6

Detection of Impacts of Contaminated Groundwater, Lively and House Brooks, Turner

Decoster Egg Farm, the largest producer of brown eggs in New England, is located in Turner, Maine. The Farm has a long history of environmental concerns including levels of ammonia and nitrates in violation of drinking water standards. This case study presents a unique example of the detection of biological impacts in a stream attaining surface water quality standards but affected by polluted groundwater recharge. High nutrient levels, caused by poor manure and chicken carcass waste management practices, resulted in contaminated leachate entering ground water on the Decoster property. Surface water violations were not recorded. In 1989 the Department brought enforcement action against Decoster Egg Farm to prohibit any further spreading of manure on the property, and to enforce proper management of other animal waste products. In 1991, the company was required to evaluate the condition of the aquatic life in surface waters affected by leachate or groundwater upwelling including two Class B streams, Lively Brook and House Brook. Field investigations included probes of the hyporheic zone (the water flowing through the stream substrate) to measure the conductivity of the upwelling groundwater. Conductivity is a measure of the ionic strength of water and is a very good means of detecting certain types of pollutants. The streambed investigation uncovered several areas of contaminated groundwater recharge to the stream. Aquatic life sampling, completed in 1992, confirmed impacts to the benthos at three stations affected by groundwater upwelling on Lively Brook and one station on House Brook. Station 188, on House Brook, is located downstream of a failing treatment system that receives waste from the egg washing operation. The waste stream is severely contaminated by nitrates. That station failed to attain minimum Class C aquatic life standards in 1992. Repeat sampling in 1997 resulted in attainment of Class C standards but the stream still fails to attain it's assigned Class B status. Biomonitoring information was used to issue a consent order requiring termination of manure spreading practices and improved treatment of the products of the egg washing facilities. The egg washing facility has been removed.

CASE STUDY 7

Adaptive Management Feedback Loop to Reduce Toxicity, Thompson Lake Outlet Stream

Robinson Manufacturing Company is situated just downstream of the Thompson Lake Dam in Oxford and discharges effluent produced during the manufacture of textiles, into Thompson Lake Outlet Stream. The facility was plagued with serious toxicity problems through the 1980s with consequent detrimental impacts to aquatic life in the stream. Three aquatic life sampling stations were established in 1984 (Stas. 76, 77, 78). Station 76 is upstream of the Robinson outfall; station 77 is at the initial point of complete mixing, about 70 m below the outfall; and station 78 is, about 0.35 km downstream of the outfall. Station 77 was discontinued in 1988. In 1984 an average of only 22 individual organisms were collected per sampler at Station 78, with only 8 different kinds of organisms. Given the high quality of the physical habitat sampled, these findings were considered to be clearly indicative of impacts of toxic conditions. Aquatic life findings triggered efforts by the industry, the Department and EPA to reduce the toxicity of the effluent. The problems with the effluent were very challenging, however, and in spite of evidence of gradual improvements in community composition, the station continually failed to attain Class C aquatic life standards, through 1992.

Management intervention at the Robinson Manufacturing Company occurring in the late 1980s and early 1990s has addressed wastewater treatment, manufacturing processes and general mill practices. Treatment changes include the construction of an equalization system to prevent large slugs of effluent from overwhelming the plant. The aeration capacity was also greatly increased. The industry hired a well-qualified, full time, treatment plant operator to run the upgraded plant, and also hired general environmental staff to holistically address environmental concerns at the mill. Within the textile mill, chemical process substitutions were initiated in an effort to reduce effluent toxicity through the use of less hazardous materials, and waste handling changes were instituted to decrease the incidence of spills and dumping.

All remedial actions combined have resulted in the discharge of a much higher quality effluent to Thompson Lake Outlet Stream. The incidence of violations of licensing limits has decreased to a fraction of violations that were recorded in the 1980s and no recent violations have occurred as a result of lack of treatment capacity. Remaining problems have tended to be associated with spills and mill operations, rather than treatment problems. Unfortunately, the stream itself has been slower to respond to cleanup efforts. As noted, the stream consistently failed to attain the minimum aquatic life characteristics for Class C standards between 1984 and 1992. Yet a closer look at the community characteristics reveals a classic trend of improving response, with recruitment of increasingly sensitive organisms. The 22 organisms in 1984 were nearly all snails (Physa). The dramatically increased numbers in the 1985 samples were comprised of over 90% worms, leeches and midge larvae (Chironomidae), with the pollution-tolerant midge larvae considered to be a favorable trend as compared to the extremely pollution-tolerant non-insects. In 1988 the very first observation of a few mayflies (7 individuals) was recorded in the downstream station (78). The 1992 samples revealed an average of 45 mayflies per sampler and filter-feeding caddisflies and black flies made up 93% of the total number of organisms (1576) colonizing the samplers. Conditions were next evaluated in 1996, following completion of the above-mentioned improvements. For the first time in the period of record, both the upstream and the downstream stations attained Class C aquatic life standards. Because 1996 was an extremely high-flow year, allowing for higher than normal dilution ratios, optimism about the long-term health of the stream must be somewhat guarded. But field observations of samples collected in 1998 suggest that standards may have once again been attained. It is clear that major improvements in water quality have been accomplished and there is justifiable hope for the future.

Robinson MFG. Co. discharge to Thompson Lake Outlet Stream, circa 1984

Thompson Lake Outlet Stream, below Robinson MFG Co., April 1999

Current Status and Issues

Available information for the Androscoggin River Basin indicates that water quality gains have been made with the result that the aquatic life classification of five stations in the basin (Stas. 41; 46; 261; 76; 78) show signs of an improvement in aquatic life condition over the period of record. (Basin Map 5 and Basin Table 5). Issues of non-attainment or provisional attainment of standards are known to currently exist in some impounded sections of the mainstem below Jay (Sta. 265). However, reduction in solids discharges from the International Paper Company is having a demonstrated beneficial effect on aquatic life in these impoundments. Expectations are high that aquatic life standards can be attained there. These findings are discussed in Case Study 11 in Basin Chapter 8, *Biocriteria as a TMDL Modeling Endpoint, Presumpscot River*, because insights gained on the Androscoggin River were directly applicable to problems on the Presumpscot River.

Applications for renewal of the Federal Energy Regulatory Commission licenses for the four hydroelectric dams in Jay (Riley, Jay, Livermore and Otis) were filed in the fall of 1997. Extensive environmental assessments of the impacts of operations of these run-of-river dams by International Paper and MDEP have been underway in the study area since 1995. The Town of Jay has also been an active participant in monitoring and decision-making. Three field seasons of benthic macroinvertebrate data have been collected by International Paper's project consulting firm, EcoAnalysts, of Bath, Maine as part of re-licensing investigations (1995, 1996 and 1997). Results from 1995 indicate non-attainment of standards for all stations between downstream sections of the Jay impoundment through the Livermore Falls bypass reach. 1995 was an unusually dry summer with flows below 7Q10, intermittently, throughout July and August. The summer of 1996 was unusually wet. Low flow conditions in 1996 met or exceeded the highest flows experienced in the summer of 1995. Between the late 1980's and 1992, by taking advantage of improved treatment technologies and attention to pollution prevention, the International Paper Mill in Jay had reduced the discharge of oxygen-consuming waste (BOD) and solids to the Androscoggin River by about 60%. On a trial basis, during the 1996 field season, the industry voluntarily reduced the input of solids discharged to the river by an additional 30% because it was concluded that excessive settled solids was the primary cause of aquatic life non-attainment. Benthic samples indicated a marked improvement of biological community characteristics in 1996 but interpretation of the results from both years must take into account that two different flow extremes were sampled. Several stations were successfully re-sampled in 1997 while for others results are indeterminate due to sampling error. For acceptable 1997 samples only one station in the Otis impoundment (Sta. 265) was found to be still failing to attain aquatic life standards. One other station exceeded standards of it's assigned classification and showed gains in pollution sensitive taxa, increased numbers of individual organisms and improvements in the structural characteristics of the community. Basin Table 5 reports 1995 results as they reflect a conservative estimate of aquatic life attainment due to the low flows that year. Ongoing monitoring is required

as a condition of re-issuance of these hydropower licenses, in order to ensure that license conditions provide for attainment of aquatic life standards through the term of the new license. The mill is currently discharging about 2-3,000 lbs. of solids per day, as compared to licensed discharge limits of 17,000 lbs. per day in 1991.

Environmental problems remain on the Decoster Egg Farm property, with no quick and easy remedies available. Although still not attaining assigned Class B standards, data from the 1997 field season shows that Lively Brook and House Brook both attain Class C aquatic life standards and appear to be responding positively to decreases in levels of nutrients in the groundwater and changes in waste management practices.

CASE STUDY 8

Expert Judgement Determination of Alteration due to Natural Causes, Little Androscoggin River, South Paris

Several stations (Stas. 43, 44, 46) in the vicinity of the Paris Utilities District (PUD) were initially sampled for benthic macroinvertebrates in 1983 (Basin Map 5). At that time the PUD was receiving effluent from the A.C Lawrence Tanning Company and in-stream and in-situ bioassays were underway to determine the level of chromium toxicity of the effluent flowing to the Little Androscoggin River. Return visits in 1984 sampled an additional station, directly downstream of the effluent diffuser (79). Stations upstream of the POTW outfall (43 and 44) attained Class A standards while stations downstream attained either Class C standards (46) or failed to attain the minimum standards of Class C (79). The A.C Lawrence Tanning Company continued to discharge through the summer of 1985, finally ceasing operation in November of that year. Station 46, about 2 km downstream of the PUD outfall, maintained Class C standards in 1985 but when re-visited in 1986, nine months after cessation of the tannery discharge, the aquatic community had rebounded sufficiently to attain Class B standards.

Findings for 1987 are quite interesting. On April 1, 1987 a 500 year flood was experienced across most of the state. Maximum discharge on the Little Androscoggin River, at 9,340 cfs, was the highest ever recorded for the river, in dramatic contrast to average March/April flows of about 300 cfs. August sampling in 1987 provided results showing a decline in attainment of standards for both the station above the discharge (Sta. 43) and the one below the discharge (Sta. 46, Basin Map 5). Both attained only Class C standards. Field staff observed that the rather sandy stream channel at the site had been dramatically re-shaped as a result of the major flooding. A close inspection of community structure revealed that the flood event caused a decrease in typical long-lived, large bodied organisms that cling to the surface of the substrate (mayflies and stoneflies, beetles, etc). Instead of the expected preponderance of clinging, long-lived organisms, the communities were 75% to 80% fly larvae (chironomid midges). These organisms are rapid colonizers and are commonly found in new, unstable or degraded habitats.

The river reach was not re-visited until 1992, at which time the downstream station had improved to the highest quality yet recorded, attaining Class A aquatic life standards. The upstream station had rebounded to attainment of Class B standards. Recruitment of more specialized, longer lived organisms, contributed to attainment of the higher aquatic life standards.

Combined Sewer Overflow discharging to the Androscoggin River in Auburn (1984, approx.)

Future Needs

The Androscoggin River Basin was intensively sampling during the 1998 field season with twenty new stations established to better represent this region. In general, most mainstem and tributary stations in the lower basin, below Lewiston-Auburn, had not been sampled for aquatic life since 1984. Ongoing issues at Thompson Lake Outlet Stream, Lively and House Brooks and the mainstem in Jay are likely candidates for continued monitoring of the success of water quality management efforts. Each year an effort is made to expand the database to include not only stations expected to show the impacts of human activities but also pristine, reference stations to insure that our understanding of the native potential of each region is adequate. 1998 sampling added a number of poorly represent tributaries to the mainstem between Bethel and Jay. The Nezinscott River watershed has no aquatic life sampling stations and should be surveyed, to establish a baseline condition, during the next rotation through this basin.