Analysis summary of Water Quality Monitoring Data 1994-2001

Introduction

Water quality monitoring on the Sheepscot by the Sheepscot Valley Conservation Association started in 1994. The initial goals of the program were to:

1. Gather baseline data to assess the impact of non-point sources of pollution on the Sheepscot River and its upper estuary.
2. Gather baseline data on temperature at three selected sites for the Atlantic Sea Run Salmon Restoration Program.
3. Assess the water quality of some river sections currently used for swimming and reproduction of the Atlantic salmon.
4. Assure that collected water samples were representative of the river reach being evaluated.
5. Create interest by riparian landowners, other river users, and public officials in the water quality of the river.
6. Create support from all concerned for required additional water quality testing, pollution source identification, and correction of major water pollution sources.

The criteria for selecting monitoring sites to help meet the above goals were to place stations:

1. On, above and below tributaries suspected of possible non-point pollution sources.
2. On, above and below the confluence of major tributaries.
3. At habitat areas of sensitive aquatic species; especially spawning and nursery areas important to the Atlantic salmon.
4. At areas now used for swimming.
5. Where the Department of Marine Resources has been testing for fecal bacteria.
6. At sampling sites where the river is accessible and can be reached safely.

Currently 32 sites are sampled along the Sheepscot and its tributaries. Water samples are analyzed for Enterococci and Fecal Coliform (estuarine stations) and E. coli (freshwater stations. They are also analyzed for dissolved oxygen and salinity (estuarine stations). Temperature readings are taken as well. Volunteers take samples from early May to mid-October on a biweekly schedule.

Analysis

In February of 2002 a task force, including representatives from the Maine DEP, Atlantic Salmon Commission, Sheepscot Watershed Council, and the SVCA met to come up with questions important to understanding the watershed's health. Analysis of the eight years of water quality data would be used to provide answers. Answers to these questions would provide useful information to each of the groups interested in the various aspects of the Sheepscot River water quality.

The following were the questions formed by the group:

1. What are the differences in water quality, if any, between reaches (main branch above Coopers Mills vs. West Branch vs. Coopers Mills to Head Tide vs. Head Tide to Sheepscot Village)?
2. Are there sites that are significantly different in violation history?
3. How do the sites cluster? Are there any clustering patterns?
4. What are some of the trends, if any?
   Are there trends in the data considering river stage?
   Does placement in the watershed make a difference?
   Over time how do sites change?

Question #3 was not answered, because it was decided that the data was not multivariate enough to make clustering useful. Trends due to river stage were not analyzed due to time constraints. The other questions were answered through statistical analysis using SYSTAT statistical package and by graphing using Excel.
Individual years were not analyzed. Because sampling started mid-spring and ended mid-fall there could not be a comparison between seasons. Reaches were analyzed by combining all data points for a reach or sub-section of a reach before comparison. Differences between individual sites were analyzed in a similar fashion.
Violations were determined by comparing raw data to state instantaneous standards and noting exceedences. It was assumed that all violations were due to human input, although this is not necessarily true, but allowed comparison to state water quality standards. Because AA waters are to be as naturally occurs standards were developed for comparison purposes. The standards used were:
AA: 7.0mg/l (D.O.), 32col/ml (E. coli geomean), 214col/ml (instantaneous E. coli measure)
B: 7.0mg/l (D.O.), 64col/ml (E. coli geomean), 427col/ml (instantaneous E. coli measure)
SA: 7.0mg/l (D.O.), 8col/ml (Enterococci geomean), 54col/ml (instantaneous Enterococci measure)
For all sites a standard of 22.5℃ (Temperature above which fish survival is questionable if maintained) was used.

1. **Differences between reaches**: The tributaries have significantly lower mean D.O. than the main river. This makes sense because there is lower flow in many of the tributaries and they are shallower. The tributaries though, have lower mean temperature than the main river. Perhaps this is because many of them are cold water spring fed, although there are many places where the tributaries are very exposed (no shade from trees or shrubs).
   The West Branch has significantly lower D.O. than the other reaches, and the Upper Main stem has significantly lower temperature than the other reaches. The West Branch has been observed to have lower flow than other parts of the watershed, although this has not been quantified.

2. **Differences in violation history:** CHABK001, CHABK002, CHABK003, and S015 had significantly higher number of D.O. and bacteria violations for their respective reaches. A pattern emerges when violations are graphed, especially for bacterial violations although no statistical significance can be inferred. S015

shows similar trends for D.O. and bacterial violations. All other sites show no connection between the parameters. None of the sites have a statistically high percentage of temperature violations.

***Lower mainstem*:**

S005, S006 and S007 all exceeded 70% of samples being in violation of Enterococci standards for all years available. It is possible that an overboard discharge (removed before 2001 season) upriver of S007 caused high counts, but it is unlikely that this would have influenced S005 or even S006 as observed. There is still an overboard discharge just below S007, but still would not be the cause of the high number of violations observed at S006 or S005. Changes due to the removal of the upriver discharge pipe can not be analyzed because there is no data available at S007 for 2001. No other sites were as consistently in violation of any parameters.

Middle mainstem:

Chaimberlain Brook sites had more bacterial violations than any other sites in the reach, although there was no consistency between years. In 2001 CHABK003 violated B standards 70% of the time, although it was sampled only seven times out of the twelve possible sampling dates. The geomean of the season's sampling was much higher than any other site's in the reach. CHABK001 and CHABK003 had consistently high numbers of D.O. violations. Perhaps this is due to the very low flow of this tributary. Sampling was halted at CHABK003 in 2001 halfway through the season for lack of water. CABK001 was also consistently below a D.O. reading of 7.0mg/l 50% of the time, possibly also due to low flow in the brook. S010 is the only site within this group and the watershed displaying higher number of temperature violations.

Upper mainstem:

Violations were uncommon for the four sites in this reach. Perhaps there is an upward trend in the number of violations at S015. In 2001 70% of samples were in violation for D.O. and 40% were in violation of B bacterial standards. Although it looks like there is a trend 2001 may have been an anomalous year. There are not enough years of data to analyze for trend.

West Branch:

WB001.5, WB002, WB003 and WB005 were in violation for D.O. over 40% of the time most years. All of the tributaries also had a high number of D.O. violations except HEBK001. As posited in question 1 this may be due to the low flows observed in this reach. Bacterial violations for the reach were few. Bacterial violations at WB004 seem to be trending upward, but as with S015 there are not enough years of data to determine whether this is statistically significant. MEBK001 has a relatively consistent number of violations per year, most years exceeding 30%. It is near a pasture and is known to be frequented by cattle.

4. Trends:

Dissolved oxygen, temperature and bacteria do not seem to trend upward or downward moving in either direction through the watershed. Problems within each reach seem to be isolated. There is no significant temperature difference between the Lower Mainstem, The Middle Mainstem and the West Branch, and

there is no significant difference in D.O. between the Lower Mainstem, the Middle Mainstem and the Upper Mainstem.
The only sites that seem to show a trend are S015 and WB004 for violations as mentioned before.

Conclusions

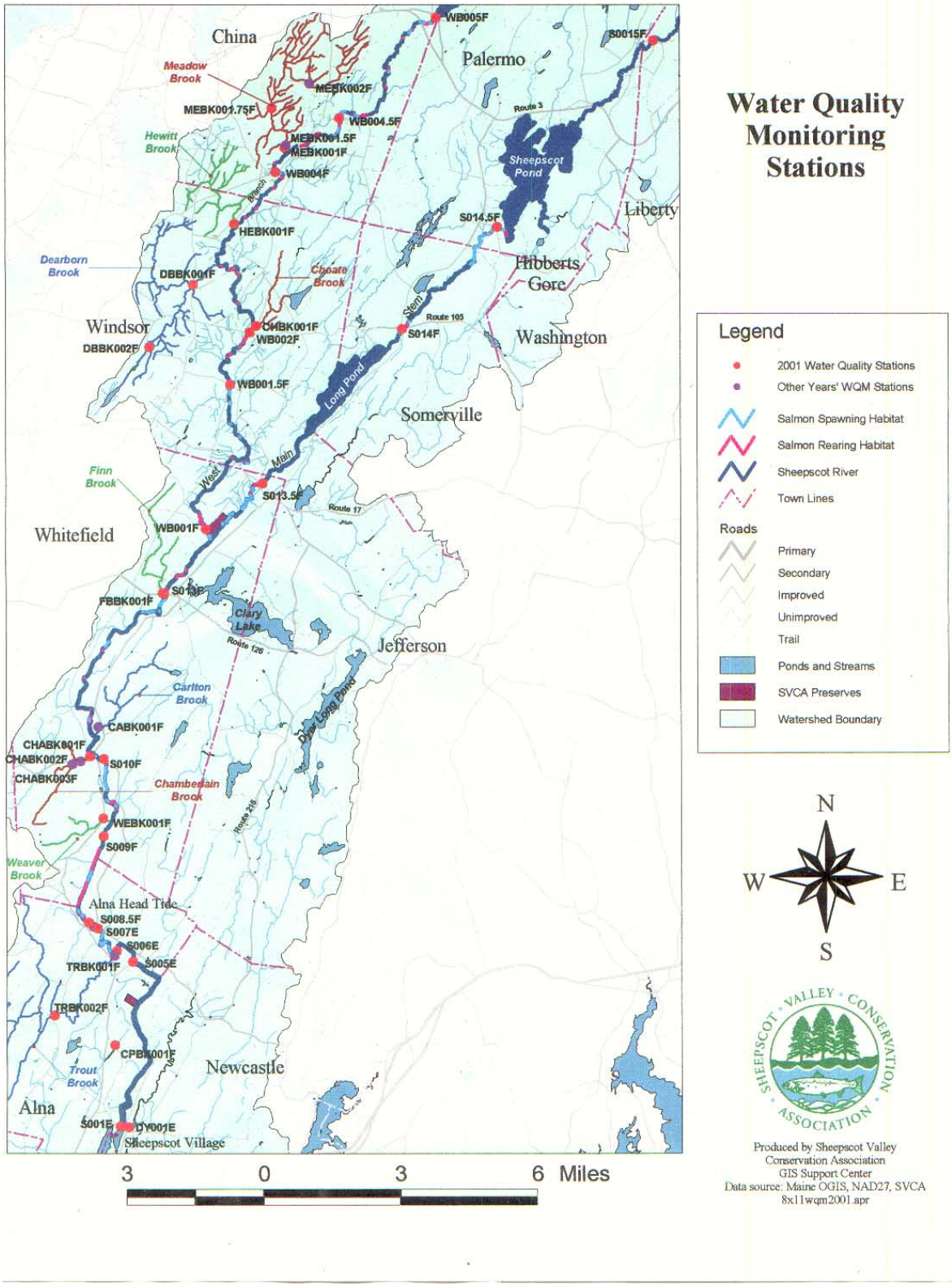
There are five major areas of concern along the Sheepscot. These are:
Puddle Dock to Head Tide- Instantaneous bacteria counts exceed standards most of the time with no clear natural bacterial source.
S010 (below Kings Mills)- Temperature readings exceed 22.5 degrees many times during the sampling season every year. This is a potential salmon spawning area and therefore of concern.
Chamberlain Brook- Dissolved oxygen is often lower than 7.0mg/l. A bacterial source for the relatively high bacterial levels can not be pinpointed.
S015- The number of bacterial and D.O. violations per year seem to be trending upward with low flow being a possible cause.
West Branch- almost the entire stretch has D.O. readings lower than 7.0mg/l many times during the season. This may be caused by low flows throughout the section, although flow rates are unknown. WB004 seems to have increasing numbers of instantaneous bacteria readings that exceed standards with unknown source.

Recommendations

The following are recommendations for the water quality program made by the author and the task force:
Continue monitoring sites and reassess in six years (15 years of data). Perhaps with fifteen years of data trends could be analyzed. With the current number of years of data there is still so much variation from year to year it is hard to determine whether sites have chronic problems except in extreme cases.
Overseers must be diligent to make sure samplers are following QAPP protocol to prevent unusable data generation. Despite the impressive data set for the Sheepscot there are many gaps in data due to sampler error. This has improved with QAPP guidelines.
Continue sampling at present stations except discontinue sampling at CHABK003.
Add a Dyer River site upstream (DY003). Chamberlain Brook often dries up in the middle of the season and therefore provides incomplete sampling data. It is not helping to find the bacterial source for the tributary. CHABK001 should be continued and a survey of the brook should be a priority. The program has sampled the Dyer River near the confluence with the Sheepscot but not in the freshwater section of the river. Considering its potential for Salmon habitat and the load limits that have been placed on it a station on Rte. 194 between N. Dyer Neck Rd. and N. Newcastle Rd. may be helpful unless this is already being done by the state.
Keep an eye on S015 and WB004 to see if trends continue.
Determine cause for high Enterococci at S005, S006, S007; high temperatures at S010; and low D.O. in the West Branch.

.***Change sampling season to May 1st through September 30th.*** This would decrease the number of samplings per site to 11 and correlate with the state's sampling season.
Utilize flow meters at several points along the river. At present there is one gauge station on the Sheepscot. Flow meters may help determine the cause of the West Branch's problems.
Possibly concentrate some extra, temporary sampling sites near problem areas for pinpointing sources.
Including turbidity measurements and pH could be helpful. Turbidity and pH would be helpful to determine causes for some of the problems seen, but the addition of these tests may be more than the organization would like to ask of its volunteers.
Connect land use practices to sites. Land use practices were not researched for this analysis. This would be an important next step to better understand problems as well as determine the utility of each station

Sheepscot Valley Conservation Association



Water Quality Monitoring Stations

Legend

- 2001 Water Quality Stations
- Other Years' WQM Stations
- Salmon Spawning Habitat
- Salmon Rearing Habitat
- Sheepscot River
- Town Lines

Roads

- Primary
- Secondary
- Improved
- Unimproved
- Trail
- Ponds and Streams
- SVCA Preserves
- Watershed Boundary

N W E S

Sheepscot Valley Conservation Association

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