RESTORATION PROJECT
CORNWALL BROOK
- 2006 -

Cornwall Brook

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1. INTRODUCTION

As a dynamic and complex system, streams and rivers serve many purposes. This system does not only encompass the active channel, but also the floodplain and the vegetation along the river banks. When a stream system is at a natural state it maintains a certain balance. Any changes to the system, may it be to the channel, the floodplain, the vegetation or the sediment load will affect the balance of the stream and make it unstable (Doll, B.A. et al., 2003). Such changes are usually but not only linked to a variety of land management activities such as livestock grazing, road construction, agriculture, urbanization, timber harvesting and many more. It is the improper management of these activities that can create the imbalance which is usually seen as changes in stream habitat, water quality, hydrology, riparian vegetation and aquatic biota (Kershner, J.L. et al., 2004).

One way to restore or to help get the watercourse's balance back to its natural state is by undertaking an ecological restoration of the stream or river. The Department of Fisheries and Oceans (2006) describes an ecological restoration as "the process of re-establishing the health and integrity of an ecosystem that has been negatively impacted". Furthermore, they encourage the use of a holistic approach which is to include and treat equally all the species and trophic levels found in the ecosystem in question when doing the restoration.

By doing a preliminary survey in 2005, the Association found that a section of Cornwall Brook had some major problems that were contributing to its degradation. This was also observed during the 2006 water quality monitoring. The major problem encountered was an excess sedimentation load caused by cattle and vehicle access.

As a result of this problem, the Association started a restoration project which proposed the following:

a. Realize a stream habitat survey
b. Clear overabundant alders
c. Selectively clean in-stream debris and garbage
d. Strategically place deflector trees
e. Stabilize deteriorated shoreline
f. Limit or prevent cattle access to watercourse

This document will present the results from **Phase I** of the restoration project which took place during the 2006 field season. This encompassed a Stream Habitat Inventory which was done using the NB Department of Natural Resources and Environment / Department of Fisheries and Oceans' Data Sheet (see Annex 1). The field crew, which consisted of a field technician and a summer student, inventoried 34 reaches of 50m each for a total distance of 1.7 km (see Annex 2) from July 25th to August 11th. During this survey, we took note of physical (water temperature), chemical (dissolved oxygen and conductivity) and morphological (substrate, vegetation and bank characteristics) parameters of the tributary, and identified potential sources of problems.

2. RESULTS

2.1 Physical Parameters

2.1.1 Water Temperature

Water temperature, which can vary over the course of the day and the year, is influenced by numerous factors. The most important being time of day or year, the amount of shade that covers the stream and the depth of water. There are no set criteria for water quality, but the literature seems to say that water above 25 or 29 degrees Celsius (^{o}C) tends to be of poor quality. Also, water temperature is the most important and most influential water quality characteristics to life in water. Water temperature also directly influences the dissolved oxygen levels.

The water temperatures for all reaches (Figure 1) went from 15.80 ^{o}C to 22.26 ^{o}C with an overall average of 18.33 ^{o}C.

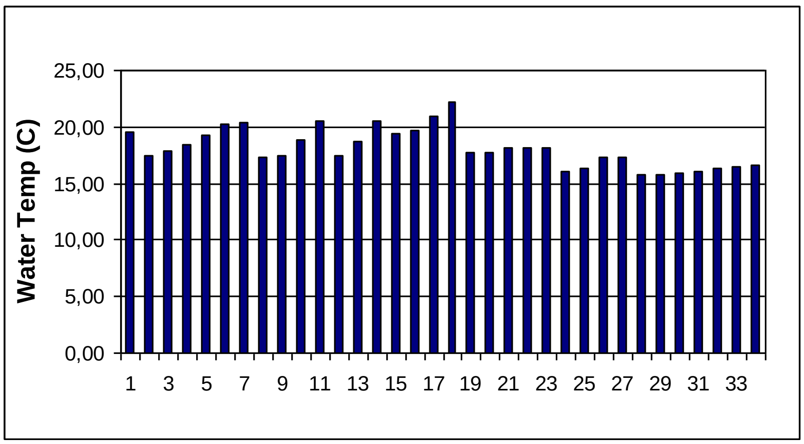

Figure 1: Average water temperatures for each reach

2.2 Chemical Parameters

2.2.1 Dissolved Oxygen

Dissolved oxygen (DO) represents the oxygen present in the water. It makes its way in the water either from the atmosphere by diffusion or by the photosynthesis of aquatic plants and algae. It is taken out by the organisms when they metabolize or breathe. The minimal amount of dissolved oxygen that we would like to see for a good quality of water is around 5 to 6 mg/L.

The DO levels (Figure 2) went from 5.75 mg/L to 7.18 mg/L with an overall average of 6.37 mg/L. There were 7 reaches that fell below 6 mg/L but none fell below 5 mg/L.

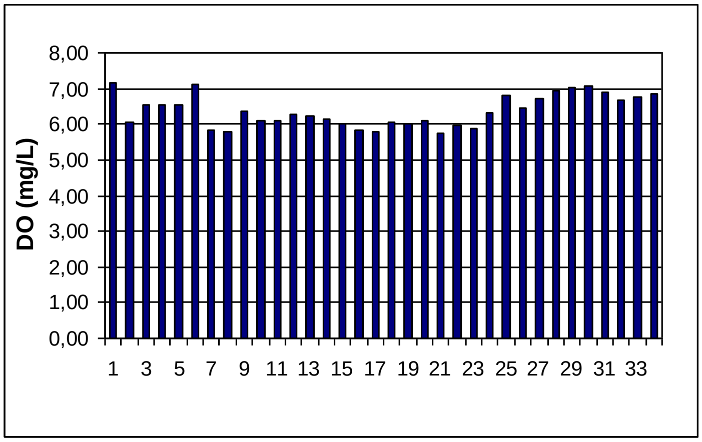

Figure 2: DO levels for each reach

2.2.2 Conductivity

Conductivity is the measurement of the ability of water to pass an electrical current. It is affected by the amount of inorganic dissolved solids (nitrate, chloride, sulfate, sodium, etc.) found in the water. The conductivity level may be influenced by rainwater, agricultural or urban runoff and the geology of the area. There are no criteria for conductivity levels for water quality, but the US Environmental Protection Agency states that streams that possess a range between 150 and 500 uS/cm usually seem to support a good mixed fisheries. Consequently, a higher conductivity level may indicate a higher amount of dissolved material in the water and the presence of contaminants.

The conductivity levels (Figure 3) went from 236.57 uS/cm to 450.60 uS/cm with an overall average of 358.41 uS/cm.

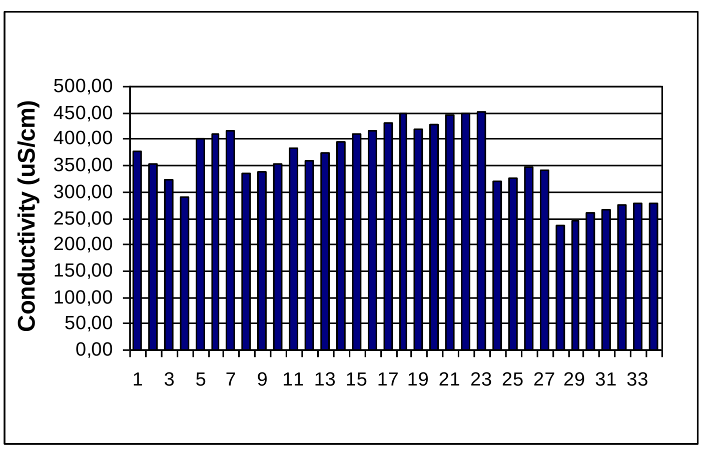

Figure 3: Conductivity levels for each reach

2.3 Morphological Parameters

2.3.1 Stream Depth and Width

The average wetted width was 3.65 metres and the average bank width was 4.86 metres. The average wetted depth was 0.318 metres and the average bank depth was 0.682 metres. No dry areas where noted during the inventory.

2.3.2 Substrate

The substrate is the materials making up the bed of a watercourse. In order for organisms to find places to hide from predators, forage for food, reproduce and rest, the stream needs to have some in stream debris and a good assortment of substrate on its bottom. A healthy stream usually has a mixture of substrate materials including fine, sand, gravel, cobble, boulder and bedrock. A sign of excess sedimentation is usually seen when the bottom of the stream is covered by an excess of fines and sand. When this happens, fish have no place to lay their eggs, invertebrates have no place to hang on to and the overall health of the section is questioned.

Overall (Table 1), sand and fines represented over 80% of the substrate found in the entire section.

Table 1: Average Substrate for all the reaches

Substrate Type	Overall Average (%)
Bedrock	0,21
Boulder	1,07
Rock	4,38
Rubble	4,3
Gravel	6,78
Sand	40,62
Fines	40,52

2.3.3 Vegetation

By providing wildlife with food, burrow sites, nursery areas, flyways and travel corridors, perching and sunning sites and protection from weather and predators, shorelines are one of the most biologically diverse natural communities. Consequently, it is very important to maintain their natural state to reduce our impact on wildlife habitat and on our watercourses. Furthermore, by maintaining a natural shoreline, the vegetation will help protect the water quality by slowing down runoff, retaining contaminants before they enter the water and by increasing infiltration.

Overall (Table 2), the stream section was mostly covered by trees with 53.13% and grass with 42.81%. Only 0.63% of the bank, on average, was bare soil.

Table 2: Average stream bank vegetation

Vegetation Type	Percentage of cover (%)
Trees	53,13
Shrubs	3,44
Grass	42,81
Bare soil	0,63

2.3.4 Stream and Bank Characteristics

The alternating presence of slow water (pools) and fast water (riffles, runs, etc.) is very important in a river system. For instance pools are ideal areas for fish to lay there eggs and for aquatic life to rest, and riffles are important in the oxygenation of the river and the transportation of food. It's the balance between both that make up a healthy stream. The pools represented 19.71% of the section or 335 meters and the riffles and runs represented 80.29% or the section or 1365 meters (Table 3). This represents a ratio of 1:4 approximately.

Table 3: Stream type representation

Stream Type	Percentage (%)
Pool	19,71
Riffle/Run	80,29

As much as undercut banks can contribute to eroding banks, they have a very important role in the stream ecosystem. For example, undercut banks serve as a hiding place for salmonides where they can feed and rest without having to worry about predators. Furthermore, most of the undercut banks recorded in the inventory where caused naturally by the river's movements. We noted (Table 4) that 30.90% of the section had the presence of undercut banks. As for overhanging vegetation, we noted that 49.75% of the section had overhanging vegetation on its bank. Most of this vegetation was tall grasses and shrubs.

Table 4: Overall average of bank characteristics

Bank Characteristic	Overall Average (%)
Undercut Bank	30,90
Overhanging Vegetation	49,75

Bank stability, which is a very important factor in sedimentation loading, was very good all along the section with the left bank and right bank stable at 97.81% and 98.44% respectively (Table 5). The eroded parts of the left and right bank where noted where the cattle and motor vehicle had access to the river. These sections represented 2.19% on the left bank and 1.56% on the right bank.

Table 5: Overall average of bank stability

State of Bank	Left Bank	Right Bank
Stable	97,81	98,44
Bare Stable	0,00	0,00
Eroded	2,19	1,56

Finally, the overall flow average for the entire area was 32.09 cm/sec. It went from 2.93 cm/sec to 72.52 cm/sec. Also, it is important to note that only 17 out of the 34 reaches had no obstruction or had moving water (we placed a 4 minutes cutting point in order to finish the inventory in time) where we were able to measure the flow. The major reason we could not measure the flow was that most of the sites had to much wood debris that were completely blocking off the stream or making it to difficult to properly execute the methodology.

2.4 Potential Problems

The major problems that we encountered were bank erosion caused by cattle access (see figure 4) resulting in important siltation problems downstream, overabundant alders along the banks, in-stream debris (see figure 5) and excessive amount of algae in some areas (see figure 6).

Figure 4: Cattle access

Figure 5: Wood debris

Figure 6: Excessive algae bloom

3. DISCUSION

During a 2005 preliminary survey and the 2006 water quality monitoring, the SBWA noticed that a tributary to Scoudouc River, Cornwall Brook, was degrading and needed some work. The major problems contributing to its degradation were sedimentation loading, caused by cattle and motor vehicle access mostly, bank erosion and debris accumulation. In order to best address these issues, the SBWA decided to develop a restoration project. Phase 1 of the project consisted in a stream habitat inventory. During this period we noted physical, chemical and morphological parameters on a 1.7 km stretch consisting of 34 50 meters reaches.

The water temperatures for all the reaches went from 15.80 ^{o}C to 22.26 ^{o}C with an overall average of 18.33 ^{o}C. The DO levels went from 5.75 mg/L to 7.18 mg/L with an overall average of 6.37 mg/L. There were 7 reaches that fell below 6 mg/L but none fell below 5 mg/L. Consequently, a low DO level for the tributary is of concern since this can and will have a direct influence on aquatic life. The conductivity levels went from 236.57 uS/cm to 450.60 uS/cm with an overall average of 358.41 uS/cm. This is not an extreme or high value, but when we take a look at the levels for the watershed in general, it is the highest levels in the monitored area. This indicates to us that there might be a problem in the amount of inorganic dissolved solids that is entering the stream and should be investigated in order to figure out the reason for this high value. For now, we believe that sedimentation loading and agricultural runoff are the cause of the problem. This is why the SBWA will be doing phase two of the project in order to fix or try to minimize the problem.

The stream depth and width levels where normal with no dry areas limiting access to fishes to areas up or downstream. By looking at the overall numbers for the substrate we can clearly see that we have a problem. Over 80% of the stream bottom is covered by sand and fines. This is way too high and is something we need to address. Once again, this is probably caused by cattle access and debris which results in eroding banks and sedimentation loading. Furthermore, the debris in the steams tends to slow down the flow and make the finer particles sick to the bottom.

It is important to note that the even if the number for overhanging vegetation seems to be low, we have to remember that more than 50% of the section was covered by trees where no vegetation was growing under the canapé. Furthermore, even if the eroded percentage is small, being under 3 % for both banks, the impact it has on the river system is very noticeable. We can clearly see this with the high value of finer substrates and the higher conductivity compared to the rest of the monitored areas.

As for the potential problems and pollution sources, the major concerns that we noted were sedimentation loading caused by cattle access to the stream, over abundant alders, algae blooms and excessive in-stream debris. Consequently, these issues will be addressed in Phase II of the restoration project in the following years.

4. CONCLUSION

In conclusion, the purpose of the Restoration Project is to restore a section of Cornwall Brook to its natural state and to improve its fish habitat. Phase 1 of the project, which consisted in doing a stream habitat inventory, was carried out from July 25th to August 11th and was done along a 1.7 km stretch consisting of 34 50 meters reaches. Furthermore, Phase 1 of the project will help the SBWA plan and organize Phase 2 of the project and will give the association a better knowledge of the stream's health.

Phase 2 of the restoration project, which we hope will start during the 2007 field season, will have many aspects and will be more hands on. First off, we will be doing a clearing of overabundant alders and in-stream debris in order for the stream to naturally flush out sediments and give us a better look at its actual state. There after we will be strategically placing deflector tree to address the siltation problem and restore the pool/riffle pattern. We would also like to limit or prevent the cattle to access the stream by fencing off a section of the stream. Finally, we would also like to create a tractor crossing in order to minimize its impact of the stream bottom and on the banks.

Lastly, this project is very important in the wellbeing of Cornwall Brook, but also the Scoudouc River and the Shediac Watershed. By minimizing or eliminating sedimentation loading in the stream and bringing the stream to its natural state, we will improve the water quality, the fish habitat and the overall health of the stream.

5. BIBLIOGRAPHY

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