Water Quality of Stoney Creek and its Effects on Salmon Spawning

Tony Oak, Michelle Thai, Indra Orgil, Kevin Ngo, Jerry Lu

Abstract

Runoff water in urban streams possesses a major threat in salmon spawning. This has been the effect on Burnaby BC's, Stoney Creek. Sample water was retrieved at four sites, with two along Stoney Creek (sites 1 and 4) and two tributaries further upstream (sites 2 and 3). To begin our research we had formulated the hypothesis that tributaries would have lower dissolved oxygen content due to no remediation efforts being applied and downstream sample sites would have higher levels of pollutants due to road runoff accumulation. Multiple means in determining water quality of Stoney Creek were employed; in-stream water quality tests for dissolved oxygen (DO), pH, and temperature were determined using a DO, and pocket pH meter. Water samples were also obtained from each site and were further analyzed for phosphorous, ammonium and chemical oxygen demand levels (COD) using the *Hach DR5000* spectrophotometer. Our last means of water quality testing was through the *Water Quality TestKit* on samples brought from site 1 and 3. In-stream testing resulted in pH levels ranging between 6.4 and 6.7, dissolved oxygen contents of 10.60mg/L and greater, and temperatures of 9.2°C and below. Accordingly, levels in pH, DO and temperature measured are all suitable for salmon spawning. Samples further tested in the lab showed higher ammonium, and phosphate levels that can effect spawning negatively. Lastly the Water Quality TestKit did not demonstrate very good accuracy, and was ruled to be unreliable. Our results indicate that Stoney Creek's conditions are favorable for salmon spawning, and that there is a strong correlation between temperature, pH and dissolved oxygen.

Introduction

The routine activity of the growing population within urban areas is ruthless towards surrounding environmental conditions. Lougheed Highway and Gaglardi Way are two streets that enclose Stoney Creek and also contain a high density of road traffic. The Creek carries the downfall of precipitation and snow melt from Burnaby Mountain down towards Lougheed Highway. It continues to flow with its terminus draining into the Brunette River. (*James, 2013*) This makes Stoney Creek susceptible to the high amounts of pollution from pavement runoff. The water quality analysis implemented is to address how urban activity surrounding Stoney Creek is affecting salmon spawning conditions within the creek. In order to address the broad range of anthropogenic activity that could possibly interfere with salmon spawning conditions, the scope of the project is narrowed down.

The study focuses on the run off from Lougheed Highway, those brought in by the tributaries as well as sources above tributaries. The progress of the Stoney Creek Ecological restoration project is also measured within our study. The Stoney Creek Environment Committee works toward improving water quality within the creek to refine Salmon spawning conditions. They have reported that spawners at Stoney Creek include: Chum, Coho, Jack and Rainbow salmon. Data regarding stream contaminants from previous years, provided by the committee was focused on metal ions. Our results will be in conjunction with this data. It will provide insight on pH, dissolved oxygen levels, and temperature of the stream water. Sediment and water runoff coming from urban activity has proven to be toxic to these Salmon species. Contaminants from residential, industrial, and commercial activities are dissolved and washed into streams as a part of

urban runoff. (*Sandahl et al*. 2007) Pavement Runoff confined to streams brings with it an accumulation of different contaminants, threatening salmon spawning within streams, near urban areas. Our purpose is to attempt to link the level of contaminants, to the possible areas within the stream that could be the primary source of pollutants. Our hypothesis states that the samples obtained further downstream will contain a higher amount of pollutants, due to the combined pollutants coming from the tributaries as well as the greater proximity to run-off from Lougheed highway.

Methods

Four locations along Stoney Creek were chosen to extract water samples from, in order to test for the water quality. The first location (fig.4), was a portion of the creek underneath Lougheed highway (1 on map), this was to test to see how the run-off from a busy street would affect the quality of stream water right beneath it. The second location (fig.5) is the spot where the first major tributary (2 on map) begins to flow into Stoney Creek. The third sampling site (fig.6) was a tributary (3 the map) chosen further upstream. These tributaries were chosen in order to assess the type of runoff that is flowing in from different sections of the mountain. The last spot chosen (4 on map), was furthest upstream (fig.7), and was tested in order to see how the water quality differs from areas below the tributaries. It is also noted that, prior to collecting our sample, it had rained the previous three days, increasing water levels and possibly diluting the samples obtained.

Salmon eggs require a higher level of oxygen in order to hatch. Areas within the stream that contain ripples are designated for salmon spawning. (*Mull et Al. 2007)* To

verify whether or not the dissolved oxygen level satisfied salmon spawning conditions, within each sample location areas with ripples were chosen to test for dissolved oxygen content. This was done using a Cyberscan DO 300 dissolved oxygen meter. The pH of the water was also tested on site using a pocket pH meter. Temperature of the water at each location was also tested. One set of water samples were collected from each location and brought back to the lab to be further tested for levels of Ammonium, Phosphate and Chemical Oxygen Demand (COD). The samples were inserted into a Hach DR5000 a spectrophotometer. In addition, a water quality test kit was also used on the same set of water samples. The test kit only contained two sets of strips which we chose to test on sites one and three in order to analyze the greatest variation between the locations furthest up and down stream. The methods chosen allowed for analysis to be conducted in order to pinpoint the primary source of contaminants.

Results

At each of the four sample locations, in-stream tests for Dissolved oxygen percentage (DO), PH, and temperature (Table. 1). Site 1 represents the sample location in Stoney Creek beneath Lougheed Highway, site 2 represents the sample location of the first major tributary into Stoney Creek above Lougheed Highway, site 3 is the tributary further upstream and site 4 is Stoney Creek above both tributaries. Results of each sample site were consistent with each other with the exception of sample site 3, which showed a lower DO percentage and PH, and a higher temperature.

In-Stream Samples

Sample Site		DOppm	PH	Temp
1.00	1	12.30	6.70	6.50
2.00	1	11.94	6.60	6.40
3.00	1	10.60	6.40	9.20
4.00	1	11.64	6.60	6.70
Total	N	4	4	4

Table 1

At each site a water sample was collected and brought back to the lab. Using the *Hach DR5000*, levels of Ammonium, Phosphate and Chemical Oxygen Demand (COD) were analyzed in mg/L (Table.2). Ammonium levels were seen to be the same in each sample, as well as phosphate levels being very similar. COD levels varied from the upper Stoney Creek sample spot to the lower Stoney creek sample spot.

HachDR5000 Testing

Sample Site		COD mg/L	Ammonium mg/L	Phosphate mg/L
1.	1	6.63	0.84	1.70
2.	1	12.00	0.84	1.67
3.	1	7.90	0.84	1.74
4.	1	12.10	0.84	1.67
Total	N	4	4	4

Table.2

Site 1 and 3 were further analyzed with a *water quality test kit* to look for significant differences between a Stoney Creek sample and a tributary sample (Table.3). No variation was found using this sample method.

Water Quality Test Kit

Sample Site		Nitrate	Nitrite	Copper	Iron	Hardness	Alkalinity	PHstrip	Chlorine
1.00	1	2.00	.00	.00	.00	50.00	12.00	6.50	.20
3.00	1	2.00	.00	.00	.00	50.00	12.00	6.50	.20
Total	N	2	2	2	2	2	2	2	2

Table.3

Discussion

It is well known that water chemistry plays a significant role in the health of stream biota, particularly Salmon. Upon analyzing our results, It was determined that the overall health of Stoney Creek is relatively suitable for salmon spawning. All sample sites had a PH of 6.4 and above, which is in the optimal range of 6-9 and still distant from 5.8, at which salmon mortality becomes significant (Kroglund, 2008). All sample locations produced a dissolved oxygen content of 10.60mg/L or greater, which falls well within the suitable range for salmon spawning of greater than 7 mg/L (Scholz, 2011). Phosphate levels averaged roughly 1.7mg/L, which is considered to be higher than what is expected in a fresh water stream (Purdue, 2000). High levels of phosphorus can contribute to algal blooms, which would lead to a decline in DO, but it is highly unlikely to be seen in a running stream (Purdue, 2000). Stoney creek is an urban stream, which makes it a likely source of fertilizer and sewage runoff. The high levels of phosphorus and ammonium observed are a possible indicator of this. The levels of ammonium found in the water were 0.84mg/L, which is not considered to be lethal to salmon, but may affect their ability to spawn (Fig. 1). A study done by B.J Wicks showed that Salmons

ability to swim is greatly reduced in water with an ammonium level greater than 0.08mg/L, meaning it may be difficult for salmon to swim up Stoney creek to spawn. Also when looking at the results, it is noticeable that sample site 3, the upper tributary, produced results that stood out compared to the others. We found it to have a significantly higher temperature, lower PH and lower DO (Fig.2/3). Although we were unable to determine a reasoning for these numbers, it provides a good demonstration of the correlation between, higher temperature and lower DO and PH(WPPDG, 2000) (Table.4).

Conclusion

Stoney Creek was very recently restored to levels suitable for spawning of Chum, Coho, Jack and Rainbow salmon. Unfortunately it is situated in a high traffic urban area directly underneath Gaglardi Way and Lougheed Highway. Naturally, being also at the bottom of Burnaby Mountain, Stoney Creek is prone to toxic road runoffs. Due to limited time and resources, variables including temperature, ammonium, dissolved oxygen, COD, pH, and phosphate were tested in four locations. Two were taken along the stream and two further up in tributaries. Ammonium and phosphate levels were slightly high, affecting the ability for salmon to swim upstream. However, they were similar among all four sites and still below lethal levels. DO, temperature, and pH also showed similar readings with the exceptions of site 3, where pH and DO were lower and temperature was slightly higher. The most notable differences were in levels of COD among sites. Upon review of our results it can be stated that our hypothesis of downstream sample locations having higher concentrations of pollutants can be rejected. Our findings indicate that all

sample locations produced relatively similar results. However, it is important to note that these tests were performed on only one set of samples. Undoubtedly, levels of tested variables can quickly change on any given day. However, from these sample tests, we believe that Stoney Creek shows negligible signs of direct damage from the surrounding urban activity. Furthermore, levels are within safe salmon spawning thresholds.

References

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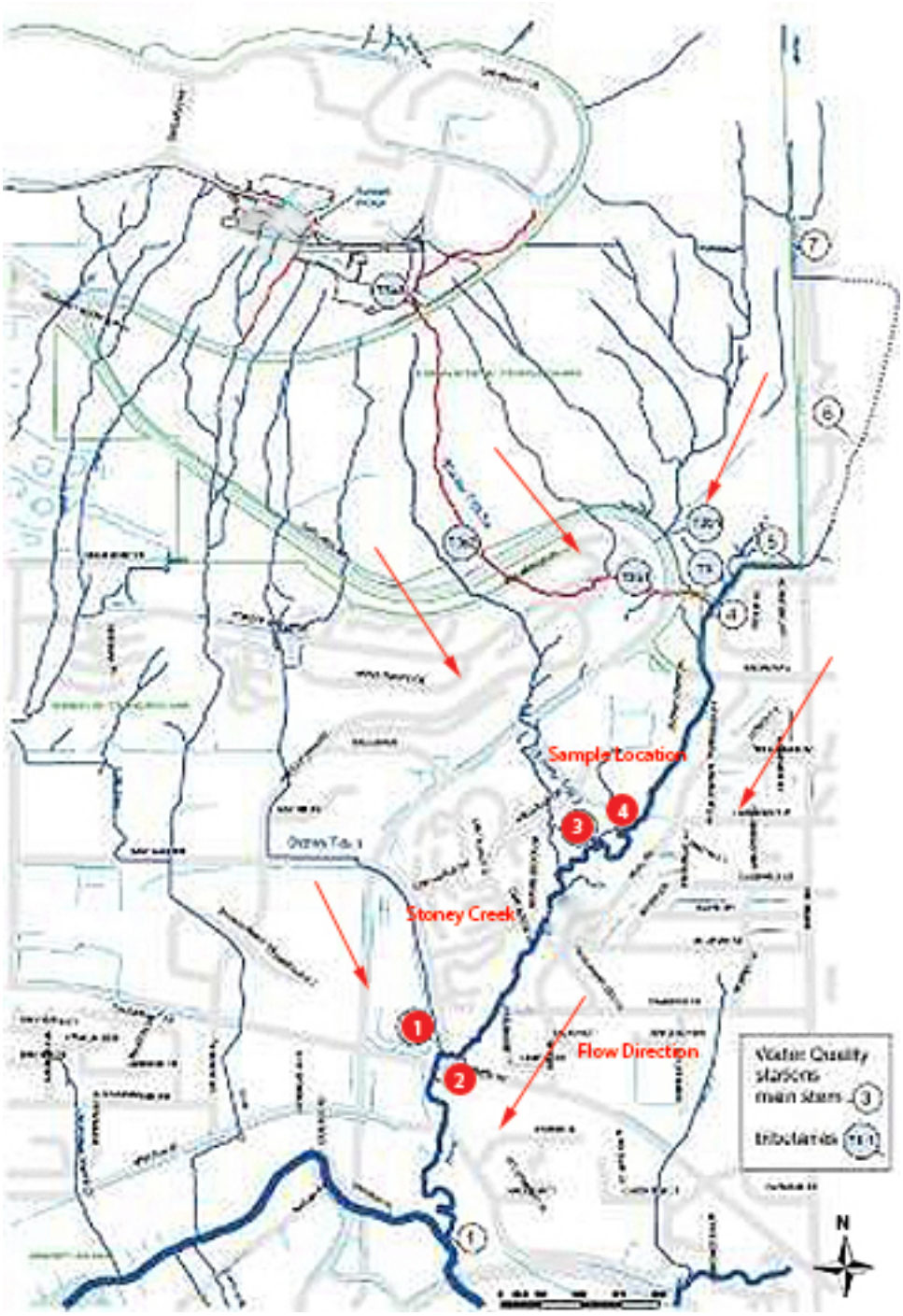
Figures



Map with site locations

Correlations				
	DO	PH	Temp	Phosphate
DO	1	.990*	-.872	-.591
PH	.990*	1	-.930	-.679
Temp	-.872	-.930	1	.893
COD	-.064	.046	-.398	-.765
Phosphate	-.591	-.679	.893	1

Table. 4

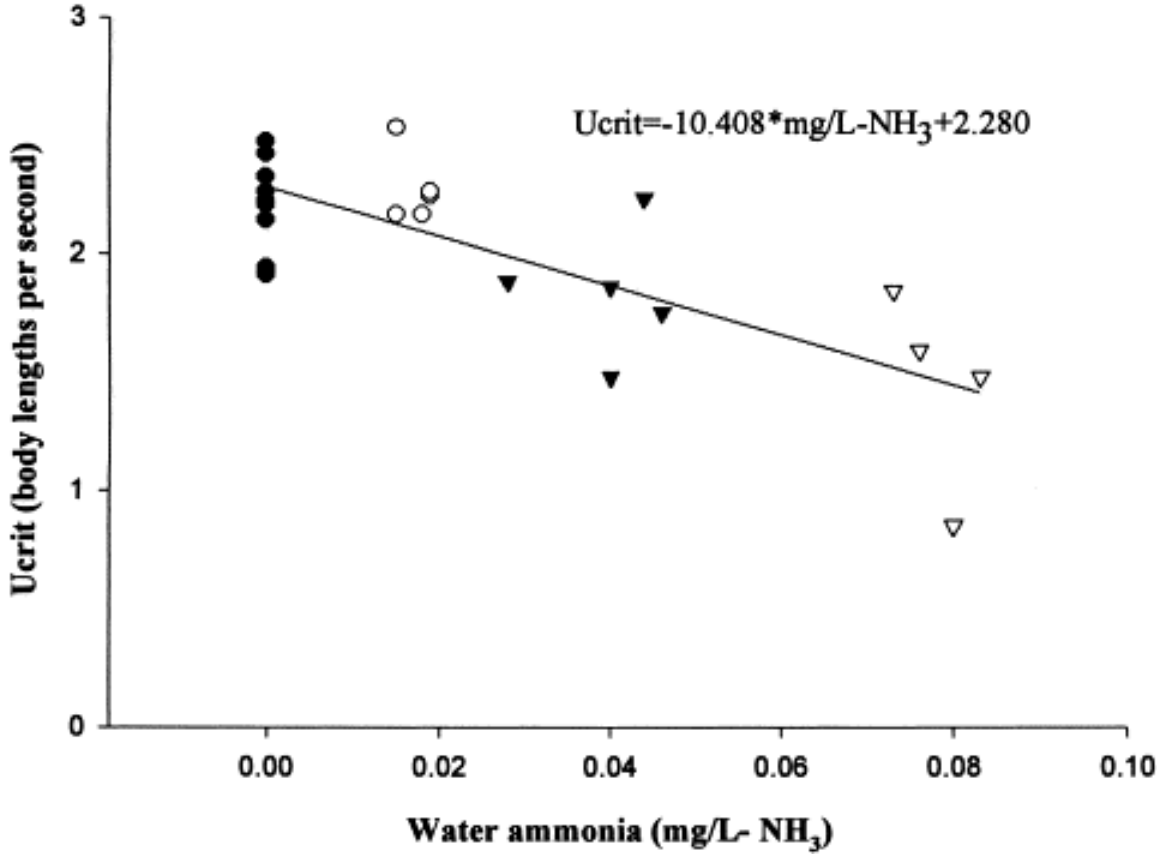


Fig.1

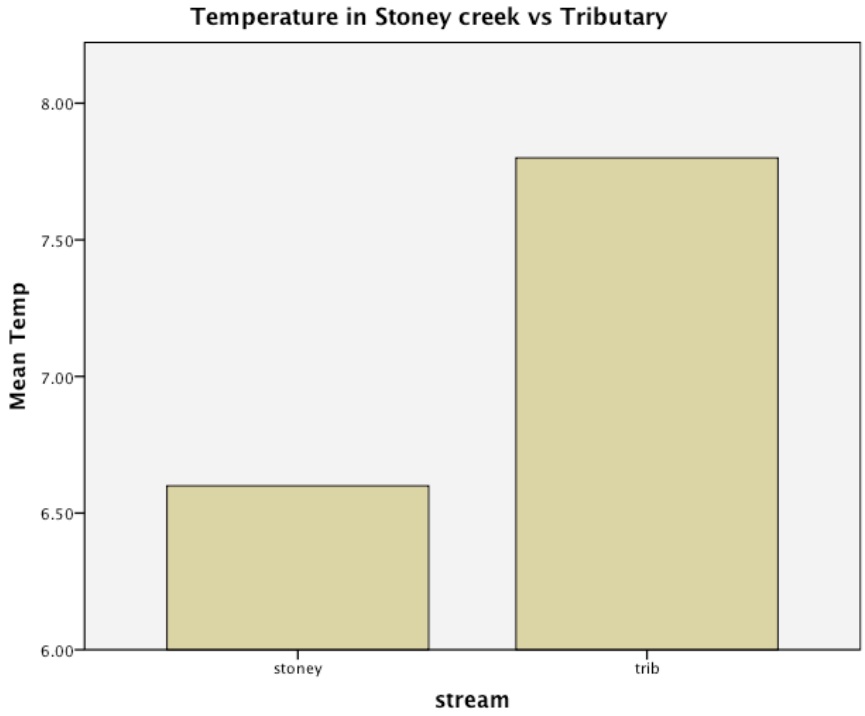

Temperature in Stoney creek vs Tributary
Mean Temp
8.00
7.50
7.00
6.50
6.00
stoney
trib
stream

Fig. 2

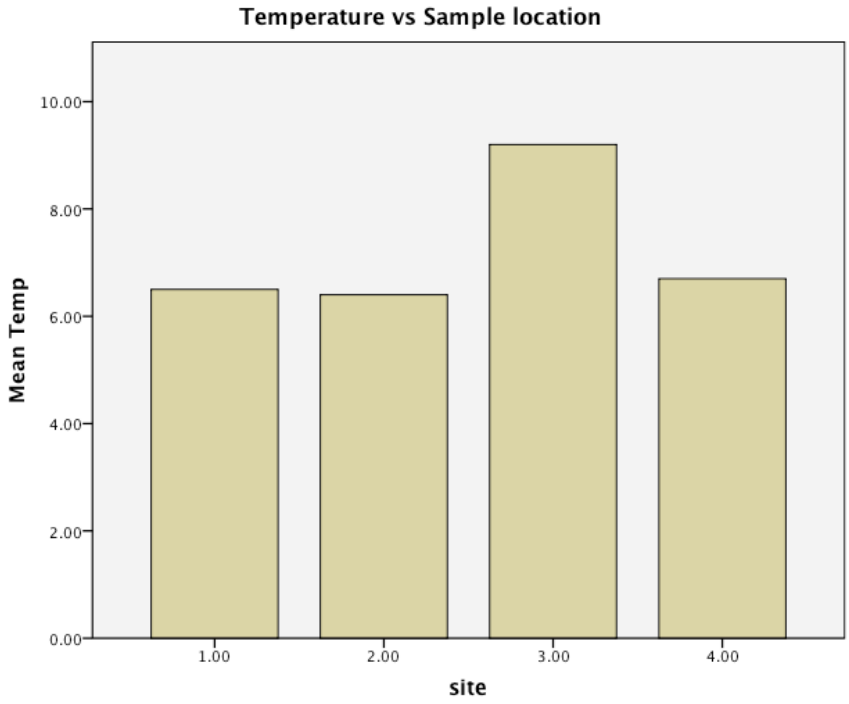

Temperature vs Sample location
Mean Temp
10.00
8.00
6.00
4.00
2.00
0.00
1.00
2.00
3.00
4.00
site

Fig.3

Fig.4 site 1

Fig.5 site 2

Fig.6 site 3

Fig.7 site 4