Water quality monitoring methods for Noons Creek salmon hatchery

Kiera Hadden

Douglas College, Environmental Science EAES 2537

Introduction

The Noons Creek Hatchery is a volunteer-run salmon hatchery operated by the Port Moody Ecological Society (PMES). Noons Creek is a salmon habitat located in the city of Port Moody and due to its proximity to urban areas, it is subject to human disturbances. Hatchery volunteers have conducted weekly water quality monitoring for many years by collecting field and lab data from Noons Creek and other nearby waterways to ensure they provide healthy salmon habitat. However, the water testing procedures used by the PMES have gone for a significant amount of time without any review or updates. Recently, the Noons Creek Hatchery joined Pacific DataStream, a database where all the water quality data produced in the lab will be publicly available. This made it necessary to question the reliability of the data produced in the Noons Creek lab.

The objective of this research project was to test some of the field and lab procedures used by PMES volunteers that could lead to data that are not representative of the actual creek conditions, and to identify any significant issues that would require the procedures to be changed. Currently, only one sample is collected from near the bank of the creek, and it is tested once. For my research, I tested two hypotheses about potential sources of variation in the collected data:

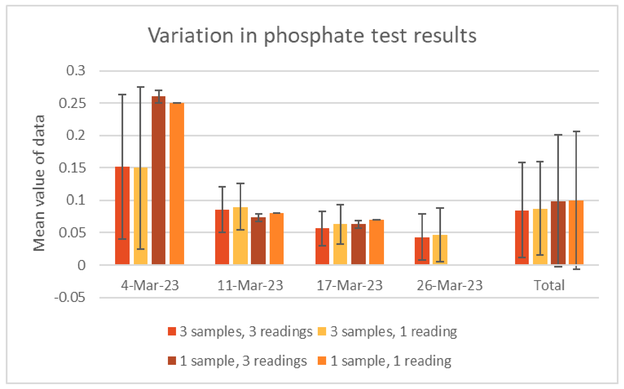
- Due to water flow velocity and depth, different sections of the creek will have different levels of dissolved oxygen, nutrient concentrations, and temperature.
- Collecting and testing one sample from the creek does not produce data that are representative of the conditions in the whole creek, and testing three samples will show this variation.

Figure 1. The portion of Noons Creek located near the hatchery where the water was collected from. This is the area of the creek where young salmon are released, and adult spawners return to. The three sites vary in water flow velocity and depth, so I questioned if this was enough to produce variation in the data.

Methods

The sample sites were all in close proximity to each other and within the same portion of the creek that the PMES lab normally tests. This location is easily accessible and near the lab. The first site was near the bank of the creek, the second was midway across, and the third was in the centre of the riffles where the water flows the fastest (shown in figure 1). Each of the three samples were collected in a 500 mL bottle which was rinsed well with creek water beforehand to avoid contamination. At the time of collection, the temperature and dissolved oxygen levels were also recorded at each site using an OxyGuard Handy Polaris probe.
The samples were then brought to the lab, where a portion of the water from each sample was tested using a Hanna Bench Photometer for Nitrate, Ammonia, and Phosphate concentrations. Three readings were done on each test for the three samples. This was so that I could compare the data from doing multiple readings on three different samples to the standard PMES lab practice of doing one reading of one sample taken near the bank. I collected samples from the same sites and tested them using these methods once a week over a period of four weeks.

Results



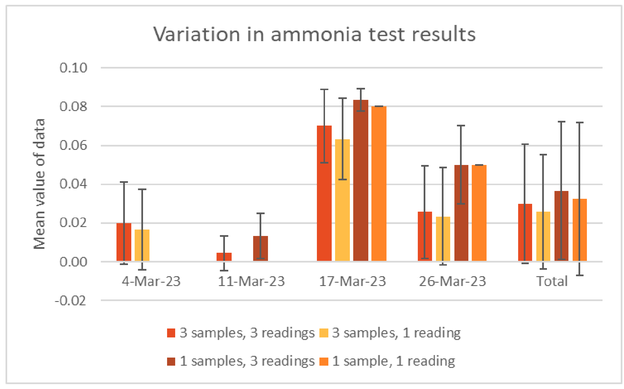


Figure 2. Displayed on these graphs is the mean value for each group of data from every testing day, as well as the total for all the days. The error bars are one standard deviation. For the total mean group, the similarities in error bars show that there is similar variability no matter what combination of samples and readings were used. A nitrate graph was not included because nitrate concentration was often zero and therefore could not be displayed in this form.

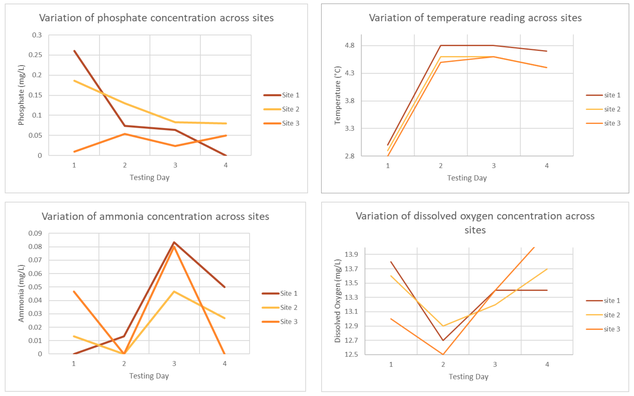


Figure 3. These graphs compare the values of two nutrient concentrations as well as temperature and dissolved oxygen readings taken from the three different collection sites on the four testing days. There does not appear to be any correlation of readings from the sites that is consistent across the testing days. For example, site 1 does not always have the highest phosphate concentration.

Chi-square tests

Chi-square tests were done on the data to determine if there is any significant variation between testing treatment groups. The observed variance seen in each group across the four testing days was compared to the expected variance, which is the variation that resulted from taking one reading of one sample.

$$Chi-square\ statistic = \frac{(n-1) \times observed\ variance}{expected\ variance}$$

Phosphate chi-square values

Group	Chi-square critical value (at p=0.05)	Calculated chi-square statistic
3 samples, 3 readings	49.766	16.712
3 samples, 1 reading	19.675	5.115
1 sample, 1 reading	19.675	10.055

Ammonia chi-square values

3 samples, 3 readings	49.766	21.176
3 samples, 1 reading	19.675	6.091
1 sample, 1 reading	19.675	8.898

Nitrate chi-square values

3 samples, 3 readings	49.766	19.532
3 samples, 1 reading	19.675	7.370
1 sample, 1 reading	19.675	7.867

Discussion

Neither of my hypotheses were supported by the results of the experiments.

- As can be seen in the graphs in figure 3, there is no correlation between nutrients, dissolved oxygen, and temperature to different portions of the creek. Contrary to the hypothesis, it is not necessarily any less representative of the conditions in the whole creek if samples are taken from any one portion of the creek. This means that there is not enough variation in conditions across sites that it matters where readings and samples are collected.
- The figure 2 graphs show how there is no significant variation between taking multiple readings of three samples, and one reading of one sample. This indicates that the accuracy of the data cannot be improved by collecting and testing multiple samples.
- For every group, the calculated chi-square statistic was below the critical value. These tests show that none of the observed variance in the data was significantly different than the expected variance at p=0.05, which confirms that there is no significant variation between taking multiple readings of multiple samples, or one reading of one sample

Conclusion

The results of my experiment show that changing the Noons Creek lab procedures to taking three samples weekly would not improve the accuracy of the data. This is ideal because it means that the PMES can save time and money, and still be confident in the data collected and uploaded to the database. The results also show that it is acceptable to collect water from the bank without compromising how well the data represents the whole creek.
I would like to continue this research by collecting more water quality data on the variation between readings from different sites in the creek. Long term data may show that there is a correlation that was not detectable over my short testing period. Further research and data analysis on the water quality of Noons Creek would help the PMES gain a better understanding of the conditions within the creek and a better ability to detect issues that could harm the salmon population.

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