**Methods**

**Study Sites**

The sites I sampled in this study were on first and second order headwater streams in the Swauk, Teanaway and Taneum drainage basins found in Kittitas County, WA. These sites are on the east slope of the Cascade Mountains and display a hydrograph mainly driven by snowmelt. The 5 sites in Swauk were on Blue, Hovey, Hurley, Iron and Swauk creeks. The 2 sites in Taneum were on First and Frost creeks and the 3 sites in Teanaway were on Jack, Miller and Standup creeks.

At each site I collected GPS coordinates (MotionX-GPS version 24.1, Fullpower Technologies on Apple iPhone 5), elevation (Google Earth), stream aspect (Lensatic compass, Engineer) stream slope (Suunto PM-5 Clinometer), bank full width and I conducted a Wolman Pebble Count (Wolman, 1954) with 50 pebbles sampled per stream

I sampled these sites during 3 periods. The first sampling period was in the summer of 2017 from July 19 to August 15, the second sampling period was in the fall of 2017 from November 5 to November 16 and the third and final sampling was in the summer of 2018 from Jun 26 to July 15. At each site and for each of these sampling periods I measured riparian overstory density (canopy openness) with a densitometer (Spherical Crown Densiometer, Convex Model A, Forestry Suppliers), and stream discharge with a portable flow meter (Flo-Mate 2000, Marsh-McBirney) according to Rantz (1982).

**Stream Metabolism**

At each site and for each sampling period I deployed a dissolved oxygen (DO) probe (miniDOT Submersible Water Logger, Precision Measurement Engineering) in the stream to measure DO in mg/L and temperature along with a photosynthetically active radiation (PAR) meter (Odyssey Photosynthetic Active Radiation Logger, Dataflow Systems) on the stream bank within 2 meters of the DO probe to measure light as PAR in µmol photons/m2/s. These two instruments were synchronized to collect data every 5 minutes for ~36 hours per stream producing diel oxygen and light curves. After the 36 hours had elapsed I moved the loggers to a different site until all sites had been sampled.

I used the diel curves for DO and PAR to estimate stream metabolism by the single station open-channel method with inverse modeling (Lamberti & Hauer, 2017). This was done with the statistical program R (R Core Team, 2013) and a supplemental R script from Lamberti & Hauer (2017). Additional data needed to complete the calculation included depth, barometric pressure and the rate of gas exchange between the air and water. I estimated the rate of gas exchange from an equation I derived from data in Hall Jr. & Madinger (2018) which includes gas exchange constants and corresponding stream slopes in headwater streams:

N=8, R2=0.68, P=0.01

Where *K600* is the gas exchange rate constant in units of 1/d and *slope* is the stream slope in m/m or %.

**Stream Nutrients**

I collected stream water in acid washed HDPE bottles in triplicate using 1µm glass fiber syringe filters (Type A/E Glass Fiber Filter, Pall Corporation). I acidified one of these samples intended for dissolved organic carbon (DOC) analysis with 100µL of 0.5N HCl. These samples were transported in a cooler out of the field and sroted in a freezer where they were kept frozen until analysis.

I analyzed the samples for dissolved inorganic nitrogen (DIN) and phosphate with an AQ1 (AQ1 Discrete Analyzer, Seal Analytical). I completed these analyses using 3 separate methods and sets of reagents, one which gives a combined value for nitrate and nitrite (**cite method**), one for ammonia (**cite method**) and one for phosphate (**cite method**).

The acidified DOC sample was analyzed using a Shimadzu TOC-L (TOC-L Total Organic Carbon Analyzer, Shimadzu) by Cindy White (Instrument Technician 3, **how to cite?) (cite method)**

**Fish**

I conducted a population estimate of stream salmonids from 25 meters upstream of each site using a backpack electrofisher (LR-20B Electrofisher, Smith Root) and an assistant who caught salmonids 50mm or more in length with a dip net and placed them in a 5 gallon bucket. I anesthetized the fish to enable measuring and weighing using Tricaine Methanesulfonate according to Central Washington University Institutional Animal Care and Use Committee (IACUC protocol #A041710). I used the two-pass depletion method to calculate the population as follows (Lockwood & Schneider, 2000):

Where, C1 is the number of fish removed in the first sample, C2 is the number of fish removed in the second sample, N is the population estimate and SE is the standard error of N.