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Snohomish County Freshwater Ecology Intern

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COLLEGE OF THE ENVIRONMENT

WESTERN WASHINGTON UNIVERSITY

MAKE WAVES.

Internship Title: Snohomish County Freshwater Ecology Intern

Organization Worked For: Snohomish County

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DATE: 8/31/23 ______________________________

Introduction

During my internship with Snohomish County, I gained many insights into natural resource monitoring and management that will help me in my future career. As a Freshwater Ecology intern, much of my work was part of the County's State of Our Waters (SOW) program. The SOW program is unique because of its comprehensive and standardized approach to monitoring. SOW monitoring uses five indicators to assess stream health, including water quality, hydrology, aquatic life, habitat, and land use.

Water quality: Parameters such as temperature, dissolved oxygen, nutrient levels, dissolved metals, and bacteria are measured monthly to track water quality.

Hydrology: The amount and timing of stream flow is tracked, along with influencing factors such as precipitation.

Aquatic life: The Benthic Index of Biotic Integrity (BIBI) is used to assess benthic invertebrate communities, and eDNA is used to track the presence of salmonid species.

Habitat: Summer habitat surveys assess canopy cover, stream substrate, bank conditions, presence of different habitat units (pools, riffles, glides/other), and other habitat characteristics.

Land use: Four land use categories are used to characterize where a stream is located, including rural, agriculture, forested, and urban.

Before the SOW program was formed in 2017, stream monitoring was indicator specific, rather than an integrated approach. There might be hydrologic data for certain streams (e.g. those prone to flooding) or assessments of aquatic life for certain streams (e.g. to track salmonid spawning), but there was unlikely to be data on all five indicators for the same site. Using all five indicators can give a much better sense of stream health. It also allows the SOW team to make more connections between indicators. For example, if a stream is in an urban area with a lot of impervious surfaces, the hydrology data might show that it is “flashy” (experiences large changes in discharge in response to rain events). This could help explain trends in water quality (e.g. high turbidity during rainy months) or signs of eroding stream banks. In addition, by collecting the same data at every site, it is much easier to compare one stream to another.

Objective #1: Learn how to collect high-quality field data and include appropriate quality controls

One of my learning objectives was to learn how to collect high-quality field data. When I set this learning objective, I was envisioning in-field practices to ensure accurate data collection. However, by learning about how the SOW program is structured, I realized the importance of planning prior to data collection. Each year approximately 30-50 stream sites are selected for SOW monitoring. Some sites are “trend” sites, which are monitored indefinitely. Others are “status” sites, which are monitored for one year. Since it’s not possible to visit every stream site in the County, it’s important that selected sites are representative of the County as a whole. Therefore, the number of sites from each land use category is weighted. For instance, there are more SOW sites in rural and urban areas because there are more stream sites in these land use categories and because stream conditions are more variable in these categories. In addition, to reduce any potential bias during site selection, all sites are randomly selected from a compiled list. Because of how the SOW sampling program is structured (random sampling weighted by land use category), collected data can be used to draw conclusions about stream health across the County, and statistical testing can be used to determine whether stream health is changing over time. Overall, SOW monitoring will be a valuable source of long-term data. It will be a resource to identify long-term trends/patterns in stream health and the most pressing threats to stream health.

As part of collecting high-quality data, I also wanted to learn how to include appropriate quality controls. In my courses at WWU, I learned about precision and accuracy. The common analogy used to explain precision and accuracy is a bull's eye. Precision is how replicable your results are, or how close your arrows are to each other. Whereas, accuracy is how close your measured result is to the true value, or how close your arrow is to the center target.

In a laboratory setting, it's possible to take a duplicate measurement from the same sample. Then, you can assess precision based on the range, variance, standard deviation, or other similar statistics. In a lab, you can also get a sense of accuracy by including a blank sample or a quality control (QC) sample with a known value. If what you measure for the blank/QC sample is off from what you would expect, you might question the accuracy of your other measurements.

However, it is more difficult to assess the precision and accuracy of a field survey. For example, how would you assess if a surveyor has accurately measured the bankfull width (BFW)? The BFW is the width of the channel at high water level (based on a 1.5-2 year interval). In this case, the measurement uncertainty isn't in the surveyor's ability to use a stadia rod or other measurement tool. Instead, the uncertainty lies in where along the channel they should end their measurement. There are several cues for determining BFW, including bank angle, depositional features, and changes in substrate or vegetation (annual to perennial). Some expert judgment is used to assess the BFW, and there isn't an easy way for a surveyor to double-check the accuracy of their measurement—which is true for many field measurements.

Therefore, the SWM monitoring team doubles down on assessing precision. Approximately 10% of sampling sites are designated QC sites. After the initial survey, QC sites are visited by a second team within a few days/weeks and resurveyed. These repeat surveys are a clear way to gauge precision—by showing how much measurement variability there is from person to person. The QC surveys also give a sense of accuracy. For instance, if one team measures BFW at transect 1 as 4.0 m and the second team measures 4.2 m, then it's clear that both surveyors determined the BFW to be in about the same spot. This might suggest that we can accurately measure BFW within a few tenths of a meter.

Objective #2: Gain experience using common sampling equipment for freshwater systems

Another one of my learning objectives was to gain experience using common sampling equipment for freshwater systems. During SOW habitat surveys, I have gained experience using various equipment, including:

Densitometer: to measure canopy cover. Canopy cover provides shade, and keeps water temperatures cool. Stream bank vegetation can also provide bank stabilization, water quality benefits, and a source of organic matter (e.g. leaf litter).

Calipers: to measure the size of stream substrate. The type of bottom substrate influences the aquatic life that lives there. For instance, salmonid species prefer to make their redds in larger substrate (ranging from small gravel to cobble). In addition, larger substrate can cause the formation of riffles, which are important habitat for benthic invertebrates and fish foraging.

Laser level and peashooter: two methods for measuring stream gradient. Stream slope influences the velocity of flow and its ability to carry sediment or cause erosion.

Surber sampler: to collect benthic invertebrates. The species and diversity of invertebrates present can indicate water quality or recent habitat disturbance (e.g. changes in historic flow, or changes to habitat type). Benthic invertebrates are also an important food source for other aquatic life, including fish.

OTT MF Pro: an electromagnetic flow meter, used to measure stream discharge, velocity, and channel depth.

Hydrolab: a multi-parameter sensor used to collect water quality data such as temperature, DO, pH, and conductivity. I have also used various methods to collect water samples for laboratory analysis, including collecting water **by hand**, using a **sampling pole**, and using a **horizontal sampler (Van Dorn)**.

FieldMaps: to navigate while in the field and to record field measurements. In future work positions, I expect many research organizations will use similar programs while in the field.

Objective #3: Learn about SWM and how SWM works with other DCNR agencies

Another of my learning objectives was to learn about the division of Surface Water Management (SWM) and how SWM works with other agencies within the County's Department of Conservation of Natural Resources (DCNR). While SOW monitoring does not require a lot of interagency collaboration, I often saw collaboration on restoration projects. For instance, when I visited a restoration site to help with fish exclusion, I met several people from the County's

Public Works division who had helped develop site plans and oversaw contract work. On a larger scale, many partner organizations were involved in the Smith Island Restoration project—which I visited for estuary monitoring. Restoration near Smith Island was a large undertaking involving the construction of a new setback dike and removing sections of existing dike to allow historic tidal marshlands to re-establish. The project required collaboration with agencies at the Federal (e.g. NOAA, DOE, U.S. Fish and Wildlife), State (WDFW), Tribal, and City (City of Everett) levels. Also, due to its scale, this project would not have been possible without funding support from multiple organizations. Overall, 70% of the project's cost was covered by state and federal grants.

Objective #4: Learn how field monitoring influences resource management

My final learning objective was to learn about how field monitoring influences resource management. A great example of data-informed resource management is the County's LakeWise certification program. Lake monitoring has shown that many of the County's lakes are in healthy condition, however, lake health has been declining. One of the main reasons is phosphorous pollution. From my courses at WWU, I know that many freshwater systems are phosphorous-limited. Meaning, any added phosphorous can lead to a boom of growth for phytoplankton, algae, and other primary producers. These organisms can lower water clarity and oxygen levels once they die off and decompose.

Phosphorus can come from many household sources including unmaintained septic systems, pet and animal wastes, lawn products/fertilizers, and exposed soils. To address phosphorous pollution, the County created the LakeWise Certification program. Landowners who live within a lake watershed can have their property LakeWise certified by completing a checklist of items that will reduce phosphorous runoff from their property. Property owners take actions such as attending a septic care workshop and getting their septic system regularly inspected, scooping and bagging pet waste in their yard, and covering bare soil with mulch or plants.

Overall, LakeWise is a bridge between monitoring and resource management. Many lake communities care about the health of their lake. LakeWise has helped raise awareness about phosphorous pollution and empowered many landowners to reduce phosphorous runoff from their property.

Conclusion

During my internship with Snohomish County, I learned new skills that will help me in my future career. I also learned a lot of stream-specific concepts, such as BFW, that I hadn't been exposed to in my courses. However, I think my courses at WWU prepared me with enough basic ecological knowledge and critical thinking skills that I was able to make connections to what I already knew and ask meaningful questions to engage deeper with any new concepts.

Overall, one of the most useful things I learned is how to set up a monitoring program, including how to develop a sampling regime. It was also valuable to see an example of how monitoring can be used to inform resource management through public outreach.