How do weather systems affect Rainbow Trout *(Oncorhynchus mykiss)* recreational fishing catch rates, on the Columbia River in Castlegar, British Columbia?

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Disclaimer

The contents provided on the following pages are student work produced as part of the written evaluation in the diploma program in the School of Environment and Geomatics, Selkirk College, Castlegar, British Columbia, Canada. This work obtained a minimum assessment grade of "C" (60%) and met the requirements of the assignment for which it was completed.

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1. Introduction

1.1 Background

Global fish abundance, has been constantly declining over the last 100 years (Burla et al. 2010) and with an ever increasing interest in recreational fishing there is more pressure being placed on fish populations (Fishing Tackle Retailer 2016). Given today's lower reduced population of fish, there is still an increase in growing recreation and commercial fishing pressures to the fish populations, as well as changing climate temperatures altering important fish habitat characteristics (Kanno et al. 2017). Proper management strategies are becoming increasingly important for the preservation and sustainability of biodiversity of this important Natural resource (crozier et al. 2019). With so many stressors to the continued success of fish species and their susceptibility to minute environmental changes, it would be of beneficial use to observe if the changes in annual weather play a role in the catch rates of certain species.

Fish are a cold blooded species whose habitats require specific characteristics in order to aid in their survival. Even the smallest changes in temperatures hold the capability to alter their metabolic rate causing them to exert greater amounts of energy. A fish species of greater susceptibility to these effects are that of Rainbow Trout (*Oncorhynchus mykiss)* (Dodrill et al. 2016). There have been little studies regarding how specific weather systems effect fish species, much more is known regarding dams and their effects; weather is a more fluid concern. Rainbow Trout, being a species more affected by changing characteristics, make them a key species to monitor in determining weathers role with fish productivity. As global warming becomes more prevalent, contributing to the rising of river temperatures, we are also seeing a reduction in habitat viability (Keefer et al. 2018). Understanding fish responses and how they are affected by

weather conditions is increasingly important in aiding managers with implementing proper preservation strategies (Di Prinzio et al. 2013).

British Columbia's Fishing industry provides hundreds of, millions of dollars to local and overall Canadian economies each year (Freshwater society, 2019). The Columbia River, who's headwaters begin within the BC interior and exit into the sea along the Oregon peninsula, provides some of the world's most pristine Rainbow Trout (*Oncorhynchus mykiss*) fisheries opportunities. It is one of the largest recreation sport fisheries in British Columbia (Freshwater Fish Society of BC 2019). Following the creation on the Grand Coulee Dam in 1942, access to the upper reaches of the Columbia River was blocked to migrating salmon (Oncorhuncus spp.) resulting in the habitat availability to Rainbow Trout (Burla et al. 2010). Seasonal Weather patterns along with dam influence and fish abundance make the Columbia River drainage system an excellent benchmark in the efforts to determine a correlation between weathers effect with Rainbow trout catch rates.

1.2 Research Goals

The Goal of my research was to determine if specific weather patterns share a relationship with Rainbow Trout catch rates within the Columbia River drainage system. To provide greater knowledge for future management strategies as well as more opportunities for recreational anglers to find success. Partnered alongside Ty Tarvd, the research we conducted followed similar guidelines to those performed by John Follows (2019) and Ian Crystal (2019) on the environmental factors affecting Trout feeding habits on the Columbia river between Hugh Keenleyside Dam in Robson and Trail, British Columbia. During the course of their study, John and Ian captured two Rainbow Trout during a below average fall season temperature gradient. They provided a baseline to follow in order to accurately acquire informative data for potential comparisons. This study provides data to the public for informative purposes to which they may better manage or angle for Rainbow Trout along the Columbia River.

Research was performed surrounding the following objectives:

- Examine behavioral patterns of Rainbow Trout to changing weather conditions through recreational fishing data collected during different weather characteristics.

- Compare catch rates to weather conditions; using fly fishing methods to catch Rainbow Trout.
- Describe how water and air temperature data affect catch rates; to better understand how weather affects habitat.
- Provide information and recommendations for future management strategies.
- Provide fishing strategies for anglers to have better fishing success when targeting rainbow trout *(Onchorhynchus mykiss)* regardless of weather.

2. Methods

2.1 Study area

The research study was conducted at multiple locations along the Columbia River drainage system. Between the Hugh Keenleyside Dam near Robson, and Highway 3B bridge in Trail, British Columbia (BC); measuring a total of 40km (Figure 1). The study area falls within the Interior Cedar Hemlock, very dry and warm (ICHxwa), Biogeoclimatic Ecosystem Classification (BEC) Zone (Mackillop and Ehman 2016). The study area was chosen for its prime fish habitat characteristics this helping optimize data collection and its position in relations with dam influences. This section of the Columbia River is classified as S1 (RMA guidebook 1995) and possesses a major confluence with the Kootaney River. The surrounding communities of Robsin, Castlegar, Ginelle, and Trail, with a total population count of approximately 22,000 people, fall within our Testing area and provide various anthropogenic influences. This section of the Columbia is a highly sought after location for recreational anglers and adventure enthusiasts alike. It is home to Tech which is a large industrial smelting business, all of these along with two hydroelectric dams provide a multitude of anthropogenic impacts to the river. Specific data collection sites were decided based on access, number of anglers, flow rates, and site characteristics. The sites used for data collection included: Waldie Island, Selkirk College Campus, Millennium Park, Ginelle Bar, and Highway 3 Bridge in trail (Figures 1,2,3,4,5).

2.2 Field Data Collection

Data collection was performed alongside my research partner Ty Tarvyd, where we first began the study by researching background information regarding similar studies. This helped us create an idea for the intended direction of our individual studies. Through the review of similar

studies, we could then decide on perimeters and important data in order to create out site data card with the help of a Microsoft excel spread sheet. Using ideal sampling characteristics, we could identify ideal sampling site location and their accessibility using google earth. The sampling method was decided to be recreational fly fishing to be performed by Ty Tarvyd and Brady Ward during the fall and winter months. Data collection was to be sporadically done at random as collection could not be done on a regular scheduled basis. Flies were to be chosen on site, subject to angler's decision where all flies mimicked those of local native food sources such as macroinvertebrates. A variety of fly rods were to be used ranging from four to seven weights as well as both floating and sinking tip fly line, compensation of which was at the discretion of the angler on site. Before entering into the field those collecting data planned and agreed to follow all safety and legal guidelines. This was achieved by never collecting data alone, collectors must always wear hip waders, belt, boots, an emergency first aid kit, as well as mandatory to possess a valid freshwater fishing license.

In the field upon the capture of a fish, data collectors would input data into field cards digitally through use of an iPad or onto a paper notebook. Data to be inputted was split into categories of usage; the first category was site information and provided the ability to identify fish based of site location and provided general characteristics data, this included:

- Date
- General location name (ie Ginelle)
- UTM Coordinates - using a Garmin 62s GPS
- Water Temp/ Air temp – using thermometer
- Barometric Pressure, Castlegar airport – using Environment Canada's website
- Current Birchbank station flow rates
- Archived Birchbank station flow rates
- Comments section for any other important information pertaining to a fish

The second section of the data collection card pertained to fish identification in order to compare Rainbow Trout data, this also helps receive a general idea of age and general overall health. We did this by taking a variety of weights and measurements providing the ability to compare to other individuals who caught along this section of the Columbia River, these measurements included:

- Start/End Time spent fishing

- Number of anglers fishing
- Total fishing effort hours (time all collectors spent)
- Length (cm)
- Girth (cm)
- Weight (g)

The last data collection sheet was designated for additional potential data and safety guidelines, and were used to obtain habitat characteristics and additional materials that may pertain to the outcome of the study, these included:

- Access (ranked from 1-5, 1 being inaccessible 5 being completely accessible)
- Safety (ranked 1-5, 1 being dangerous fishing conditions and 5 being safe)
- Water clarity (ranked 1-5, one = <10cm, two = 11-20cm, three = 21-30cm, four = 31-40cm, five = >41cm)
- Number of other anglers using river
- Cloud cover 0, 25, 50, 75, 100 (%)
- Precipitation (none, Light, Heavy)
- Insect observation

2.3 Analysis

All data collected was recorded and stored in Microsoft Excel for later review. The main directive of my data was intended towards weather related conditions and how they correlated with Rainbow Trout catch rates. As my counterpart Ty Tarvyd would look at how regulated flows of a dammed system would affect catch rates, and also looking at some dam data would prove to be beneficial as there is the potential to have some overlapping effects towards catch rates success. Using the excel program we were able to format the data in order to compare where larger Rainbow Trout are most likely to be captured when in comparison to temperatures and weather related conditions along the Columbia River. We could also calculate a catch per unit effort (CPUE) by dividing total fishing effort in hours by number of fish captured. Through comparison of data, we hope to find evidence supporting some already established theories regarding feeding behaviors as well as potentially discover unknown correlations between feeding and weather occurrences.

3. Results

3.1 Data Collection

Data collection on the Columbia River took place between the dates of October 15, 2019 and February 3, 2020. A total number of 7 Rainbow Trout were captured within 14.8 hours of angling effort, performed by multiple anglers. Of the five sampling areas, Genelle proved to be most productive providing four Rainbow Trout samples. Next was Selkirk College campus with two fish captured and Waldie Island with one, no Rainbow trout were captured at Millennium park or the Trail bridge. All Samples were collected using fly fishing methods and a variety of bugs, the most successful bugs proved to be Caddis fly (Trichoperta), and Midges (Chaoboidae), each capturing three Rainbow Trout, followed by bloodworms (Glycera) that captured one. Of the dry line and sinking line methods, used sinking line proved to be most effective catching five of the samples recorded with two being caught on dry line. All angling effort were preformed through on shore access areas where safety and accessibility received scores between 4-5.

3.2 Fish Data

On sampling dates, the temperature gradient between water and air temperatures were <1 degree Celsius in separation, this proved to be most successful (Table 1). There proved to be more success in capturing Rainbow Trout at water temperatures >6 Degrees Celsius as well as larger specimens. It was found that smaller specimens of < 45cm were captured during sampling collections with colder water temperatures. Number of anglers did little to effect productivity as there could be no correlation made between number of anglers and number of fish captured. Throughout all sampling dates and locations water clarity stayed consistent with scores ranging between a 3-4 visibility range (Table 2). Most sampling days correlated with days of greater than 75% cloud cover and proved to have little effect on capture success. Sample dates with any form of precipitation proved to have no effect towards capture success (Table 2). Barometric pressure ranged between 101.1 – 102.7 hectopascals and demonstrated more success on sampling dates with the lowest barometric pressure. Weight of captured Rainbow trout ranged from lightest 581 grams(g) to 1814g and measured between 19cm and 24cm in girth.

4. Discussion

4.1 Data Constraints

Before investigating into data it is important to consider some possible constraints regarding our data collection methods, first of which being inexperience. While Ty Tarvyd is an experienced fly fishing guide, my fishing experience lies more in ocean fishing techniques, these are two extremely different methods that required learning different fishing strategies. Therefore my fishing abilities may have played a role in the overall success rates of capturing Rainbow Trout. Another constraint would be inconsistency in sampling dates, while me and my partner Ty are both full time students, we are also avid fishermen whose time can be easily distracted by the many abundant rivers within the Kootenay area. This leading to a difficulty in establishing sampling dates in which our schedules aligned, also leading to restrictions on not only amount of data we would have prefered to collect but also variety of data such as the changing weather conditions or flow patterns.

4.2 Data discussion

After extensive review of the data collected, my partner Ty Tarvyd and I were able to determine some small trends formed into the data. Most notably is that of Barometric Pressure. With regards to weather, a lower barometric pressure typically means greater chance for weather events to occur. Alternatively, this means a higher Barometric Pressure reading would result in a nicer day. In our study we found our most successful days came on those with the lowest barometric pressure indicating that as pressure drops Rainbow Trout are more likely to be feeding. This is likely due to the swim bladder, it is believed that as pressure drops, the swim bladder within fish expands causing irritation in fish and can even dissuade fish from eating until pressures level out allowing for gas to escape. As their swim bladders expand, fish can sense potential storm events and will eat in excess in order to prepare before the storms arrival (Coyne 2018). Outside of Barometric Pressure we found weather systems to have little effect on Rainbow Trout feeding habits, as precipitation and cloud cover was discovered to not have effected catch rates. However, a potentially large storm system or a dam release uncharacteristic to seasonal patterns hold the capability to cause their food source to go down to greater depths.

In efforts to control metabolism fish are typically less active in colder water where food is scarce, therefore in order to conserve energy they are not likely to expend much energy in order to feed except for nearby easy prey (Dodrill et al. 2016). For this reason, we expected to

see a decline in catch rate matching that of temperatures declines but this was not the case. We found that temperatures held little to no effect on feeding habits and only contributed to the size of fish being captured. This is likely due to the fact that the majority of our sampling period was preformed outside of peak Rainbow trout food availability. The caddisfly (Trichoptera), one of Rainbow Trout's main food source, have hatch events occurring during mid to late fall (Keefer et al. 2008). Because Rainbow Trout feed based on food availability this means after these large hatch events are finished Rainbow Trout's become very inactive in order to conserve energy. This is due to preparation for overwintering, therefore it is likely that the fish we captured were docile nearby and feed out of easy access. More likely in the case of the smaller fish they were feeding out of ill preparedness heading into winter, regardless of temperatures. Because our largest and smallest Trout caught, in terms of length and girth, did not range far apart, it is likely that ill preparedness is the leading factor and not that off temperature.

4.2 Conclusion

Based on overall amount of data collected as well as non-ideal variability in sampling conditions, we were unable to draw any abundantly clear conclusion regarding weathers effect on Rainbow trout catch rates. However, some useful information can be taken from this study; such as the potential connection between barometric pressure and catch rates, giving recreational fishermen an ability to predict a potentially productive fishing day by watching downward trends in barometric pressure. Second is food source and time of year, to optimize Rainbow Trout catch rates, mid to late fall may be the ideal time as temperatures are starting to shift into the colder seasons and food sources are in greater abundance for fish heading into over wintering.

Overall this study holds the potential for baseline data in potential future studies regarding Rainbow Trout in the Columbia River. It would be interesting to monitor catch rates moving forward on a year round regulated schedule in order to optimize data outcomes, but under school schedule related constrictions this proves to be difficult. Even so this study proved to be beneficial from a learning standpoint, not only in terms of becoming a better angler but organizing and implementation everything that is involved in an applied research project. These skills I have obtained I can now build on moving forward in my future endeavors.

5. Tables and figures

Table 1. various weather, water, and air measurements taken by Ty Tarvyd and Brady ward on the Columbia River between Hugh Keenleyside dam and Trail BC, October 15th, 2019 - February 3rd, 2020.

Date	Water temp (oC)	Air Temp (oC)	Barometric Pressure (KPA)	Fish captured
15-Oct-19	7	10	101.9	1
16-Oct-19	8	9	101.1	2
20-Oct-19	6	6	101.6	1
08-Nov-19	5	6	101.3	2
03-Feb-20	5	3	102.7	1

Table 2. variety of weather and water conditions taken by Ty Tarvyd and Brady Ward on the Columbia River between Hugh Keenleyside dam and Trail BC, October 15th, 2019 - February 3rd, 2020.

Date	Cloud cover (%)	Precipitation	Water clarity (1-5)	other anglers	Fish Caught
15-Oct-19	75	no	4	0	1
16-Oct-19	75	Light	4	0	2
20-Oct-19	100	Heavy	3	4	1
08-Nov-19	75	no	3	3	2
03-Feb-20	0	no	4	0	1

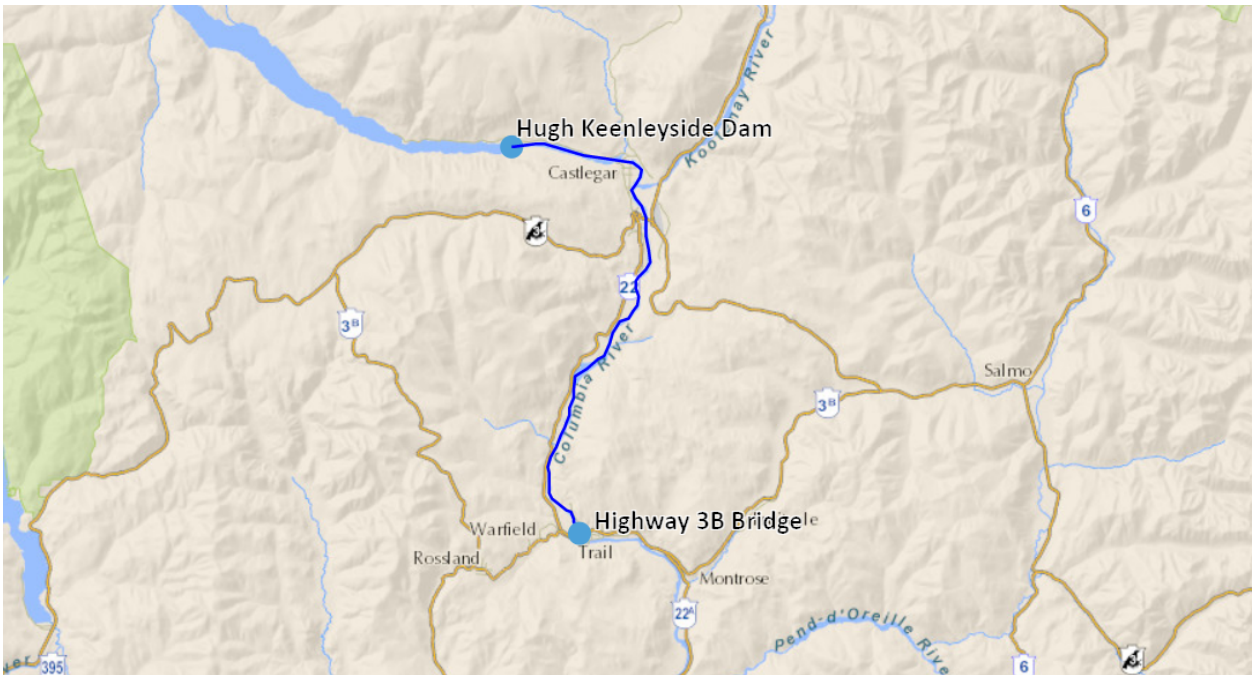

Figure 1. Map of study area on Columbia River between Hugh Keenleyside dam and Trail, BC November 24th, 2019 (Imap BC).

Figure 2. Genelle sampling location on the Columbia River between Hugh Keenleyside dam and Trail, BC February 7th, 2020.

Figure 3. Selkirk College Castlegar campus sampling site located on the Columbia River between Hugh Keenleyside dam and Trail, BC, February 7th, 2020.

Figure 4. Waldie Island sampling area on the Columbia River between Hugh Keenleyside dam and Trail, BC, February 7th,2020.

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