EEB313 Mid-project Update: Investigating impacts of Rainbow Trout aquaculture on biochemical indicators in boreal shield lakes.

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Hypotheses and predictions

Hypotheses:

- Rainbow trout aquaculture in boreal shield lakes affects particulate phosphorus concentrations at the epilimnion layer.
    - Phosphorus concentrations will increase when aquaculture is implemented on the study lake.
- Rainbow trout aquaculture in boreal shield lakes affects particulate nitrogen concentrations at the epilimnion layer.
    - Nitrogen concentrations will increase when aquaculture is implemented on the study lake.
- Rainbow trout aquaculture in boreal shield lakes affects particulate carbon concentrations at the epilimnion layer.
    - Particulate carbon concentrations will increase when aquaculture is implemented on the study lake.
- Rainbow trout aquaculture in boreal shield lakes affects chlorophyll A at the epilimnion layer of the lake.
    - Chlorophyll A will increase when aquaculture is implemented on the study lake.

Null Hypotheses:

- Rainbow trout aquaculture in boreal shield lakes does not affect particulate phosphorus concentrations at the epilimnion layer.
- Rainbow trout aquaculture in boreal shield lakes does not affect particulate nitrogen concentrations at the epilimnion layer.
- Rainbow trout aquaculture in boreal shield lakes does not affect particulate carbon concentrations at the epilimnion layer.
- Rainbow trout aquaculture in boreal shield lakes does not affect primary productivity at the epilimnion layer of the lake.

Description of Data

The data source was collected from the IISD-Experimental Lakes Area (ELA) located in northwestern Ontario. This research site has been active since 1986 and contributes to one of the longest and most comprehensive data sets on freshwater lakes

in the world. This site consists of 58 small lakes where they focus on answering problems related to climate change, water management, and other anthropogenic processes and their influences on freshwater systems. IISD-ELA is known for their whole ecosystem experiments where whole lake manipulations can be conducted. One such experiment was conducted to determine the impacts of aquaculture on a whole lake ecosystem from 2003 to 2007. A significant amount of data, such as water chemistry and species populations, has been collected on this lake before, during, and after this experiment was set up. The data collected from this experiment has been used to provide guidelines for the aquaculture industry (Bristow et al., 2008; Kennedy et al., 2019; Rennie et al., 2019).

Analysis Plan for phosphorus (one variable)

* Minimal data wrangling needed
    - Column “treatment” was added
        - “before” = observations collected before 2003, “during” = observations collected between 2003-2007, “after” = observations collected after 2007
1. Determine distribution of all phosphorus data
    a. Plot histogram for the data to check if data fits normal distribution
    b. Run a shapiro-wilks test to investigate normality
    c. If data is not normal transform data by taking log of the values
    d. Add new column to hold transformed data if required

2. Statistical analysis
    a. ANOVA
        i. Independent variable = Treatment(Categorical)
        ii. Dependent Variable= phosphorus concentration (Continuous)
        iii. AOV(result_value~Treatment,data = p_data_with_treatment)
    b. GLM
        i. Independent variable = Treatment(Categorical)
        ii. Dependent Variable= phosphorus concentration (Continuous)
        iii. GLM(result_value~Treatment,data = p_data_with_treatment)
    c. LMM
        i. Independent variable = Treatment(Categorical)
        ii. Dependent Variable= phosphorus concentration (Continuous)
        iii. Random Variable=Year as a factor
        iv. lmer(result_value~Treatment+(1|as.factor(p_data_with_treatment$year)), data=p_data_with_treatment, REML=FALSE)
    d. ARIMA

i. Forecasting over the next year.
ii. auto.arima(P_dataa)
iii. Data needs be univariate

e. Conduct model selection using AICC scores

Repeat these analyses for all other variables: particulate nitrogen, particulate carbon, chlorophyll A.

Author contributions:

At this point in the project, Kumal has led the data exploration and cleaning. Elli, Jaden, and Karen have helped with obtaining the dataset, literature review, and writing up the current data analysis. All group members have thoroughly discussed aspects relating to this project to determine the direction of analysis. After reading week, all group members will contribute to data cleaning and providing biological insight. Kumal does this for the love of the game.