

# 2024 Analysis of Chlorophyll in Bed Sediments within Bellingham Bay in Puget Sound, WA

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## Introduction

Phytoplankton, algae, and kelp are photoautotrophs that perform as the primary producers of marine ecosystems. As the primary producers, they are fundamental to the health and stability of the Puget Sound estuary ecosystem (Williams et al. 2001). It is vital to comprehend the role that external variables impact these foundational species.

Primary producers utilize the chlorophyll molecule to produce carbohydrates as a function of exposure to certain wavelengths of light. As chlorophyll is essential for the health and productivity of these species, concentration of the molecule within sediment can be interpreted as the quantity of primary production within a sample area. (Szymczak-Żyła et al. 2011)

This baseline study analyzed chlorophyll concentrations in sediment. Further analysis can be conducted to evaluate the effects of climate change on estuary ecosystems and the marine environment at large. This analysis is a continuation of work that began in Spring 2023.

## Methods

### Field Sampling

- > Samples were collected from Bellingham Bay bed sediment using a .5L Van Veen grab sampler
- >Samples were placed in 1qt Ziploc clear plastic bags and wrapped in a black plastic bag
- > Samples were placed in a cooler for retention and transferred to UWT campus for analysis

### Laboratory Processing

- (Analysis followed the protocol developed by Nguyen & Narayan 2023)
- > Each sample was analyzed in triplicate
  - > 40 mL of 90% acetone was added to 5mL of sediment
  - > Frozen for minimum of 12 hours at -8°C
  - > Thawed samples were centrifuged at 3000 rpm for 25 minutes (fig. 1)
  - > Chlorophyll-a concentrations measured using a Fluorometer Turner Trilogy Module CHL-A Acid before and after acidification (fig. 1)
  - > > Data was averaged and used to calculate the concentration (µg/L) of chlorophyll in bed sediment



Figure 1: Images of Centrifuge and Fluorometer used for separation and fluoresent analysis of chlorophyll-a concentration.

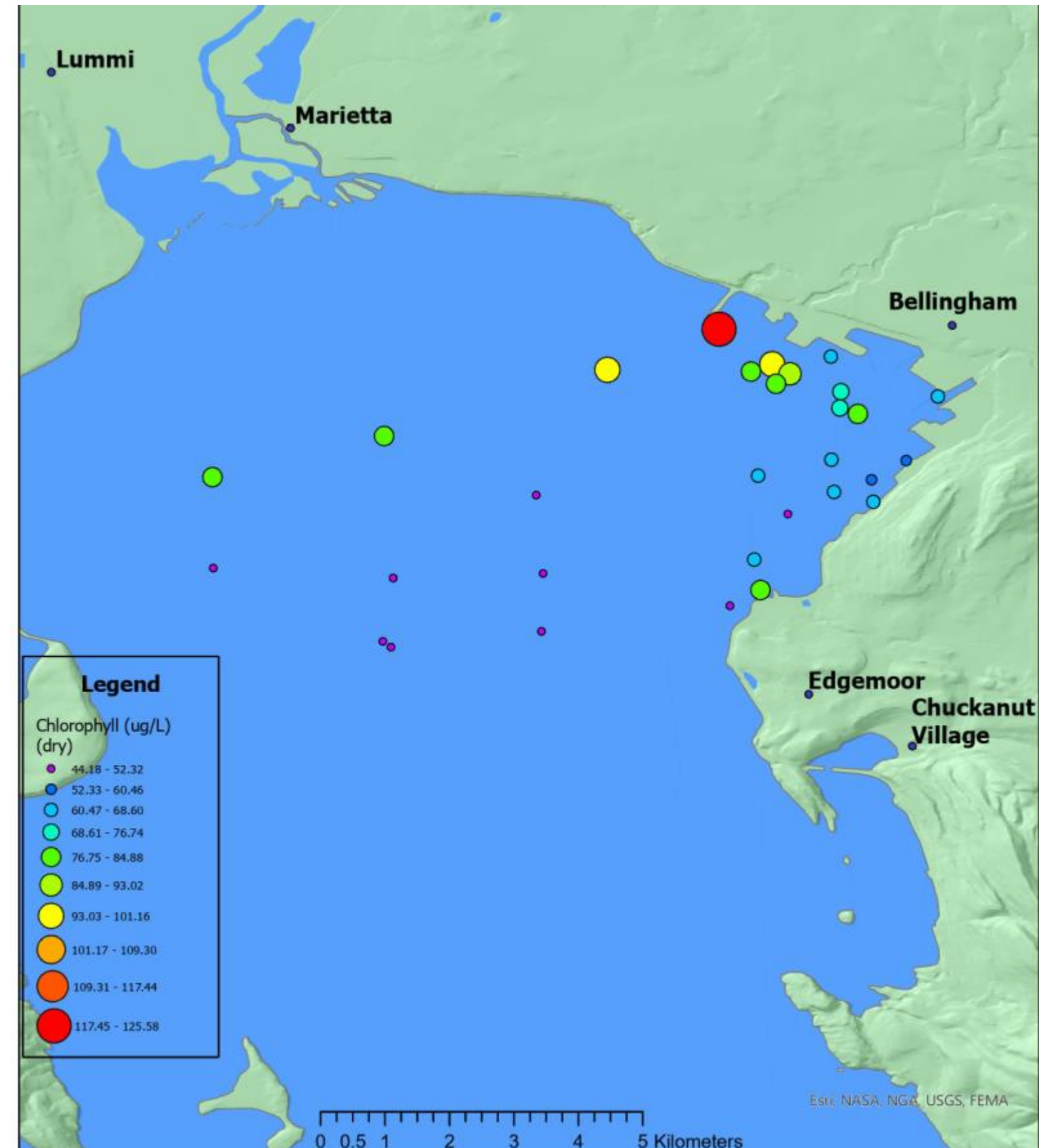


Figure 2: Chlorophyll concentration in µg/L in dry sediment throughout the Bellingham Bay region of Puget Sound, WA

### Quick Facts

- > **Phytoplankton, algae, and kelp are fundamental to marine ecosystems as aquatic primary producers**
- > **Primary producers use chlorophyll to generate carbohydrates for chemical energy**
- > **Chlorophyll can be used as an index for the amount of primary production in an area.**
- > **Highest concentrations of chlorophyll were observed along the Bellingham waterfront and near-center regions (fig. 2)**
- > **Moderate correlation between dry weight Chlorophyll and % of Total Organic Carbon by dry weight (R<sup>2</sup>=0.5967) (fig. 6)**
- > **Standard deviation for chlorophyll wet was 20.68µg/L and for chlorophyll dry it was 18.09 µg/L**

## Future Work

- the waters near a construction site before and after should be tested for TOC and chlorophyll to look for evidence of a weak causal relationship
- more raw data should be gathered and put together over time to show annual cycles and changes
- measuring for non chlorophyll a pigments
- investigate relationship with cyst count
- more areas should be tested
- the effect of geography should be more specifically studied

## Chlorophyll (Wet weight)

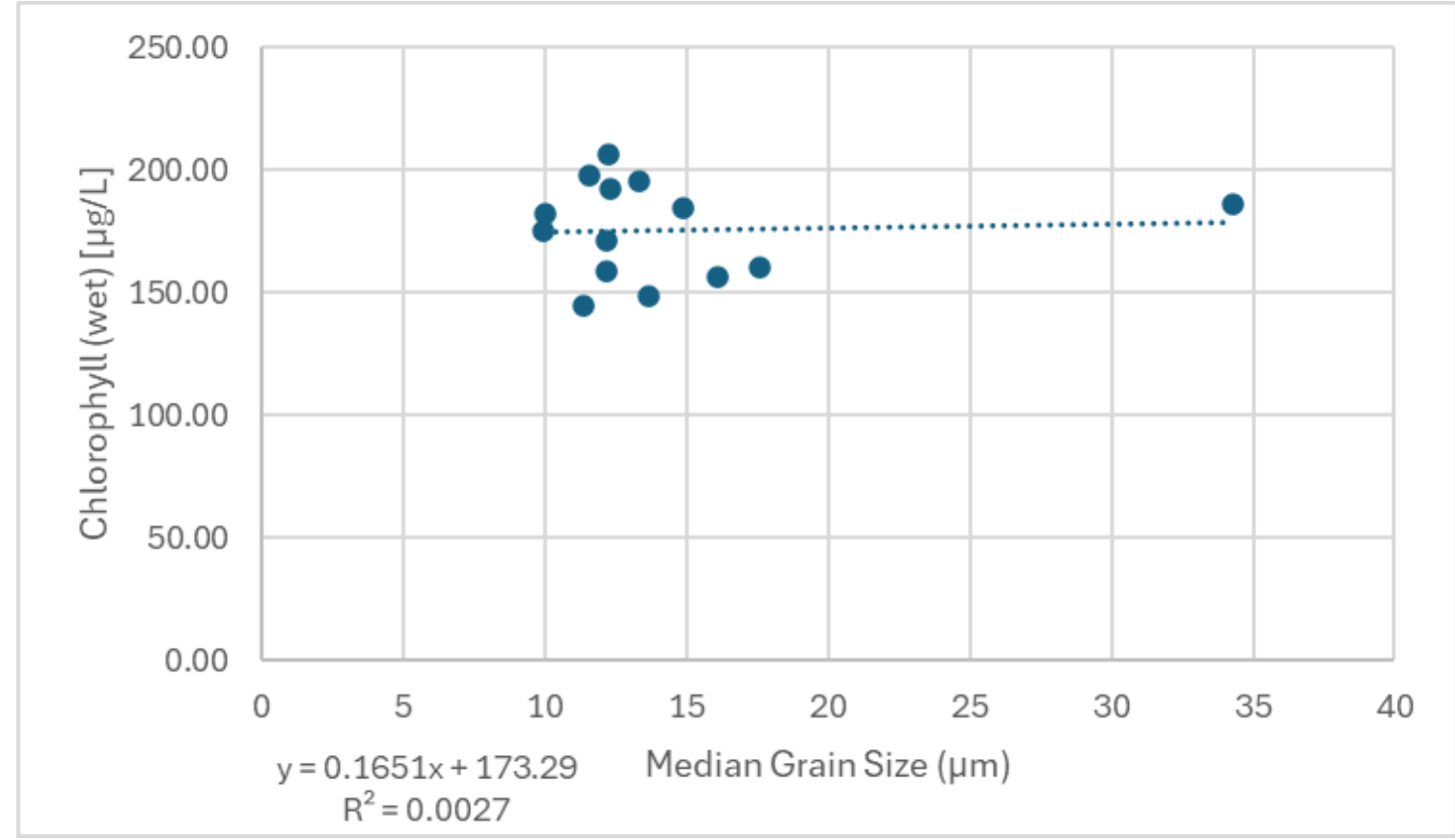


Figure 3: Linear Regression analysis of Wet Chlorophyll vs median grain size

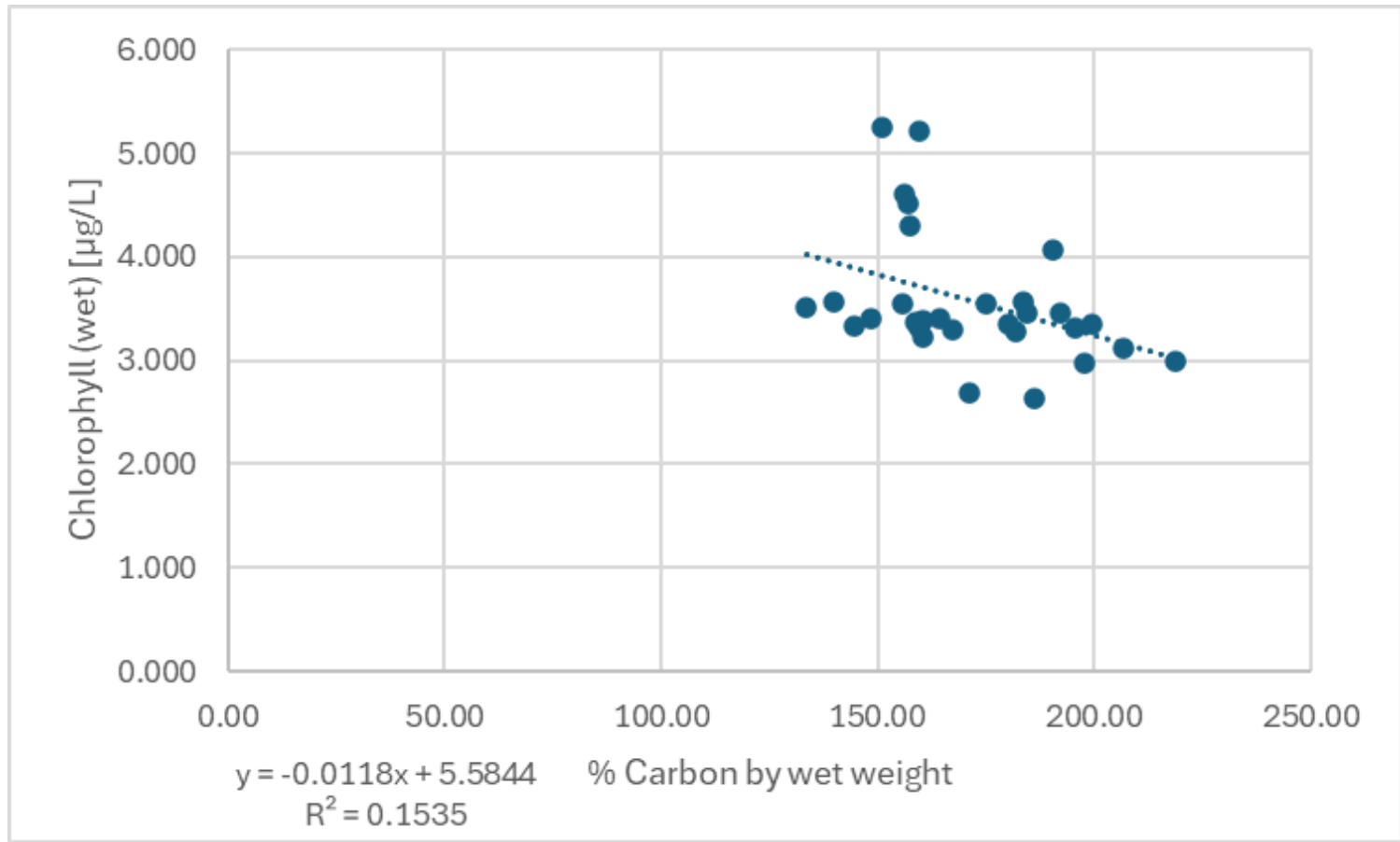


Figure 5: Linear Regression analysis of Wet Chlorophyll vs %Carbon by wet weight

## Results - Wet Weight

- >Chlorophyll wet weight with median grain size was had an R<sup>2</sup> of 0.0342, indicated there was a very low correlation (fig. 3).
- >Chlorophyll wet weight with % Carbon by dry weight had an R<sup>2</sup> of 0.1535 demonstrating a very low correlation (fig. 5).

## Conclusion

Existing research has demonstrated a weak negative relationship between median grain size and chlorophyll-a (Cahoon et al. 1999). This study found no significant relationship with wet weight chlorophyll-a and median grain size (R<sup>2</sup>=0.0027). However, it did find a moderate positive correlation between wet weight chlorophyll-a and median grain size (R<sup>2</sup>=0.4341). Existing research has found a negative quadratic relationship between Total Organic Carbon and Chlorophyll-a (Sohrin and Sempéré 2005; Dunalska 2011; Pilla and Griffiths 2024). Supporting this information this study found a very low, negative linear relationship between wet-weight chlorophyll-a and %mass of total organic carbon (R<sup>2</sup>=0.15), and a moderate relationship between dry weight chlorophyll-a and total organic carbon. (R<sup>2</sup>= 0.5967)

Analysis of this study was limited by the inability to analyze the entirety of the sample collection due to closure of lab spaces. Sample integrity within this study may have been impacted by the catastrophic power outage experienced by the University of Washington - Tacoma campus from 2024/07/06 - 2024/07/22.

## Chlorophyll (Dry weight)

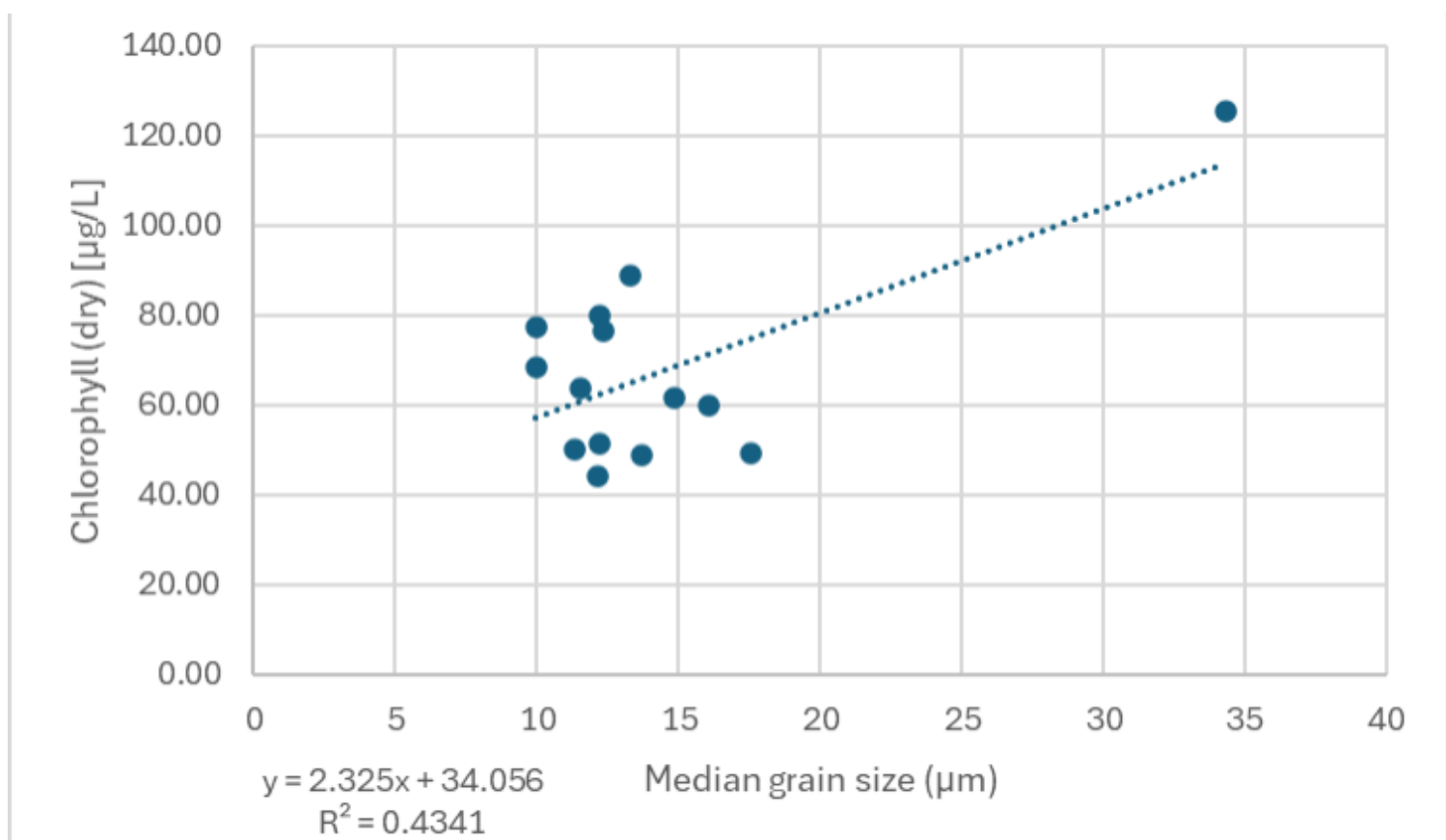


Figure 4: Linear Regression analysis of Dry Chlorophyll vs median grain size

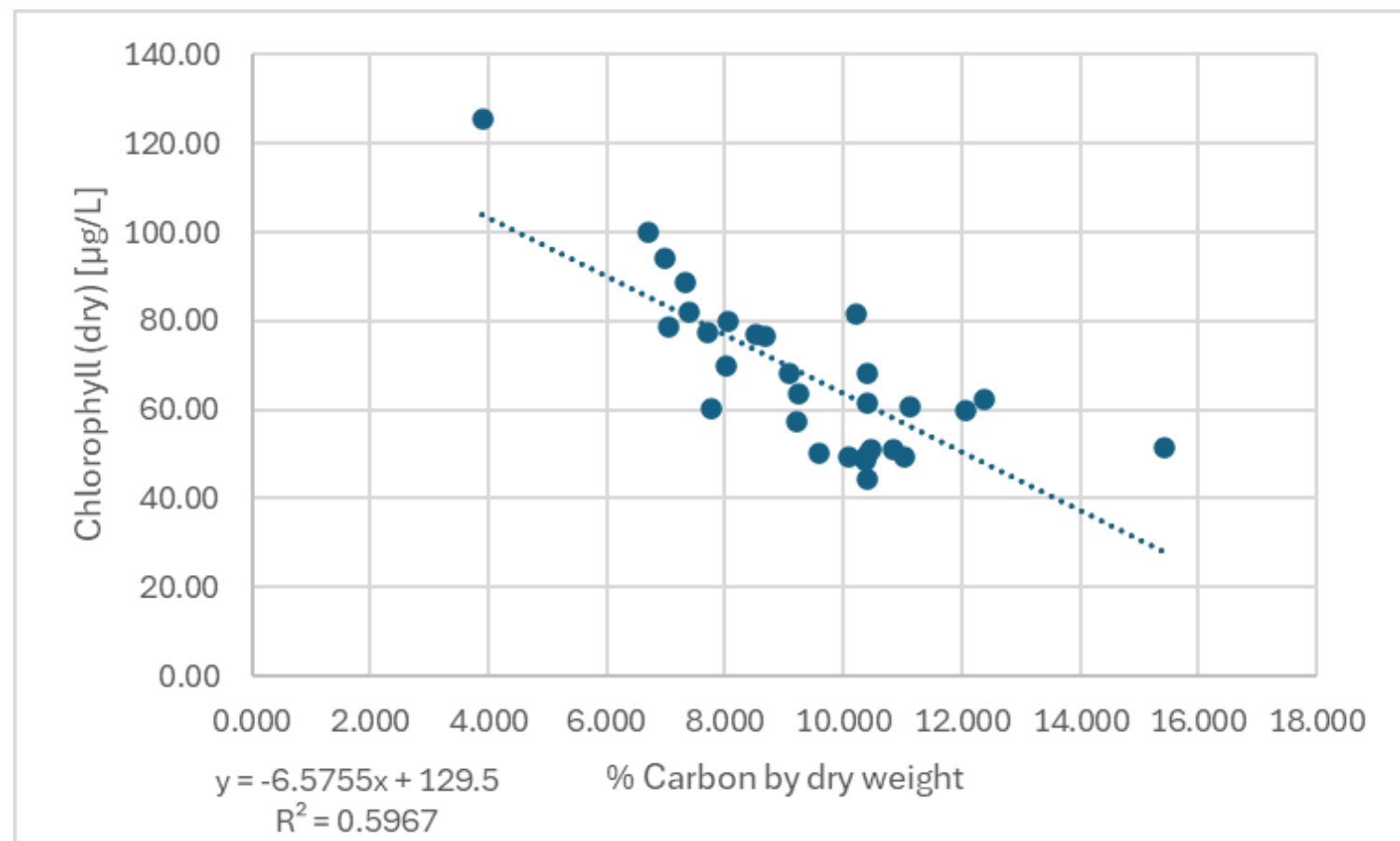


Figure 6: Linear Regression analysis of Dry Chlorophyll vs %Carbon by dry weight

## Results - Dry Weight

- >Chlorophyll dry weight had a low correlation with median grain size with an R<sup>2</sup> of 0.4341 (fig. 4).
- >Chlorophyll dry weight with %Carbon by dry weight had a moderate negative correlation with an R<sup>2</sup> of 0.5967 (fig. 6).

## Credit

Thanks to the Department of Ecology's Marine Sediment Monitoring Team for providing the bed sediments samples, and the Center for Urban Waters for sharing lab space and equipment.

## References

