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). so It is valuable to know the about the effects of external variables on 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 by boat using a .5L Van Veen grab sampler

> Samples placed in 1qt Ziploc clear plastic bags and wrapped in a black plastic bag

> Samples were then placed in a cooler for retention and movement and transferred to UWT campus for analysis

Laboratory Processing

(Analysis followed the protocol developed by Nguyen & Narayen 2023)

> Each sample was analyzed in ways: with acetone, just acetone, and with HCl

> 40 mL of 90% acetone was added to 5mL of sediment

> Samples were separated at 3000 rpm for 25 minutes in a centrifuge

> Chilled for minimum of 12 hours at -8℃

> Chlorophyll-a concentrations measured using a Fluorometer Turner Trilogy Module CHL-A Acid before and after acidification (fig. 1)

> Recorded 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 fluorescent analysis of chlorophyll-a concentration.

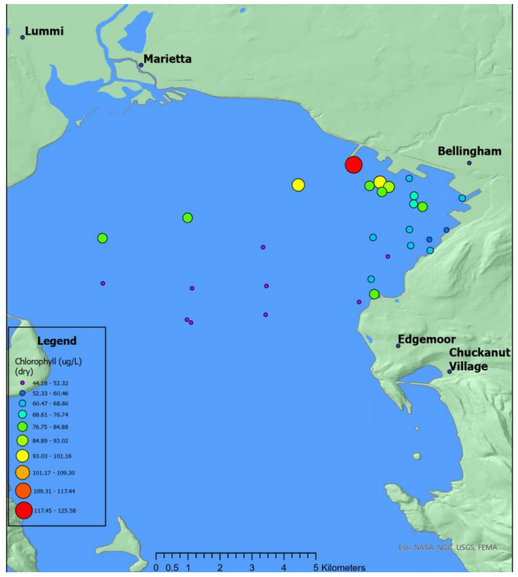

Figure 2: Visual Representation of Chlorophyll concentration in µg/L in dry sediment throughout the Bellingham Bay region of Puget Sound, WA

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 (fig. 2)

> Moderate correlation between dry weight Chlorophyll and median grain size (R^2=0.4341) (fig. 5)

> Standard deviation for chlorophyll wet was 20.68µg/L and for chlorophyll dry it was 18.09 µg/L

Future Work

-continue data collection on an annual cycle
-study the causal relationship between TOC and chlorophyll content more closely
-study more areas and collect more raw data
-cross reference with cyst counts
-the effects of geography or proximity to construction more closely studied

Chlorophyll (Wet weight)

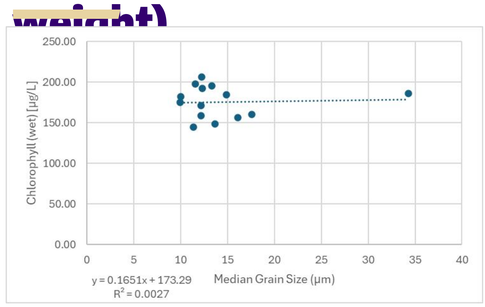

Figure 3: Linear Regression analysis of Wet Chlorophyll vs median grain size

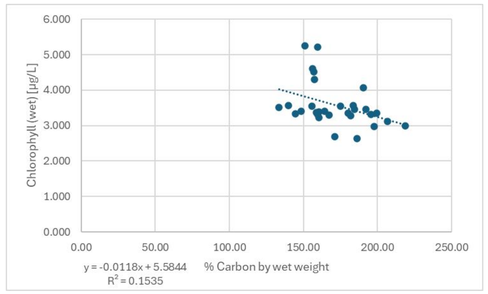

Figure 4: Linear Regression analysis of Wet Chlorophyll vs %Carbon by wet weight

Results - Wet Weight

>chlorophyll wet with median grain size had no correlation with an R^2 of 0.0342,(fig. 3).

>Chlorophyll wet with % Carbon by dry weight had no correlation with an R^2 of 0.1535 (fig. 4).

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^2=0.0342). However, it did find a moderate positive correlation between dry weight chlorophyll-a and median grain size (R^2=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). our study didn't found a correlation between wet-weight chlorophyll-a and %mass of total organic carbon (R^2=0.1535), but a moderate relationship between dry weight chlorophyll-a and total organic carbon was found. (R^2=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)

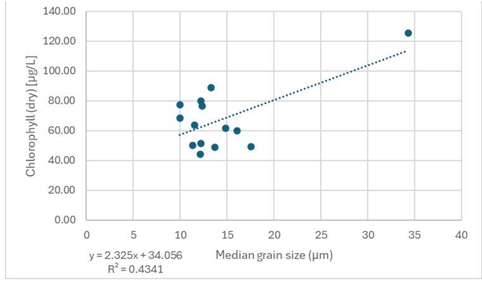

Figure 5: Linear Regression analysis of Dry Chlorophyll vs median grain size

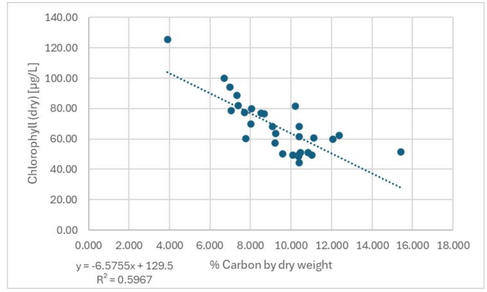

Figure 6: Linear Regression analysis of Dry Chlorophyll vs %Carbon by dry weight

Results - Dry Weight

>Chlorophyll dry had a poor correlation with median grain size with an R^2 of 0.4341 (fig. 5).

>Chlorophyll dry with %Carbon by dry weight had a moderate negative correlation with an R^2 of 0.5967 (fig. 6).

Credit

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References