**Project Title:** Land-sea metabolic coupling in temperate eelgrass beds: The role of watershed connectivity and environmental gradients on carbon sequestration of seagrass meadows

**Fellow Name:** Elizabeth Elmstrom

**University:** University of Washington

**NOAA Award #:** NA20NOS4200121

**Award Period:** September 1, 2020 - August 31, 2022

**Reporting Period:** September 1, 2021 – February 28, 2022

**Workplan:** Download the current version of the Work Plan from [GitHub](https://github.com/eelmstrom/padilla_bay/blob/main/documents/Davidson%20Fellowship%20Work%20Plan_ElmstromMarch2021Updates.docx)

**Timeline:** Download the current version of the Timeline from [GitHub](https://github.com/eelmstrom/padilla_bay/blob/main/documents/Davidson%20Fellowship%20-%20timeline_ElmstromMarch2021Updates.xlsx)

### Accomplishments: September 1 – February 28th

**Research Accomplishments**

1. Final calibration of sensors (Field and tank experiments)

Each suite of field sensors (oxygen, light, salinity, and depth) requires pre and/or post calibration to ensure data accuracy and sensor comparability. During this reporting period Elmstrom finalized sensor calibrations for light, depth, and salinity sensors, with both field and tank experiments. Code for calibration equations was documented in annotated R scripts and backed up to the database described below.

1. Creation of Padilla and Samish Bay metabolism database (data wrangling, R scripts)

A database of spring and summer field data was compiled, organized, and backed up to a shared GitHub repository. This repository includes raw and corrected data (based on calibration equations), along with reproducible R scripts to be used for future data wrangling and sensor calibrations. The creation and organization of a database this size was no small feat.

1. Estuarine ecosystem metabolism models (data creation, R scripts)

The analysis of oxygen data has made decent progress. Oxygen data have been corrected and cleaned for time out of water, and preliminary estimates of ecosystem respiration (ER), gross primary productivity (GPP), and net ecosystem productivity (NEP; i.e. the three different rates of ecosystem metabolism) have begun. R scripts for these models, while still a work in progress, are projected to be finalized by the end of April. Metabolic rates will then be de-tided and statistically analyzed to compare differences across sites.

1. Multivariate autoregressive state space models (MARSS) (statistical analysis, R scripts)

Each time series of metabolic rates will be analyzed using the MARSS multivariate autoregressive state-space modeling framework. R scripts for these models are completed and are backed up to a GitHub repository. Models have now been tested using preliminary data. Once the metabolic data has been finalized, we will use these models to summarize spatiotemporal variation, and test for the inclusion of covariates.

**Engaging reserve sectors**

Preliminary results were formally presented to the Padilla Bay research sector on February 18th. This talk served two purposes: 1) To update the research reserve sector on project progress, and 2) to gain feedback and local knowledge from Padilla Bay research scientists. This presentation resulted in a successful transfer of knowledge and allowed Elmstrom the opportunity to gain access to bay wide eelgrass biomass dataset. These data are now planned to be included in the statistical MARSS component of the analysis.

**Professional Development**

Professional development trainings accomplished during this reporting period include virtual attendance to the NERR Annual Meeting. The NOAA Facilitation Basics training will occur in early April.

### Challenges / Delays

**Field challenges**

Over the course of this fellowship, access to the reserve and in-person field studies has been significantly impacted by to the Covid-19 pandemic. This delayed the originally proposed field work by 6 months, resulting in the loss of fall 2020 and winter 2021 sampling deployments. Ideally, these sample deployments would have been rolled over to fall 2021/winter 2022. However, this timing coincided with the fellow’s other research projects and PhD milestones, unfortunately making them unfeasible in the context of her greater PhD dissertation timeline. There simply was not enough time in the day to complete writing tasks and embark on another intensive field deployment without the help of summer field hands.

**Professional Development/Outreach**

In addition to field work related delays, there have also been significant social distancing-related setbacks due to Covid-19 health precautions. Certain education and outreach activities have been canceled or moved online due to COVID-19. For example, both the Salish Sea Stewards volunteer training program and classes offered through the Coastal Training program remained virtual until this February. While it is important to note that Elmstrom participated in virtual trainings, she has yet to engage person.

Padilla Bay’s Breazeal Interpretive Center also remained closed until late August 2021, altering Elmstrom’s progress to create an in-person project-based learning activity. Although this has been proposed to be completed in August 2022, we anticipate that the setbacks to the field and subsequent data analysis will cause the timing of these activities to shift. We also anticipate that the needs of the education sector may have shifted over the course of the pandemic. Now that the Breazeal Interpretive Center is open, Elmstrom will work with the education sector in the upcoming months to determine what is needed.

**Time and fund reallocation**

Due to a myriad of Covid-19 related delays, we have opted to reallocate the timing of fundsand apply for a no-cost extension for the academic year 2022-2023. Updated changes to the budget justification of remaining funds are described below.

### Budget

1. **PERSONNEL**

*Elizabeth Elmstrom: Graduate Student Fellow*

A portion of the remaining funds will be used for nine more months of Elmstrom’s stipend support, estimated at $24,881 (current stipend rate of $2,585, future stipend rate of $2778, plus a 3% expected rate increase July 1st). This includes the originally proposed stipend coverage for Spring 2022 and Summer 2022. It also includes stipend coverage for Fall 2022 or Winter 2023 to be used during the extension period. The timing of stipend coverage during the extension period will be determined based on the timing of project related tasks (e.g. if the majority of tasks fall within the Fall 2022 quarter, funds will be used during the fall, or if the majority of tasks fall within Winter 20223, fund will be used during the winter.) During this period, the Fellow will conclude any remaining field sampling necessary, and complete the proposed modeling, statistical analysis, and associated writing.

1. **FRINGE BENEFITS**

Fringe benefit rates for the University of Washington FY2022 include 21.6% for graduate student fellows. Fringe benefits is based on the above Fellow’s time and is estimated at $5,168 for the three quarters. As the University’s benefit rates are determined late Spring/early Summer of each fiscal year (July – June), the rate for FY2023 is presently unknown (https://finance.uw.edu/fr/sites/default/files/fy20-load-rates%20on%20the%20web.pdf)

1. **TRAVEL**

*A total of $593 of domestic travel funds will be allocated to support student travel. This includes vehicle travel with mileage reimbursed of $0.585 per mile. This covers an estimate of 7 trips to complete field work, meetings, and lectures at the Padilla Bay NERR.*

1. **EQUIPMENT**

None

1. **SUPPLIES**

*$452 will be allocated to support for field, laboratory, and computing work. This includes $265 to cover replacement sensor parts for 4 dissolved oxygen sensors, and $188 to replace a broken computer keyboard and adapter.*

1. **CONTRACTUAL**

None

1. **CONSTRUCTION**

None

1. **OTHER**

*Graduate Operating Fees:* A portion of the remaining funding will be used to support Graduate Operating Fees commensurate with the Fellow’s time and is estimated at $13,185. Rates are based on the current 2021-22 academic year fee schedule of $1623.75 for Summer (2-credits) and estimated rates applying a 5% increase on the current fee schedule for the 2022-23 academic year of $5780.25 for Fall and $5,781.30 for Winter 2023

1. **TOTAL DIRECT CHARGES**

Total Directs Costs for remaining funding: $44,486

1. **INDIRECT CHARGES**

Per the University of Washington’s current DHHS Negotiated Rate Agreement dated September 30, 2020 and per the Funding Opportunity,the applicable rate for this activity is 0.00%. The cost base is Modified Total Direct Costs (MTDC) which excludes Fellowships from indirect charges.

1. **TOTALS (direct and indirect charges)**

$44,486