Datasets: Genomic, Environmental, and Restoration Monitoring Data for Eelgrass (Zostera marina) Resilience and Restoration Trials in the North Carolina and Chesapeake Bay National Estuarine Research Reserves

This document provides detailed information about four datasets that were generated through a collaborative research project titled *Evaluating and Enhancing Eelgrass Resiliency and Restoration Potential in a Changing Climate*. This webpage provides information about the project. The project was supported by the National Estuarine Research Reserve System (NERRS) Science Collaborative, which is funded by the National Oceanic and Atmospheric Administration. All Science Collaborative supported projects that collect new data adhere to federal data sharing and archiving requirements.

About the Associated Project

Project page: https://nerrssciencecollaborative.org/project/Jarvis22
Grant Type: Collaborative Research
Focus Area(s): Climate Change, Habitat Restoration
Keyword(s): restoration, eelgrass, climate change

Reserve(s): Chesapeake Bay, VA

Project Duration: October 2022 - March 2025
Grant Amount: $395,503.00
Project Contacts:
Project Lead:
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Collaborative Lead:
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Project Description
In the lower Chesapeake Bay, Virginia, warmer water temperatures in recent years have resulted in large scale diebacks of eelgrass meadows (*Zostera marina*). Historically stable, dense eelgrass meadows have converted to low-density, ephemeral meadows. In contrast, many eelgrass populations in Back Sound, North Carolina appear to be more resilient to warming water temperatures. Restoring this iconic species in Virginia and beyond will require understanding the drivers of eelgrass resilience to climate change.

By coordinating a network of the intended users from reserves, state agencies, and Chesapeake Bay nonprofits, this project compared resiliency traits of eelgrass populations in Virginia and North Carolina. The project team worked with a user advisory group, which held regular

brainstorming meetings, to design an approach that would inform management decisions related to eelgrass, especially restoration. The team conducted reciprocal restoration trials of Virginia and North Carolina eelgrass seeds (i.e. planting seeds sourced from NC at restoration sites in VA, and vice versa). In addition, the team performed whole genome sequencing of eelgrass sourced from both VA and NC. Restoration trials showed that seeds sourced from NC performed better than local VA seeds at some, but not all, of the restoration sites in VA. Genomic results confirmed that eelgrass populations in VA and NC are locally adapted and use different molecular pathways to achieve resilience to warming conditions.

These results offer insights into the drivers of these regional differences in eelgrass resilience. They indicate the importance of seed sources in potential future eelgrass restoration, in addition to focusing on site selection. The team used the results to develop a draft decision-making framework to guide eelgrass restoration efforts with an emphasis on climate resilience. The framework integrates genomic data, environmental monitoring, and site-specific stressor assessments to inform donor site selection and restoration planning. This framework not only synthesized a wide range of data but also incorporated early and consistent input from the End User Advisory Group, which helped ensure that it was both scientifically rigorous and practically relevant.

Overview of Datasets

Four datasets are described in this document:

- **Dataset 1: Reproductive metrics and meadow condition data for *Zostera marina* in North Carolina and Virginia estuarine reserves**

  Site-level summary statistics of eelgrass (Zostera marina) meadow condition across multiple estuarine sites in North Carolina and Virginia during the 2023 growing season. Available at the UNC Dataverse via the following link: https://doi.org/10.15139/S3/MIE0B9

- **Dataset 2: Temperature and light availability data from *Zostera marina* restoration and reference sites in NC and VA reserves**

  Time-series environmental monitoring data collected from seagrass restoration and reference sites in North Carolina and Virginia, including continuous summer measurements of water temperature (°C) and photosynthetically active radiation (PAR). Available at the UNC Dataverse via the following link: https://doi.org/10.15139/S3/GUWZQA

- **Dataset 3: Reciprocal eelgrass (*Zostera marina*) seed restoration monitoring data across NC and VA sites**

  Field monitoring data from a reciprocal seed restoration experiment conducted at multiple Zostera marina transplant sites in North Carolina and Virginia during the 2024 growing season. Available at the UNC Dataverse via the following link: https://doi.org/10.15139/S3/C4GJFA

- **Dataset 4: Whole-genome resequencing and genomic variation data for *Zostera marina* across temperature gradients in NC and VA**

  High-throughput sequencing data from eelgrass populations in both states. Includes SNP data, clone filtering, population structure, and environmental association analyses related to thermal stress adaptation. Available at the NCBI BioProject database via the following link: http://www.ncbi.nlm.nih.gov/bioproject/1282164

Questions about these datasets can be directed to:

Dr. Jessie Jarvis, University of North Carolina Wilmington, jarvisj@uncw.edu

About the Project Datasets

Detailed dataset descriptions are provided below.

Dataset 1: Reproductive metrics and meadow condition data for *Zostera marina* in North Carolina and Virginia estuarine reserves

Data overview:
Site-level summary statistics of eelgrass (*Zostera marina*) meadow condition across multiple estuarine sites in North Carolina and Virginia during the 2023 growing season. Includes quadrat-level data on shoot density, flowering effort, percent cover (total and by species), seed bank density, and viability from meadows. Collected in spring, summer, and fall to assess seasonal responses to thermal stress.

Keywords: *Zostera marina*, seagrass, shoot density, percent cover, seed bank, seed viability

Data collection period: May, 2023 to September, 2023

Geographic extent:

State	Site Number	Site Name	Latitude (dd)	Longitude (dd)
VA	1	Poquoson A	37.163480	-76.335340
VA	2	Poquoson B	37.145870	-76.328180
VA	3	Goodwin A	37.223420	-76.387500
VA	4	Goodwin B	37.217580	-76.392970
VA	5	Allens Island	37.253717	-76.428067
VA	6	Guinea	37.266933	-76.373167
VA	7	Big Island	37.272067	-76.355033
VA	8	Monday Creek	37.277817	-76.369483
VA	9	Goodwin C	37.223333	-76.400900
VA	10	Browns Bay	37.304983	-76.389633
NC	1	Bogue_1	34.683104	-77.00355
NC	2	North River	34.722445	-76.61477
NC	3	MM-A	34.690900	-76.62221
NC	4	MM_C	34.699014	-76.59602
NC	5	Morgans Is	34.660346	-76.5263
NC	6	Bogue_2	34.670750	-77.07332
NC	7	Harkers Island	34.699278	-76.52529
NC	8	Davis Island	34.770850	-76.41731
NC	9	South Core	34.768430	-76.43422
NC	10	Topsail	34.398447	-77.61568

File format:
Microsoft Excel (.xlsx)

File name(s):

Zostera marina Reproduction and Meadow Condition NC and VA Reserves 2023.xlsx

Data access and archival:
Data have been have been archived on the UNC Dataverse and are publicly accessible at: https://doi.org/10.15139/S3/MIE0B9

All files are openly available for download under a Creative Commons Attribution (CC0 1.0) license. Users are encouraged to cite the dataset using the provided citation information on the Dataverse page.

Maps and schematics for data collection:

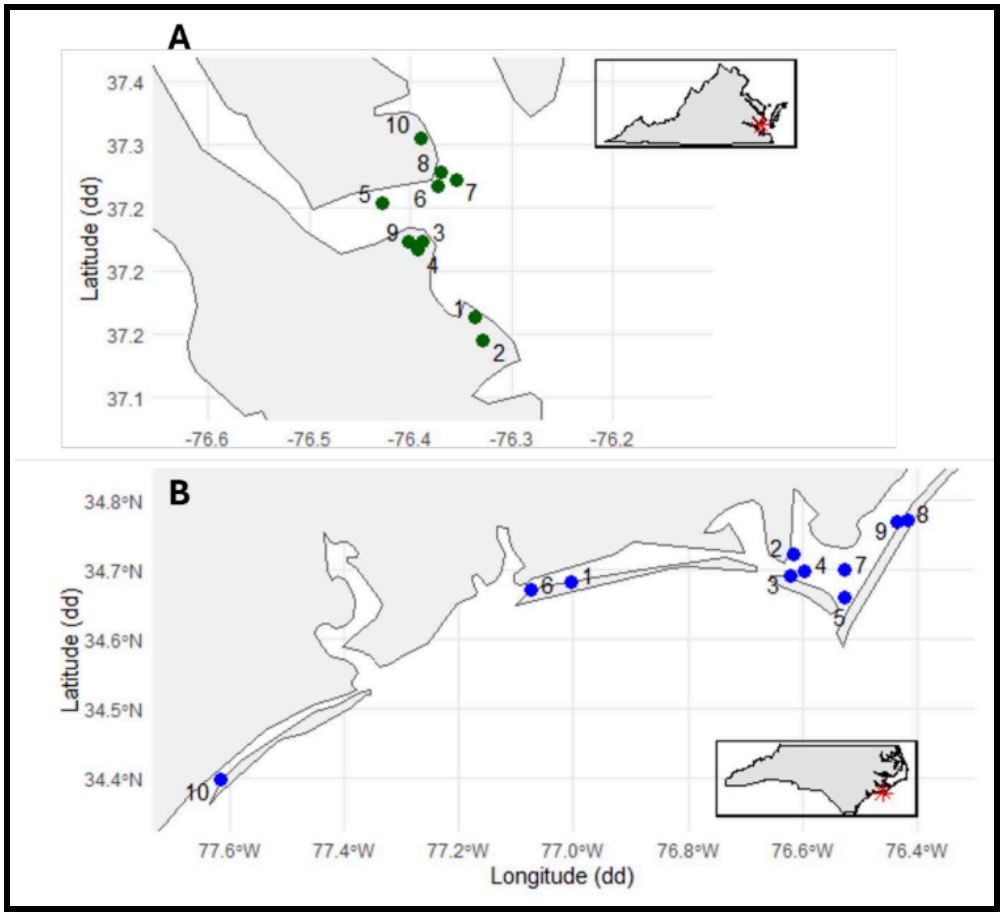

Figure 1: Map of Virginia (A) and North Carolina (B) eelgrass (*Z. marina*) donor meadow sites.

Dataset 2: Temperature and light availability data from *Zostera marina* restoration and reference sites in NC and VA reserves

Data overview:
Time-series environmental monitoring data collected from seagrass restoration and reference sites in North Carolina and Virginia. Continuous summer measurements of water temperature (°C) and photosynthetically active radiation (PAR) from eelgrass transplant and reference sites.

Keywords:
water temperature, PAR, seagrass, climate, stress

Data collection period:
February 5, 2024 to October 13, 2024

Geographic extent:

State	Site Number	Name	Latitude (dd)	Longitude (dd)
VA	1	Poquoson A	37.163480	-76.335340
VA	3	Goodwin A	37.223420	-76.387500
VA	5	Allens Island	37.253717	-76.428067
NC	1	Bogue_1	34.683104	-77.00355
NC	2	North River	34.722445	-76.61477
NC	10	Topsail	34.398447	-77.61568

File format:
Microsoft Excel (.xlsx)

File name(s):
Zostera marina Temperature and Light Data NC and VA Reserves.xlsx

Data access and archival:
Data have been have been archived on the UNC Dataverse and are publicly accessible at: https://doi.org/10.15139/S3/GUWZQA

Maps and schematics for data collection:

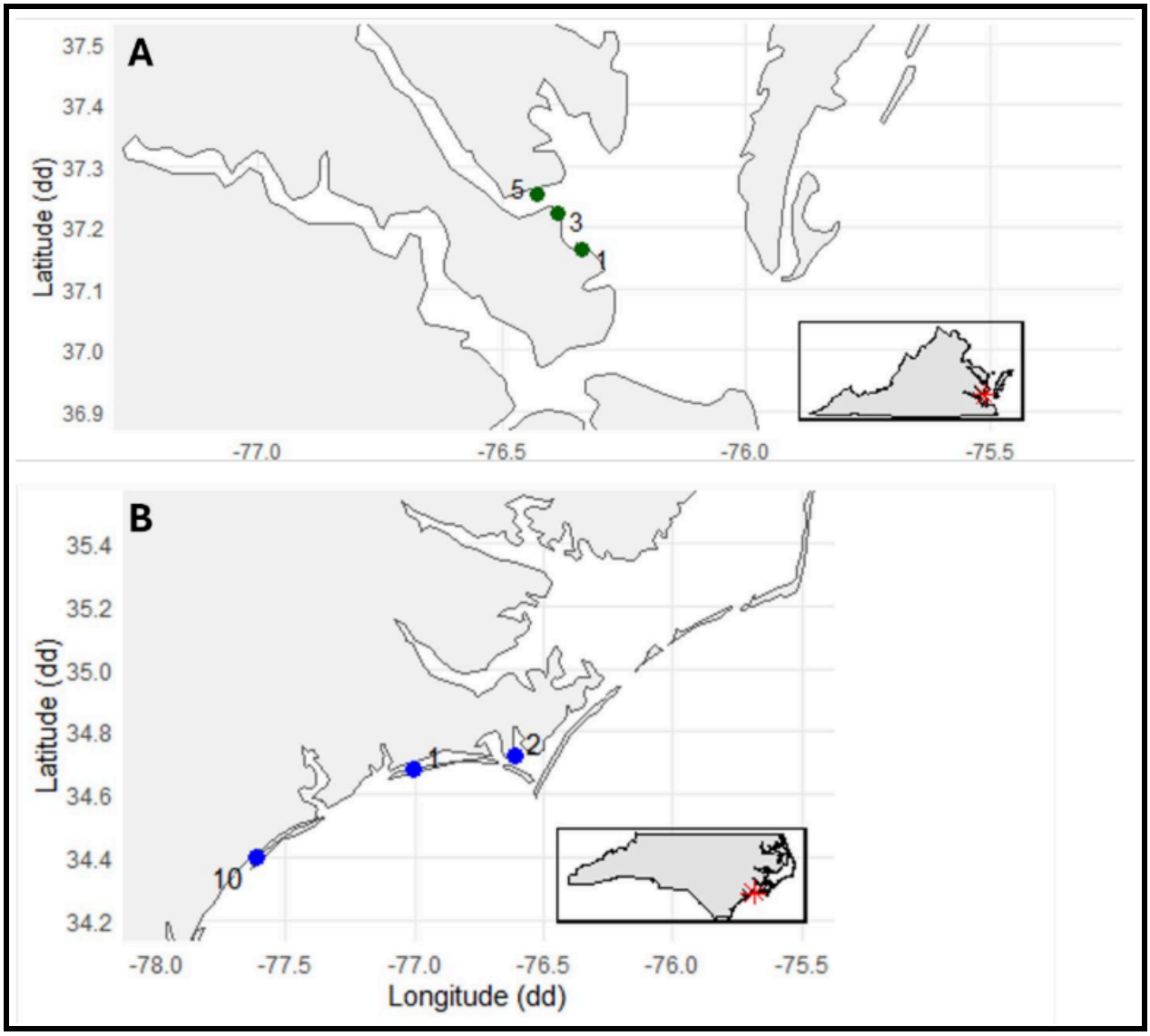

Figure 2: Map of Virginia (A) and North Carolina (B) eelgrass (*Z. marina*) restoration sites.

Dataset 3: Reciprocal eelgrass (*Zostera marina*) seed restoration monitoring data across NC and VA sites

Data overview:
Field monitoring data from a reciprocal seed restoration experiment conducted at multiple *Zostera marina* transplant sites in North Carolina and Virginia during the 2024 growing season. Includes plot-level percent cover, shoot density, species composition, and flowering data from seed-based transplant plots. Tracks seedling survival by source and destination site across spring, early summer, and late summer.

Keywords: eelgrass, restoration, seed source, transplant, common garden, shoot density, percent cover

Data collection period: March, 2024 to September, 2024

Geographic extent:

State	Site Number	Name	Latitude (dd)	Longitude (dd)
VA	1	Poquoson A	37.163480	-76.335340
VA	3	Goodwin A	37.223420	-76.387500
VA	5	Allens Island	37.253717	-76.428067
NC	1	Bogue_1	34.683104	-77.00355
NC	2	North River	34.722445	-76.61477
NC	10	Topsail	34.398447	-77.61568

File format:
Microsoft Excel (.xlsx)

File name(s):
Reciprocal Eelgrass Seed Restoration Monitoring Data Across NC and VA Sites.xlsx

Data access and archival:
Data have been have been archived on the UNC Dataverse and are publicly accessible at: https://doi.org/10.15139/S3/C4GJFA

Dataset 4: Whole-genome resequencing and genomic variation data for *Zostera marina* across temperature gradients in NC and VA

Data overview:
High-throughput sequencing data from eelgrass populations in both states. Includes SNP data, clone filtering, population structure, and environmental association analyses related to thermal stress adaptation

Keywords:
eelgrass genomics, SNPs, thermal adaptation

Data collection period: May, 2023 to September, 2023

Geographic extent:

State	Site Number	Site Name	Latitude (dd)	Longitude (dd)
VA	1	Poquoson A	37.163480	-76.335340
VA	2	Poquoson B	37.145870	-76.328180
VA	3	Goodwin A	37.223420	-76.387500
VA	4	Goodwin B	37.217580	-76.392970
VA	5	Allens Island	37.253717	-76.428067
VA	6	Guinea	37.266933	-76.373167
VA	7	Big Island	37.272067	-76.355033
VA	8	Monday Creek	37.277817	-76.369483
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NC	5	Morgans Is	34.660346	-76.5263
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NC	8	Davis Island	34.770850	-76.41731
NC	9	South Core	34.768430	-76.43422
NC	10	Topsail	34.398447	-77.61568

File format: FASTQ (.fastq.gz) used for text-based file format used to store raw sequencing data from high-throughput sequencers; Software Needed: FASTQ Toolkit by Illumina; file sizes are ~1.04 GB per sequence file

File name(s):
The files used in this project use the following format: “ProjectNumberKam_StateMeadow-Shoot” (where Kam are the first 3 letters in the PIs last name. Example file name: 23219Kam_NC10-1. Also make a note to ensure that the file names match your HPCC requirements.

Data access and archival:

Data have been have been archived on the he NCBI BIoProject database and will be publicly accessible (following publication) at: http://www.ncbi.nlm.nih.gov/bioproject/1282164