



University of
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Size-Fractionated Phytoplankton Respiration Rates on NOAA's 3rd East Coast Ocean Acidification Research Cruise

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Introduction

ECO-A-3:

- East Coast Ocean Acidification Cruise
- Ongoing program: NOAA
- Monitors carbon system along the U.S. East Coast
- Links marine biological and chemical processes
- Track long-term ocean change

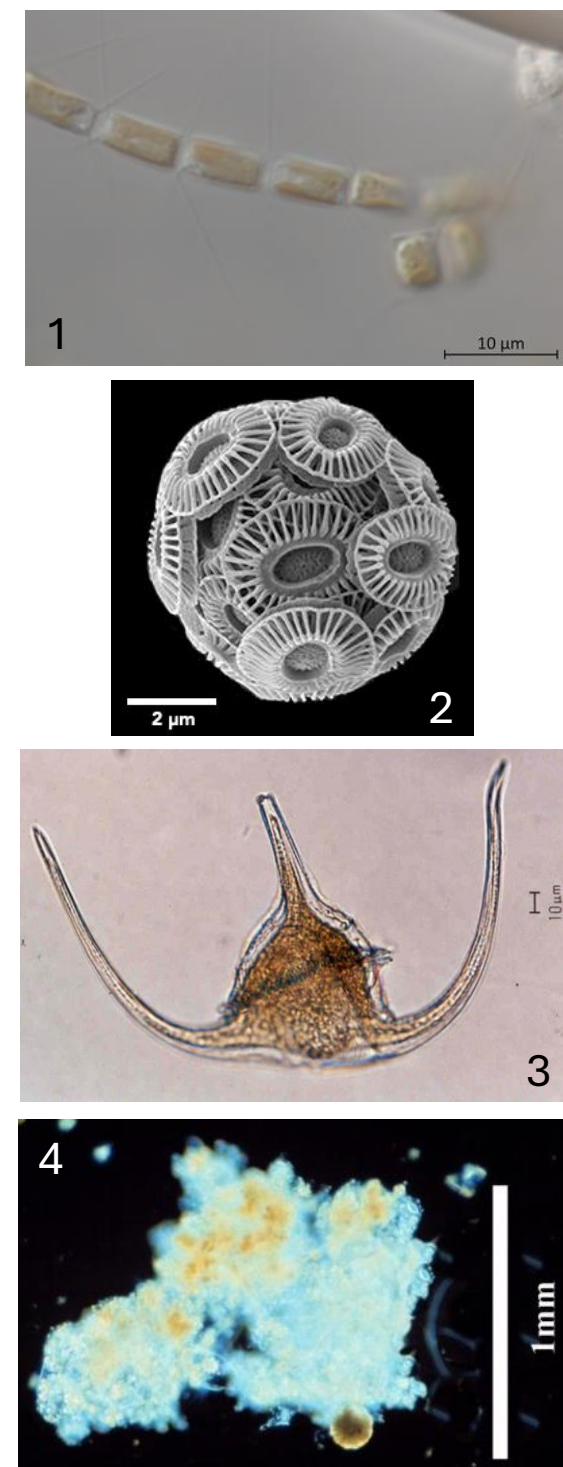
The Carbon Cycle:

- Ocean = carbon sink
- Anthropogenic climate change
 - Temperatures ↑
 - Cellular respiration rates ↑
 - CO₂ production ↑
 - Dissolved inorganic carbon ↑
 - pH ↓
 - Ocean Acidification
 - Respiration – important in food webs

Size Fractionation:

- Plankton sizes are changing
- Warmer waters = changes in plankton types

- 4 um Filter: Single Cells
 - Cyanobacteria
 - Picoeukaryotes
 - Diatoms and coccolithophores
- 8 um Filter: Aggregates
 - Diatoms
 - *Chaetoceros tenuissimus* 1
 - Coccolithophores
 - *Emiliania huxleyi* 2
 - Dinoflagellates
 - *Tripes muelleri* 3
 - Eukaryotes
 - Fecal Pellets
 - Marine Snow 4



Methods

Measuring Cellular Respiration (CR):

- Water samples taken at surface and deep chlorophyll maximum
- Measuring electron transport system activity (ETS) using INT
 - (Tetrazolium salt 2-para [Iodo-phenyl]-3[Nitro-phenyl] Tetrazolium chloride).

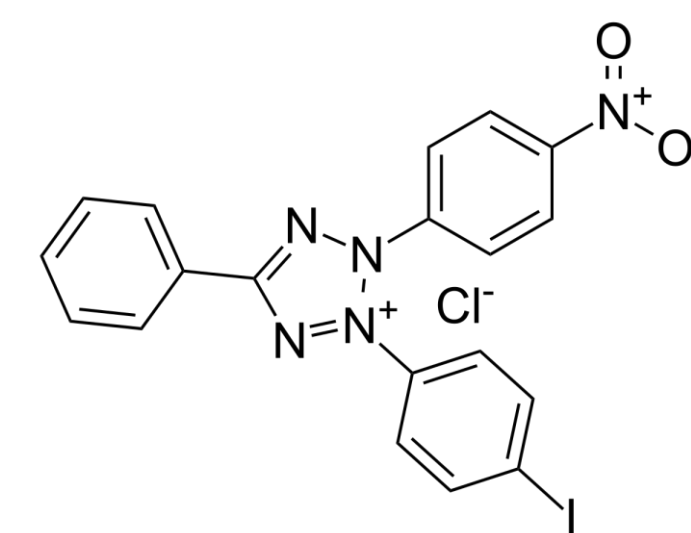


Figure 5. Chemical structure of Tetrazolium salt 2-para (Iodo-phenyl)-3[Nitro-phenyl] Tetrazolium chloride (Wikipedia).

- Samples incubated with INT substrate for 2-4 hours
- Then neutralized with formaldehyde
- Filtration through 8um and 4um filters
- Filters collected, processed and analyzed for absorbance
- Used to calculate the cellular respiration at each size fraction using the following equation:

$$\log CR_{O_2} = 0.72 \log INT_T + 0.64$$

Equation 1. Cellular respiration where: CR_{O₂} is dissolved oxygen consumption, and INT_T is the INT reduction (Garcia-Martin et al., 2019).

- Cellular respiration rates at each size were plotted using Ocean Data View

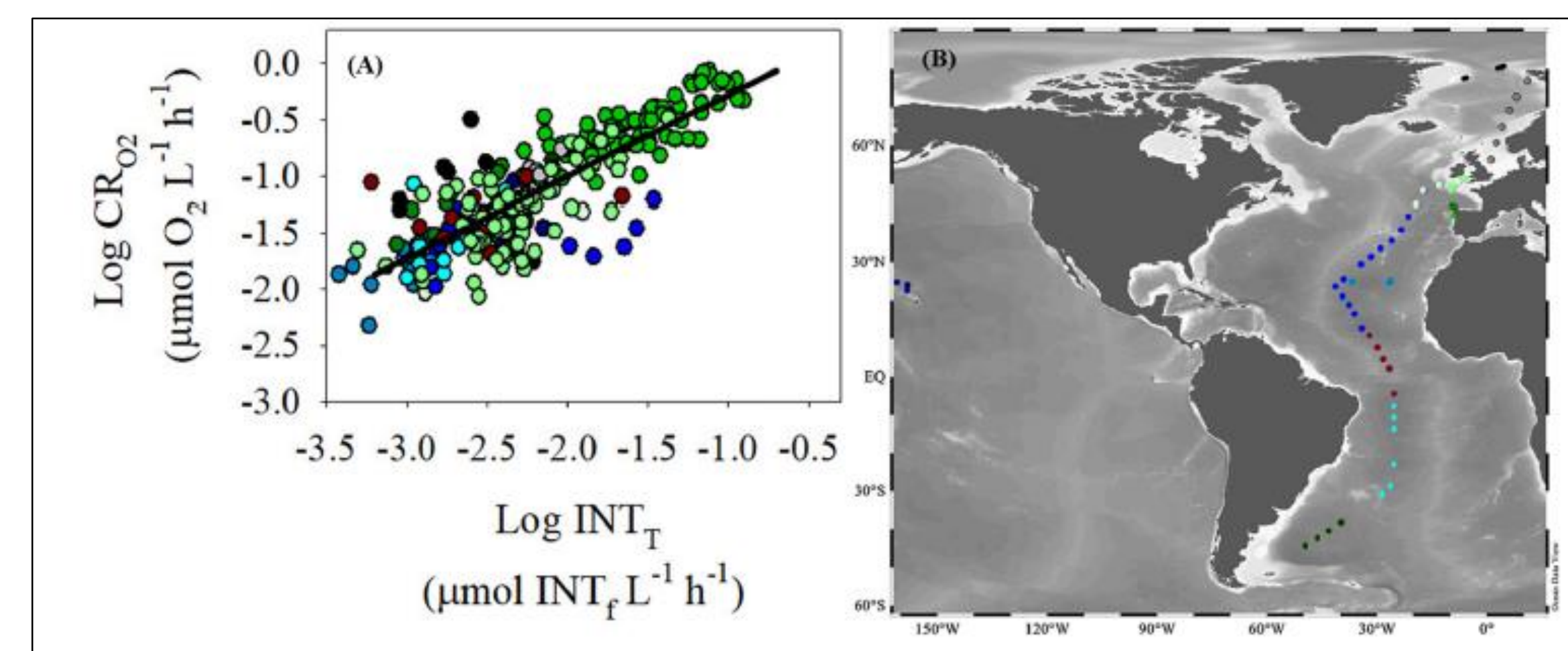


Figure 6. Correlations between CR_{INT} and oxygen consumption (Garcia-Martin et al., 2019).

Results

CR [ug O₂ L⁻¹ d⁻¹] @ DEPTH [M]=5

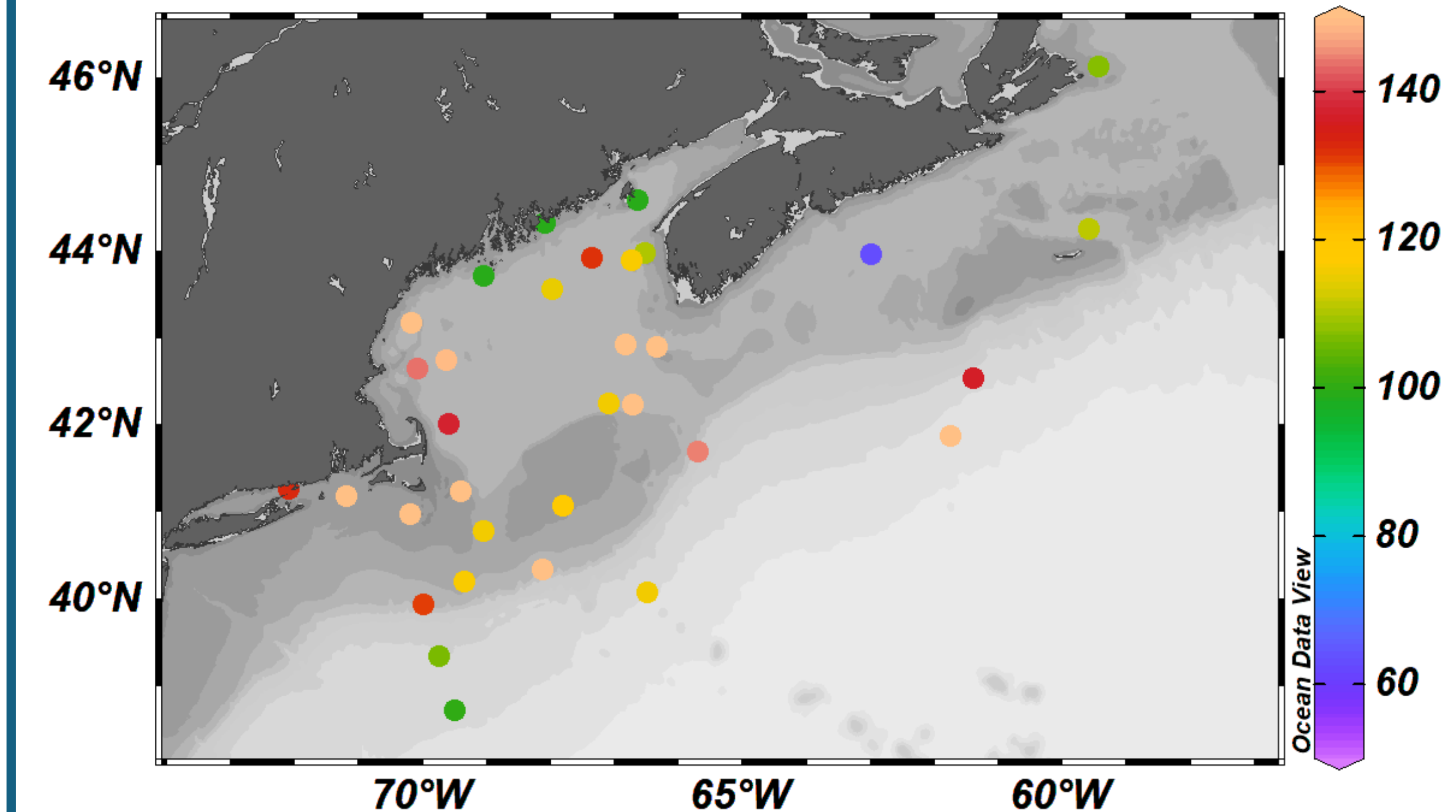


Figure 7. Combined cellular respiration rates (ug O₂ L⁻¹ d⁻¹) at the surface (~5m) from the 2022 ECOA-3 Research Cruise.

CR [ug O₂ L⁻¹ d⁻¹] @ DEPTH [M]=15

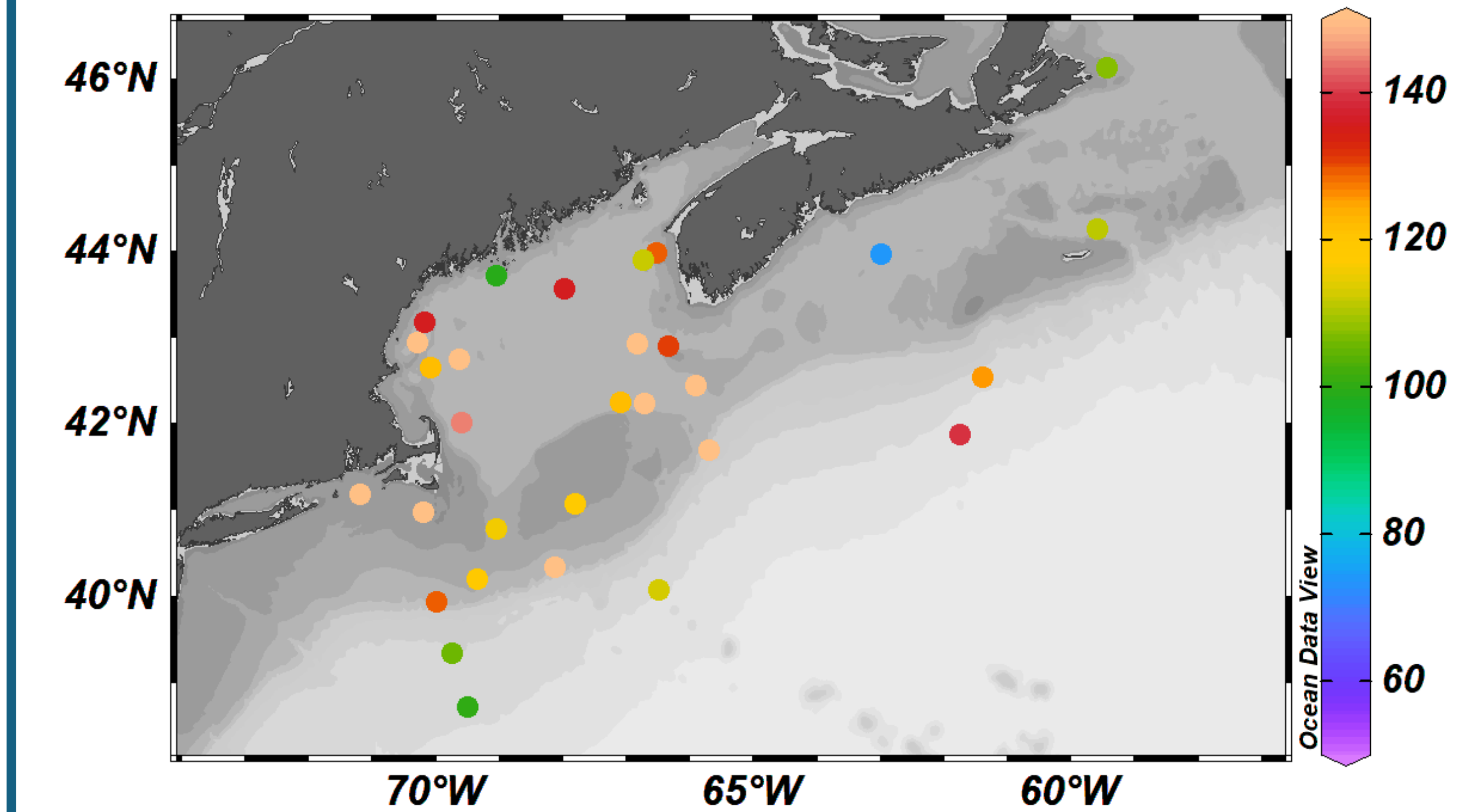


Figure 8. Combined cellular respiration rates (ug O₂ L⁻¹ d⁻¹) at the deep chlorophyll maximum (~15m) from the 2022 ECOA-3 Research Cruise.

Hypothesis

Coastal Regions = Higher CR Rates

Larger Size (0.08um) Dominates

Subsurface = Higher CR Rates

Findings

Rates Varied Spatially

8/10 Highest CR Rates Dominated by 0.8um

0.2um Higher CR Rates: Surface
0.8um Higher CR Rates; Subsurface

References

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- Figure 1: <https://www.ccap.ac.uk/catalogue/strain-1010-43>
- Figure 2: https://en.wikipedia.org/wiki/Emiliania_huxleyi
- Figure 3: <http://coo.fieldofscience.com/2013/07/ceratium-er-neoceratium-er-tripos.html>
- Figure 4: <https://marinemadnessdotblog.wordpress.com/2020/01/27/the-snow-that-falls-to-the-bottom-of-the-sea/>
- Figure 5: [https://en.wikipedia.org/wiki/INT_\(chemical\)#:~:text=INT%20\(iodonitrotetrazolium%20or%20%2D,\(used%20for%20quantitative%20redox%20assays.](https://en.wikipedia.org/wiki/INT_(chemical)#:~:text=INT%20(iodonitrotetrazolium%20or%20%2D,(used%20for%20quantitative%20redox%20assays.)

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