

# Daniel E. Sandborn, Ph.D.

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## EDUCATION

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### University of Minnesota

2024

Ph.D. Limnology and Oceanography

*Inorganic carbon cycling in Lake Superior and responses to anthropogenic carbon dioxide*

*Advisor: Elizabeth C. Minor*

### California Polytechnic State University San Luis Obispo

2020

B.S. Chemistry *summa cum laude* with Honors

## RESEARCH EXPERIENCE

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### University of Minnesota — Large Lakes Observatory

Duluth, MN

*Ph.D. Dissertation Research with Prof. Elizabeth Minor*

*August 2020 - Present*

- Designed, built, and tested novel open-source alkalinity measurement instrumentation to advance the accessibility of high-quality environmental chemical analysis.
- Described CO<sub>2</sub> dynamics and fluxes in the Laurentian Great Lakes using continuous and discrete observations and machine learning models.
- Advanced the use of CaCO<sub>3</sub> saturation state as a novel predictor of invasive mussel habitat in freshwater ecosystems.
- Created and contributed to software for marine chemical equilibrium and particle tracking research.

### California Polytechnic State University

San Luis Obispo, CA

*Research Assistant to Prof. Emily Bockmon*

*January 2018 - June 2020*

- Pioneered seawater carbonate chemistry timeseries on the California Central Coast.
- Built spectrophotometric pH instrument capable of high-accuracy measurement of seawater chemistry.
- Coordinated and volunteered with community marine science outreach.

### Pacific Northwest National Laboratory

Richland, WA

*Summer Undergraduate Laboratory Internship with Dr. Aditi Sengupta June 2019 - September 2019*

- Developed methods for respiration rate analysis of soil and sediment samples.
- Participated in soil, water, and gas sampling study of salinity encroachment upon terrestrial ecosystems.
- Assisted with WHONDRS global biogeochemistry sampling campaign.

## TEACHING EXPERIENCE

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### University of Minnesota Duluth

Duluth, MN

*Graduate Teaching Assistant*

*August 2020 - December 2023*

- CHEM 2212: Environmental Chemistry — 3 semesters

Redeveloped laboratory experiment manual to promote student engagement and application of environmental chemistry concepts to real-world contexts. Designed and delivered lectures on analytical methods. Planned and led field science activities.

- CHEM 1153: General Chemistry I — 2 semesters

Led discussion groups with undergraduate students.

- CHEM 1154: General Chemistry I Laboratory — *3 semesters*

Led laboratory activities with undergraduate students.

### California Polytechnic State University

*Undergraduate Learning Assistant*

San Luis Obispo, CA  
August 2019 - January 2020

- CHEM 124: General Chemistry I — *1 quarter*

Assisted faculty in studio chemistry classrooms.

## FIELD EXPERIENCE

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### Scientific Cruises

- Scientist, SeaGrant sampling campaign, *RV Blue Heron*, May 14-16 2022
- CTD Watchstander, GO-SHIP A13.5, *RV Marcus G. Langseth*, February 2-March 24 2024
- **Chief Scientist**, *RV Kingfisher*, August 11 2022
- Scientist, GLOS Mooring Deployment, *RV Blue Heron*, June 7-9 2022
- **Chief Scientist**, *RV Kingfisher*, June 1 2022
- Scientist, SeaGrant sampling campaign, *RV Blue Heron*, August 3-4 2022

### Field Research

- EXCHANGE sampling campaign, Summer 2022
- WHONDRS Soil/water sampling, July 2019

## PUBLICATIONS

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### *Refereed Publications*

1. **Sandborn, D. E.**; Minor, E. C.; Hill, C. (2023). "Total alkalinity measurement using an open-source platform". *Limnol. Oceanogr. Methods*, 21: 334-344. doi: 10.1002/lom3.10549
2. **Sandborn, D. E.**, & Minor, E. C. (2024). Underway pCO<sub>2</sub> surveys unravel CO<sub>2</sub> invasion of Lake Superior from seasonal variability. *Journal of Geophysical Research: Biogeosciences*, 129, e2023JG007877. <https://doi.org/10.1029/2023JG007877>

### *Submitted, In preparation and In review*

1. **Sandborn, D. E.**; Minor, E. C. "A neural network predictive model for Lake Superior surface pCO<sub>2</sub>". *In preparation*.
2. **Sandborn, D. E.**; Austin, J. A.; Lafrancois, B. M. "Developing a particle tracking model in Lake Superior". NPS Reports. *In preparation*.

### *Software*

1. Humphreys, M. P., Schiller, A. J., **Sandborn, D. E.**, Gregor, L., Pierrot, D., van Heuven, S. M. A. C., Lewis, E. R., and Wallace, D. W. R. (2022). PyCO<sub>2</sub>SYs: marine carbonate system calculations in Python. Zenodo. doi:10.5281/zenodo.3744275.
2. **Sandborn, D.E.** RPi-Alkalinity: Publication Release. Zenodo. doi:10.5281/zenodo.7864447

## GRANTS AND FELLOWSHIPS

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### Student Conference Award

*Northeastern Association of Marine and Great Lakes Laboratories*

2023

\$400

- Presentation at the 2023 Ocean Carbon Biogeochemistry Summer Workshop

**Graduate Research Fellowship***Cooperative Institute for Great Lakes Research*

2022-2023

\$25,000

- “Aragonite Saturation State as a Driver of Invasive Dreissenid Habitat”

**Early Career Travel Award***Association for the Sciences of Limnology and Oceanography*

2022

\$400

- *Presentation at the 2022 Joint Aquatic Sciences Meeting*

**COAST Undergraduate Research Award***Central Coast Center for Marine Sciences*

2019

\$500

- “Purifying *meta*-Cresol Purple Indicator Dye for Accurate Measurements of Ocean pH”

**PRESENTATIONS**

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## Invited Presentations

1. **Sandborn, D. E.**; Minor, E.C.; Austin, J. “Drivers of Dreissenid Habitat: Moving Beyond Calcium and Temperature”. Invasive Mussel Collaborative meeting. December 2024. *Virtual*.
2. **Sandborn, D. E.**; Minor, E.C. “The Breath of Lake Superior and Observation of “The Other CO<sub>2</sub> Problem”. Twin Ports Freshwater Folk meeting. December 2024. *Virtual*.
3. Minor, E.C.; **Sandborn, D. E.**; Brinkley, G. 2022. “Are increasing atmospheric CO<sub>2</sub> concentrations causing lake acidification in Lake Superior?”. MN AWWA Annual Conference. September 2022. Duluth, MN. [*Minor, invited oral presentation*]

## Abstracts

1. **Sandborn, D.E.**; Austin, J. “Patterns of Lake Superior AIS dispersal illustrated by particle tracking.”. Meeting of the Association for the Sciences of Limnology and Oceanography. June 2024. Madison, WI.
2. **Sandborn, D.E.**; Austin, J. “Patterns of Lake Superior AIS dispersal illustrated by particle tracking.”. Meeting of the International Association for Great Lakes Research. May 2024. Windsor, ON.
3. Kittaka, P. K.; **Sandborn, D.E.**; Minor, E.C. “Diel, Seasonal and Storm-related Changes in Carbonate System Variables in Lake Superior Tributaries”. Meeting of the American Geophysical Union. December 2022. Chicago, IL.

## Presentations

1. **Sandborn, D.E.**; Minor, E.C. “The Other CO<sub>2</sub> Problem in the Saltless Seas: High-Resolution Observations in Lake Superior”. June 2023. Poster presentation. Ocean Carbon Biogeochemistry Summer Workshop. Woods Hole, MA, USA.
2. **Sandborn, D.E.**; Minor, E.C.; Errera, R.M. “CaCO<sub>3</sub> Saturation State: The Case for a Comprehensive Dreissenid Chemical Predictor”. October 2022. Poster presentation. Cooperative Institute for Great Lakes Research All Partners Meeting. *Virtual*.
3. **Sandborn, D.E.**; Minor, E.C. “CO<sub>2</sub> Acidification in Lake Superior: Developing a Chemical Forecast”. May 2022. Poster presentation. Joint Aquatic Sciences Meeting, Grand Rapids, MI, USA.
4. **Sandborn, D.E.**; Minor, E.C. “Quantifying Spatiotemporal Heterogeneity in Inorganic Carbon Chemistry of Lakes Superior and Michigan”. June 2021. Oral presentation. Association for the Sciences of Limnology and Oceanography Meeting. *Virtual*.

5. **Sandborn, D.E.**; Sengupta, A. "Developing methods for sediment carbon flux measurement via incubation". August 2019. Poster presentation. Pacific Northwest National Laboratories Undergraduate Symposium. Richland, WA, USA.
6. Bockmon, E.; **Sandborn, D.E.**; Schmidt, G.; Norgaard, A. "Improving instrumentation for characterizing the carbon dioxide system in seawater". August 2018. Poster presentation. Cal Poly Frost Symposium. San Luis Obispo, CA, USA.
7. Bockmon, E.; **Sandborn, D.E.**; Schmidt, G.; Norgaard, A. "Seawater carbonate chemistry at the Cal Poly Pier, Avila Beach". August 2018. Poster presentation, Cal Poly Frost Symposium. San Luis Obispo, CA, USA.
8. **Sandborn, D.E.**; Lehr, C.R.; "Solubility behavior of Cyanuric Acid". May 2018. Southern California Undergraduate Research Conference. Pomona, CA, USA.

## HONORS

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<b>Outstanding Graduate Teaching Assistant Award</b>	<i>2022</i>
Swenson College of Science and Engineering	
<b>Learning Assistant of the Year</b>	<i>2020</i>
Cal Poly Department of Chemistry and Biochemistry	
<b>Award for Excellence in Analytical Chemistry</b>	<i>2018</i>
Cal Poly Department of Chemistry and Biochemistry	

## PROFESSIONAL SERVICE AND AFFILIATIONS

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<b>Professional Affiliations</b>	American Chemical Society Member 2016-Present Assn. for the Sciences of Limn. and Oceano. Member 2020-Present International Assn. for Great Lakes Research Member 2022-Present
<b>Profesional Service</b>	Student Fees Coordinator for Large Lakes Observatory 2022-Present Water Resources Students in Action Coordinator 2021-2022
<b>Outreach</b>	<i>RV Blue Heron</i> Science on Deck Volunteer 2023 LLO Open House Volunteer 2023 UMN Day of Data Presenter 2022 UMD Chemistry Mole Day Volunteer 2022 CCMS Pier Open House Volunteer 2019