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EDUCATION

2022 **Harvard University**, *Cambridge, MA*
Ph.D., Environmental Science and Engineering
S.M., Applied Mathematics
Thesis: An Analytical and Statistical Toolbox for Per- and Polyfluoroalkyl Substances Biogeochemistry and Source Attribution

2017 **University of Colorado Boulder**, *Boulder, CO*
B.S., Environmental Engineering
summa cum laude with honors

PEER-REVIEWED PUBLICATIONS

PUBLISHED:

1. **Ruyle B.**, Thackray C., Butt C., LeBlanc D., Tokranov A., Vecitis C., Sunderland E. (2023) "Centurial Persistence of Forever Chemicals at Military Fire Training Sites." (2023). *Environmental Science & Technology*. https://doi.org/10.1021/acs.est.3c00675
2. **Ruyle B.**, Schultes L., Akob D., Harris C., Lorah M., Vojta S., Becanova J., McCann S., Pickard H., Pearson A., Lohmann R., Vecitis C., Sunderland E. (2023) "Nitrifying microorganisms linked to biotransformation of perfluoroalkyl sulfonamido precursors from legacy aqueous film forming foams." *Environmental Science & Technology*. https://doi.org/10.1021/acs.est.2c07178
3. Dunn M., Becanova J., Snook J., **Ruyle B.**, Lohmann R. (2023) "Calibration of Perfluorinated Alkyl Acid Uptake By a Novel Tube Passive Sampler in Water." *ACS ES&T Water*. https://doi.org/10.1021/acsestwater.2c00384
4. Pickard H., **Ruyle B.**, Thackray C., Chovancova A., Dassuncao C., Becanova J., Votja S., Lohmann R., Sunderland E. (2022) "PFAS and Precursor Bioaccumulation in Freshwater Recreational Fish: Implications for Fish Advisories." *Environmental Science & Technology*. https://doi.org/10.1021/acs.est.2c03734
5. Tokranov A., LeBlanc D., Pickard H., **Ruyle B**., Hull R., Barber L., Hull R., Sunderland E., Vecitis C. (2021) "Surface-water/groundwater boundary effects on seasonal PFAS concentrations and PFAA precursor transformations." *Environmental Science: Processes and Impacts*. https://doi.org/10.1039/D1EM00329A
6. Ge B., Hu X., **Ruyle B.**, Sun J., Sunderland E. (2021) "A Statistical Approach for Identifying Private Wells Susceptible to Perfluoroalkyl Substances (PFAS) Contamination." *Environmental Science & Technology Letters*. https://doi.org/10.1021/acs.estlett.1c00264
7. **Ruyle B.**, Pickard H., LeBlanc D., Tokranov A., Hu C., Vecitis C., Sunderland E. (2021) "Isolating the AFFF Signature in Coastal Watersheds using Oxidizable PFAS Precursors and Unexplained Organofluorine." *Environmental Science & Technology*. https://doi.org/10.1021/acs.est.0c07296
8. **Ruyle B.**, Thackray C., McCord J., Strynar M., Mauge-Lewis K., Fenton S., Sunderland E. (2021) "Reconstructing the Composition of Per- and Polylfuoroalkyl Substances in Contemporary Aqueous Film-Forming Foams." *Environmental Science & Technology Letters*. https://doi.org/10.1021/acs.estlett.0c00798
9. Sitterly K., Rosenblum J., **Ruyle B.**, Keliher R., Linden K. (2020) "Factors impacting electrocoagulation treatment of hydraulic fracturing fluids and removal of common fluid additives and scaling ions." *Journal of Environmental Chemical Engineering*. https://doi.org/10.1016/j.jece.2020.103728
10. Rosenblum J., Nelson A., **Ruyle B.**, Schultz M., Ryan J., Linden K. (2017) "Temporal characterization of flowback and produced water quality from a hydraulically fractured oil and gas well." *Science of the Total Environment*. https://doi.org/10.1016/j.scitotenv.2017.03.294

IN REVIEW:

11. Antell N., Yi S., Olivares C., **Ruyle B.,** Kim J., Tsou K., Dixit F., Alvarez-Cohen L., Sedlak D. "The Total Oxidizable Precursor (TOP) Assay as a Forensic Tool for Per- and Polyfluoroalkyl Substances (PFAS) Source Apportionment."
12. **Ruyle B.,** Pickard H., Schultes L., Fredriksson F., Heffernan A., Knappe D., Lord H., Meng P., Mills M., Ndung'u K., Roesch P., Lord H., Westerman D., Yeung L., Sunderland E. "An Interlaboratory Comparison of Extractable Organofluorine Measurements in Groundwater and Eel (*Anguilla rostrata*): Recommendations for Methods Standardization."
13. Mauge-Lewis K., **Ruyle B.**, McCord J., Sunderland E., Ferguson S., Strynar M., Chappell V., Fenton S. "Lipid-inducing activity of fluorotelomer-containing aqueous film-forming foams (AFFF) in human liver cells: Content characterization and impact."

IN PREPARATION:

14. **Ruyle B.,** et al. "Fluorine content of municipal wastewater in the United States."

PRESENTATIONS

INVITED TALKS:

1. "Using EOF and the TOP Assay to Understand PFAS Biogeochemistry Downstream of Historical Fire-fighting Training." Northeast Conference on the Science of PFAS: Public Health & the Environment. April 2022.
2. "PFAS Detection in Cape Cod, MA Watersheds." Sources, Transport, Exposure, and Effects of PFAS Superfund Research Program Center Let's Talk About PFAS webinar series. June 2021.
3. "Assessing Poly- and Perfluoroalkyl Substances (PFASs) Sources, Transport, and Health Risks." United States Geological Survey Minnesota Water Science Center. June 2018.

TALKS:

4. "Reconstructing the Composition of PFAS in Aqueous Film-Forming Foams." Platform presentation at the Society of Environmental Toxicology and Chemistry (SETAC) North America Annual Meeting. November 2020.
5. "Detection and transformations of PFAS Downstream from Fire Training Areas in Groundwater-fed Coastal Watersheds." Platform presentation at the Society of Environmental Toxicology and Chemistry (SETAC) North America Annual Meeting. November 2019.

POSTERS:

6. Centurial Persistence of Forever Chemicals at Military Fire Training Sites Without Remediation. Poster at the Gordon Research Conference Environmental Science: Water. June 2022.
7. A Mass Budget for PFAS Subsurface and Riverine Transport and Retention in a Coastal Groundwater and Surface Water System. Poster at the American Chemical Society (ACS) National Meeting. August 2018.

TEACHING, LEADERSHIP, & SERVICE

Fall 2022 **Interim Allston Burr Resident Dean**, *Dunster House | Harvard College*
Chief academic officer of one of the undergraduate Houses within the Harvard College residential system

Responsibilities include:

- Oversee the academic progress and wellbeing of 450 students
- Liaise with health and mental health services, Registrar, Office of Undergraduate Education, and Dean of Students, course staff and partner offices to provide holistic student care

- Enforce the Handbook for Students as a voting member of the Administrative Board
- Supervise the Academic Coordinator and ensure proper record keeping and confidentiality of student files
- Serve in a 24/7 on-call capacity to provide support for serious student incidents

2020 – 2022 **Resident Tutor**, *Dunster House* | *Harvard College*
Subspecialties Roles: BLGTQ and culinary
Support and advise undergraduates in one of the Houses within the Harvard College residential system

Responsibilities include:
- Advise 7-9 sophomores per year in course selection and declaration of field of study
- Plan and coordinate events themed to promote the BLGTQ community within the House
- Create the menu and cater the monthly Faculty Dean open houses for ~200 students
- Serve in a rotating 24/7 on-call capacity to provide support for serious student incidents

Fall 2018 **Teaching Fellow**, ES6 *Introduction to Environmental Science and Engineering* | *Harvard College*

Wrote and graded homework and exams and held office hours for class of 30+ students. Topics included fundamentals of climate, soil, water quality, air pollution, and public health impacts

2020-2022 **Co-founder and member**, *Queer Earth Scientists Organization* | *Earth and Planetary Science Department, Harvard University*

2020-2022 **Member**, *Finance and Benefits Committee* | *Harvard Graduate Students Union*

Guided student workers through the application process to receive health care, dental, and childcare expenses and evaluated their applications to guarantee documentation of all listed claims.

Journal Reviewer for Environmental Science & Technology, Chemosphere, Environmental Research, Critical Reviews in Environmental Science and Technology, and Frontiers in Environmental Science

HONORS & AWARDS

2021	National Institute of Environmental Health Sciences June 2021 Extramural Paper of the Month
2019	National Science Foundation Graduate Research Fellowship Program Honorable Mention
2019	National Defense Science and Engineering Fellowship Honorable Mention
2017	University of Colorado Boulder Outstanding Senior of Environmental Engineering
2017	Marshall Scholarship Finalist
2016	Udall Scholar

GRANTS

2021 "Application of Novel Analytical Methods to Assess Toxicokinetic of PFAS Mixtures."
Superfund Research Program K.C. Donnelly Externship Program Award ($10,000)

RESEARCH EXPERIENCE

2023 – **Postdoctoral Fellow**, *Carnegie Institution for Science Department of Global Ecology*
PI: Dr. Anna Michalak

2022 **Postdoctoral Fellow**, *Biogeochemistry of Global Contaminants | Harvard University*
PI: Dr. Elsie Sunderland

Completed Projects:
Nitrifying Microorganisms Linked to Biotransformation of Perfluoroalkyl Sulfonamido Precursors from Legacy Aqueous Film Forming Foam
- Analyzed PFAS concentrations from incubations, performed data analysis consisting of kinetic rate and box modeling, and synthesized chemical and microbiological data to elucidate links between PFAS precursor transformation process and nitrification. Code is available at https://github.com/SunderlandLab/pfas-precursor-biotransformation

Projects in progress:
An Interlaboratory Comparison of Extractable Organofluorine Measurements in Groundwater and Eel (Anguilla rostrata): Recommendations for Methods Standardization
- Convened seven participant labs from three continents spanning academia, for profit and nonprofit businesses, and government, coordinated sample collection and shipment, measured concentrations, and lead data analysis. The manuscript of this work is currently in review.

Fluorine content of municipal wastewater in the United States
- Measured total fluorine, fluoride, extractable organofluorine, PFAS, and fluorinated pharmaceuticals in municipal wastewater influent and effluent across the U.S.
- Created a fluorine wastewater discharge inventory for all municipal wastewater treatment plants in the United States

2017 – 2022 **Graduate Research Assistant**, *Biogeochemistry of Global Contaminants | Harvard University*
Advisor: Dr. Elsie Sunderland

Completed Projects:
Reconstructing the Composition of Per- and Polyfluoroalkyl Substances in Contemporary Aqueous Film-Forming Foams
- Conceptualized and co-wrote Bayesian inference model to infer the concentrations and perfluorinated structure of precursor PFAS from the total oxidizable precursor assay. Code and data are available at https://github.com/SunderlandLab/oxidizable-pfas-precursor-inference
- Applied combined analytical and statistical method to AFFF to complete the PFAS mass balance in current use products

Isolating the AFFF Signature in Coastal Watersheds using Oxidizable PFAS Precursors and Unexplained Organofluorine
- Designed field campaign, collected samples, and performed sample analysis (LCMS, CIC) for PFAS in surface waters on Cape Cod, Massachusetts
- Applied statistical methods (PCA, hierarchical clustering) to examine the compositional fingerprint of PFAS of AFFF and non-point sources
- Press: https://www.bostonglobe.com/2021/03/08/metro/forever-chemicals-pervade-drinking-water-sources-cape-cod-study-finds/, *https://news.harvard.edu/gazette/story/2021/03/new-tool-finds-pfas-compounds-on-cape-cod/*

Centurial Persistence of Forever Chemicals at Military Fire Training Areas
- Collected groundwater and performed sample analysis on archival samples to establish first multi-decade record of PFAS in groundwater at a contaminated site on Cape Cod
- Developed and co-wrote coupled first-order rate equations and Bayesian inference model to infer chemistry from observations to understand long term PFAS fate and precursor biodegradation. Code and data are available at https://github.com/SunderlandLab
- Press: https://www.wbur.org/news/2023/05/15/pfas-water-joint-base-cape-cod, https://news.harvard.edu/gazette/story/2023/05/epas-new-rules-on-forever-chemicals-dont-go-far-enough-study-

suggests/?utm_source=SilverpopMailing&utm_medium=email&utm_campaign=Daily%20Gazette%2020230517%20(1)

2014 – 2017 **Undergraduate Research Assistant**, *University of Colorado Boulder*
Principal Investigator: Dr. Karl Linden

Projects: Acclimation of wastewater microbes to high salinity hydraulic fracturing flowback water, water quality characterization of fracking flowback water (TSS, VSS, TOC, hardness), curation of accurate mass suspect screening list from reported chemicals on FracFocus

2015-2017 **Research Assistant**, *Intermountain Oil and Gas Best Management Practices Project*

Projects: Transcribed terms in memorandums of understanding (MOUs) pertaining to contamination mitigation between county governments and fracking operators to database

SKILLS

COMPUTING/ANALYTIC SKILLS:

- Python, keras, tensorflow, jax, emcee, R, C++, parallel computing

LAB TECHNIQUES:

- Liquid chromatography mass spectroscopy: triple quad (Agilent, SCIEX), quadrupole time of flight (Agilent, SCIEX)
- Combustion/ion chromatography: Anions, cations, total fluorine, extractable organofluorine (Metrohm)
- Total organic carbon (Shimadzu)