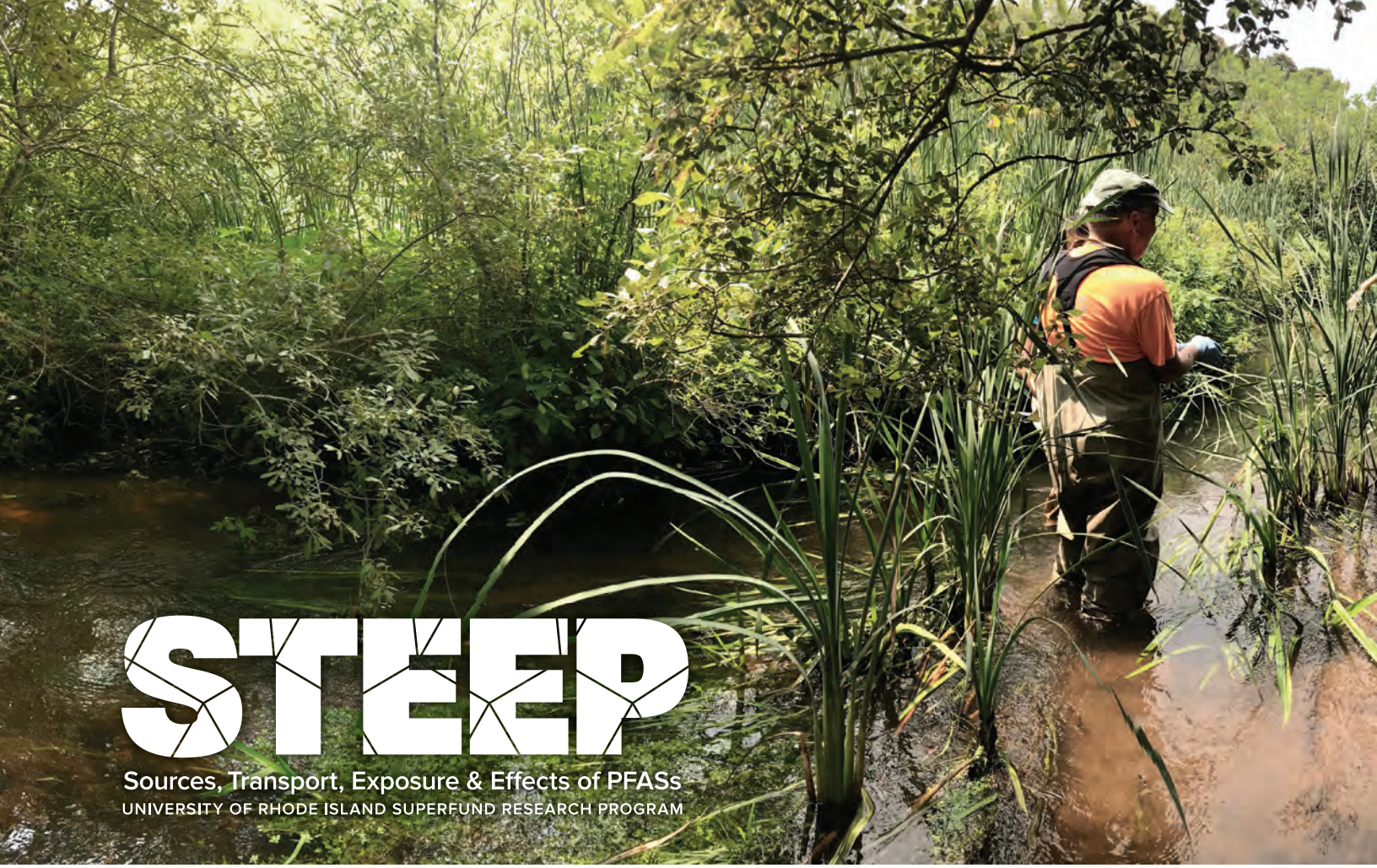


External Advisory Committee Meeting

August 28-29, 2018

University of Rhode Island

Director: **Rainer Lohmann, PhD**
Graduate School of Oceanography, University of Rhode Island

Welcome to the first year progress report from the newly established STEEP Center.

This University of Rhode Island-led initiative—in collaboration with colleagues from Harvard T.H. Chan School of Public Health and the Silent Spring Institute—is delighted to share STEEP's progress. I have been working for nearly 20 years in the field of emerging contaminants with particular focus on the coastal marine environment. From dioxins to PCBs, I have seen the damage that human-produced chemicals have wrought to human and environmental health; however, PFASs present a whole new level of challenges as they are extremely resistant to environmental degradation and are ubiquitous in groundwater and sediments as well as permeate the air.

As the public learned of adverse health impacts, the US shifted away from the most commonly used PFASs; however, new fluorinated compounds continue to be developed to meet society's demand for the convenience of these chemicals and human exposure continues. Recent initiatives all point towards safe drinking water concentrations much below current EPA advisories. STEEP's research implies that lower limits are needed to protect humans from PFASs' adverse effects. STEEP will continue to work with its stakeholders to ensure that the best available science is used to protect people from undue PFAS exposure. It is a privilege to share the leadership of this interdisciplinary team toward such worthy and essential goals.

Co-director: **Philippe Grandjean, MD DMSc**
Harvard T.H. Chan School of Public Health, Department of Environmental Health

For 30 years, I have dedicated my medical research to environmental epidemiology. My main emphasis is on the adverse health effects of environmental chemicals. As the fetus and the young child are likely to be highly vulnerable to toxic chemicals, most of my efforts have concentrated on studying the effects on early human development.

Together with my colleagues, I have initiated birth cohorts, i.e., consecutive births at the Faroe Islands. Our first focus was on mercury from marine food, and we found that elevated exposures during pregnancy were harming brain development. In the last ten years, our main focus has been on perfluorinated alkylate substances (PFASs), and we found that the immune system is highly sensitive to adverse effects.

We are now meticulously characterizing pre- and postnatal PFAS exposures, including transfer via human milk from breastfeeding, to obtain detailed information on PFAS exposures during critical developmental windows and their associations with changes in the most sensitive organ functions. We rely on sustained and willful collaboration of interdisciplinary science with impacted communities in our ambition to confront the relentless threat of these chemicals on child development and future wellbeing.

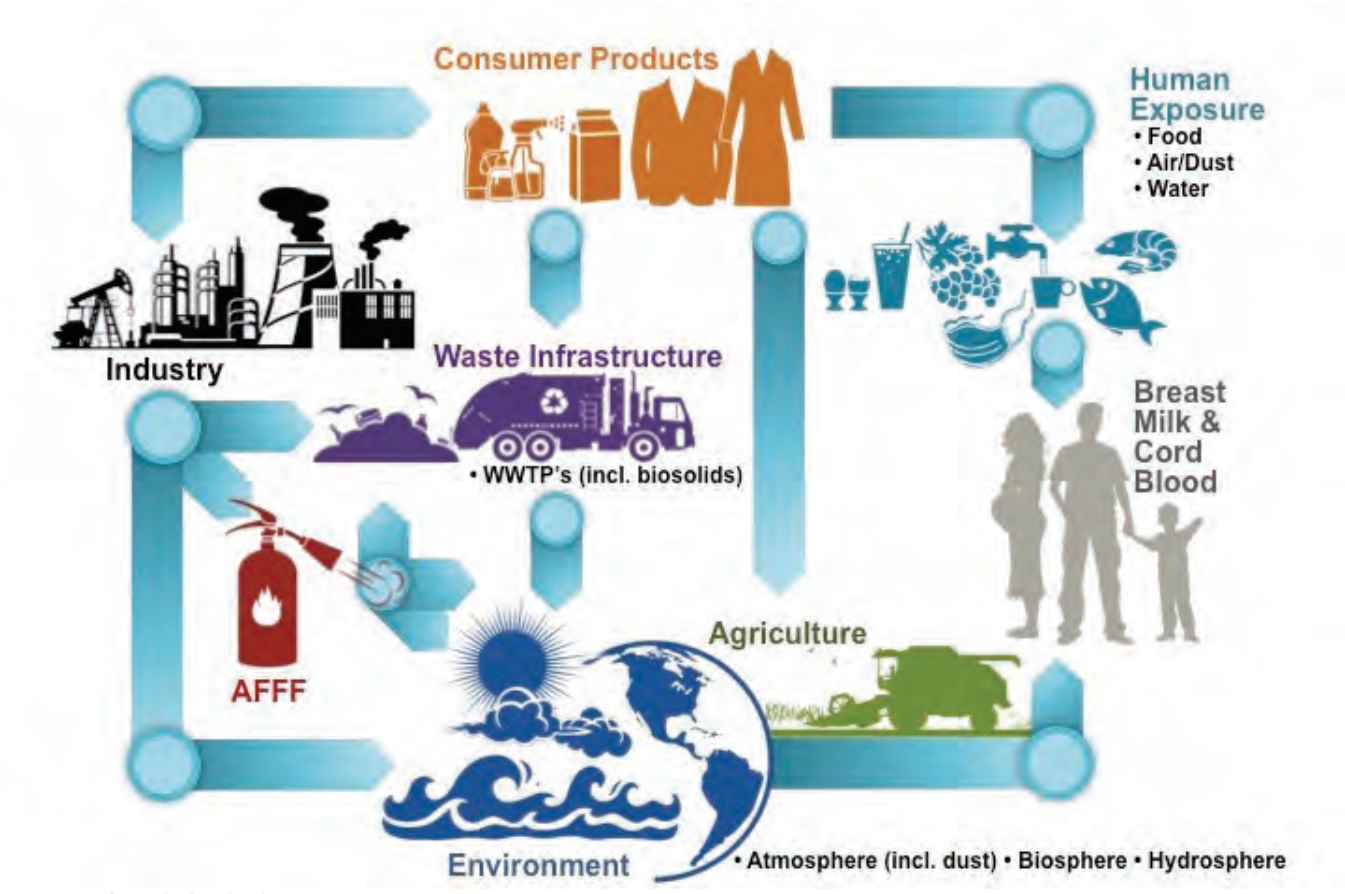
To achieve the greater goal of prevention, we need to perturb this profound and insidious threat of PFAS exposure with science of the best possible quality. Through the support of NIEHS, STEEP supports our highest aspirations in addressing and preventing future health impacts caused by the ill-conceived use of untested chemicals.

Contents

STEEP Overview

Per- and polyfluorinated alkyl substances (PFASs) are extremely resistant to environmental degradation and are found in humans and the environment around the world.

The most notable PFASs include perfluorooctanoic acid (PFOA) and perfluorooctanoic sulfonate (PFOS). In the U.S., there are industrial PFASs production and manufacturing sites, and over 600 fire/crash training sites nationwide where PFAS-containing aqueous film-forming foams have most likely contaminated groundwater and sediments. Additional human exposure results from widespread use of PFASs in consumer products, e.g., stain-resistant furnishings and carpets, grease-proof food packaging and wrappers. Production and use of PFOS and PFOA have declined in the U.S. since the early 2000s following a voluntary phase-out by 3M, and subsequent stewardship plans by U.S. EPA and international agreements. Industrial production in the



Courtesy of Sunderland Lab

U.S. shifted away from PFOA and PFOS as the public was provided evidence of their adverse human health impacts. As production decreased in the U.S., new fluorinated compounds have been and continue to be developed to meet society's demand. As a result, environmental contamination and human exposure continues.

Despite widespread PFAS use since the 1950s, there are still knowledge deficits about their environmental and public health impacts, thus this contaminant is considered emerging. STEEP is committed to researching compelling environmental and human health concerns to inform development of appropriate benchmark dose levels for PFASs. Moreover, STEEP will disseminate these research results to a variety of stakeholders as well as train the next generation of scientists essential to the management of these highly stable and ubiquitous compounds.

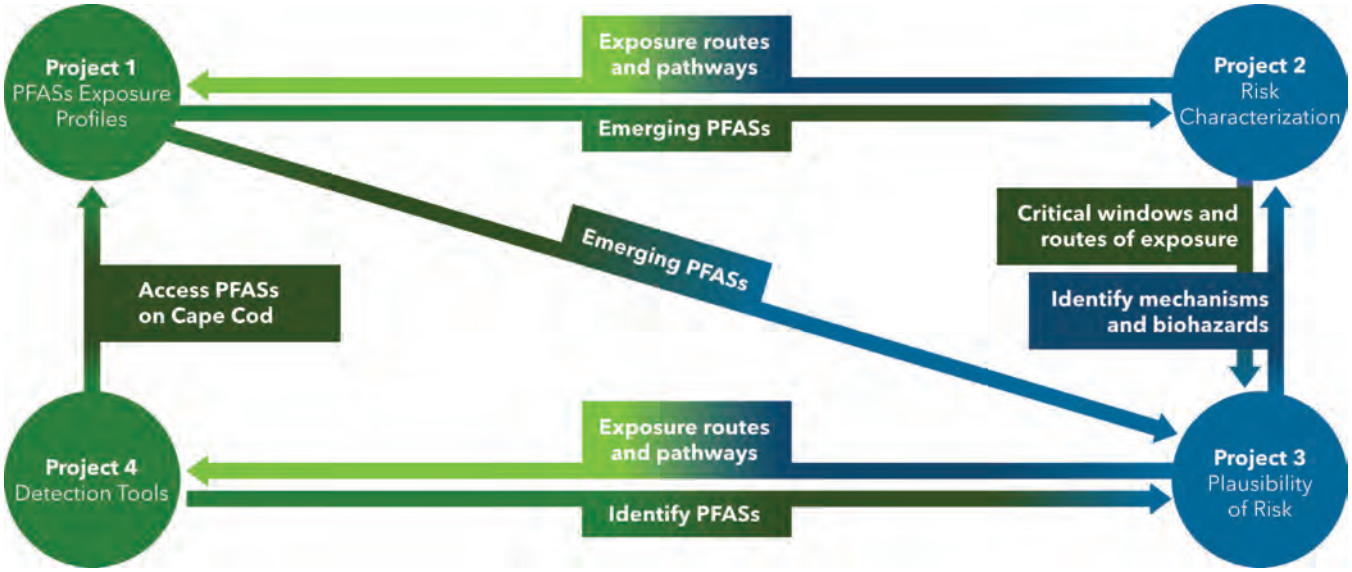
Director Lohmann and co-Director Grandjean combine complementary expertise in environmental and epidemiological science. They brought together a team of individuals that function as an effective and integrated interdisciplinary team. This includes researchers from the University of Rhode Island Graduate School of Oceanography, Coastal Institute, and Colleges of Pharmacy, Engineering, and the Environment and Life Sciences; Harvard T.H. Chan School of Public Health, Department of Environmental Health; and the Silent Spring Institute.

Research Overview

STEEP Research Projects aim to better understand the pathways of PFASs contamination from entry into the environment through groundwater contamination, dispersal through the food web, and distribution to vulnerable human populations during early development, in part through breast milk. In addition, STEEP supports the development and deployment of in situ passive sampling techniques for PFASs and their precursors in water. STEEP is thereby addressing limitations in the current understanding of human exposure to PFASs by combining targeted human exposure assessment with chemometric approaches to characterize existing PFASs sources.

Core Overview

To ensure a legacy of scientific awareness, dissemination of broadly accessible research findings, and practical application by affected communities, STEEP Cores serve to prepare the next generation of interdisciplinary emerging contaminant researchers, translate scientific findings generated by STEEP projects for internal and external stakeholders, and engage Cape Cod communities on the front lines of PFASs exposure through contaminated drinking water.

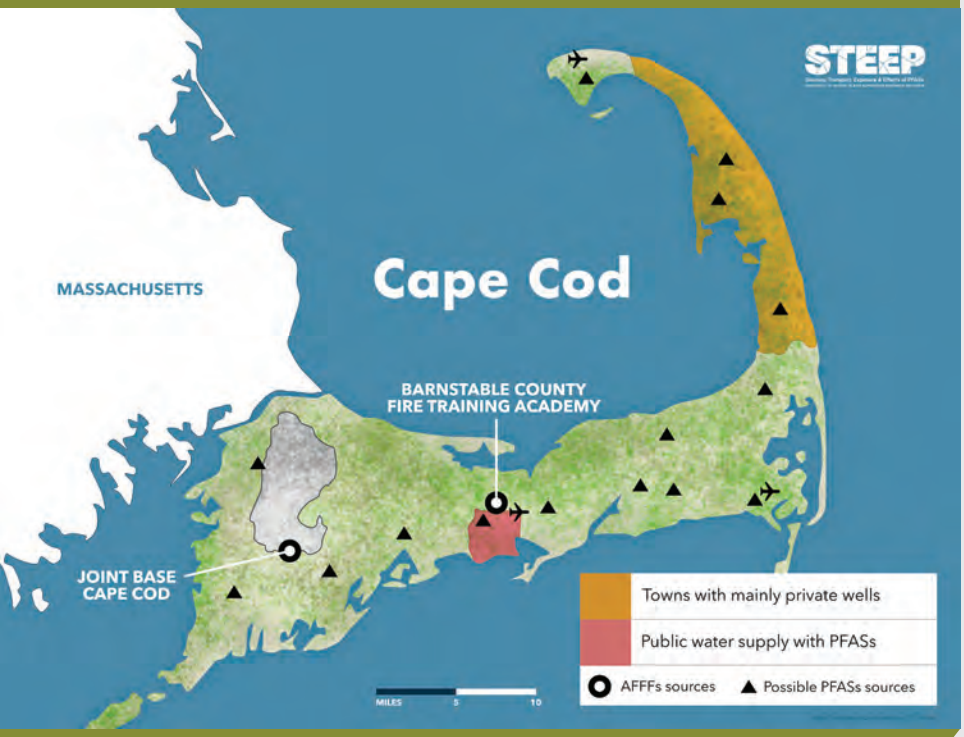


Communities

STEEP is focused on two study sites, one on Cape Cod and the other in the Faroe Islands. Barnstable County, MA, is STEEP's primary site for community engagement activities. STEEP partner Silent Spring Institute has conducted community-engaged research and activities focused on water quality and public heath on Cape Cod for more than 20 years.

Faroe Islands is STEEP's epidemiological research site, where for decades co-director Grandjean, in partnership with Pál Weihe, MD (Adjunct Professor, University of the Faroe Islands; Head, Department of Occupational Medicine and Public Health), has studied the impact of persistent chemicals on pre-natal and post-natal health which enriches STEEP's understanding of the adverse health impacts of PFASs.

The vast majority of people worldwide are exposed to some level of PFASs due to its presence in a wide range of manufactured products and consumer goods; however, some communities akin to STEEP study sites experience increased exposure from secondary sources. In Cape Cod, the additional exposure to PFASs is linked to contaminated groundwater that finds its way to residents' tap water. Communities in the Faroe Islands may experience additional exposure linked to a cultural tradition of consuming pilot whale meat and blubber.



Barnstable County, MA, is a Cape Cod area beloved for its sweeping coastline, quaint villages, and welcoming community ambiance. Groundwater on Cape Cod has been contaminated by PFASs from multiple sources. To date, these sources have been identified as fire training areas, airports, military bases, landfills, municipal wastewater, and septic systems. The spread of PFASs is exacerbated by Barnstable's location in an outwash plain with permeable soil. The result is that groundwater aquifers are highly susceptible to movement of contaminants from the surface of the ground—the place where surface water both contributes to aquifers and enters the food web. Once PFASs get into groundwater, they move with the groundwater and eventually can contaminate both public and private drinking water sources. Given these multiple inputs of PFASs and the unique geology of the area, there is an ongoing threat to Cape Cod's sole source aquifer that provides drinking water for 200,000 year-round and 500,000 summer residents.

The Faroe Islands consist of 18 remote, rocky, volcanic islands, which are connected by a network of roads, ferries, subsea tunnels, and bridges. Located in the Atlantic Ocean between Norway and Iceland, these remote islands are a self-governing archipelago of the Kingdom of Denmark. With a population of slightly more than 50,000, this prosperous fishing community is situated in the heart of the Gulf Stream in the North Atlantic, northwest of Scotland and halfway between Iceland and Norway. Faroese culture emphasizes tradition and the arts. In a generation, with the help of the fishing trade that accounts for approximately 20 percent of GDP, Faroese affluence has grown in the widespread use of technology and well-established infrastructure. Beginning in 1985, study cohorts of ~2300 Faroese children focused on the effects of mercury in their diet and later expanded to include PFASs. Consequently, the overall health threats from toxic chemicals to the current and future generations of Faroese are compelling and timely.

Project 1: Environmental Fate & Transport

Environmental Engineering: Exposure assessment and chemometrics of PFASs

CENTRAL HYPOTHESIS:

Environmental exposure sources–drinking water and fish–of PFASs have unique chemical signatures (fingerprint), which can be used to trace PFASs through the environment.

Lead: **Elsie Sunderland**
Harvard T.H. Chan School of Public Health, Department of Environmental Health (HSPH)

Key Personnel: **Alan Vajda**
University of Colorado-Denver (UCD)

Overview

More than 600 sites across the U.S. are contaminated by poly- and perfluoroalkyl substances (PFASs) but the extent of transport away from these sites and entry into human exposure pathways (drinking water and fish) is virtually unknown. This information is critical for assessing human health risks associated with exposures to PFASs from contaminated sites.

This project is measuring a suite of PFASs present in drinking water and fish near the Joint Base Cape Cod (JBCC), a region contaminated by historical fire training activity and designated as a National Priorities List site.

This project will:

- Apply novel statistical methods to fingerprint profiles of PFASs measured in fish and drinking water around the JBCC site in order to better understand contamination sources in biological exposure sources and surface water. PFAS profiles in drinking water and fish are being compared to those from consumer products (that enter wastewater) to identify exposures originating from contaminated sites.

Images courtesy of Vajda Lab

- Leverage long-term research by the U.S. Geological Survey (USGS) near the JBCC site characterizing hydrological flow paths and groundwater geochemistry to better understand how environmental factors influence the transport and transformations of PFASs away from contaminated sites and into drinking water supplies since little is known about the potential biological effects of exposure to PFAS-contaminated groundwater.
- Investigate pathways for the movement of PFAS-contaminated groundwater to surface waters that serve as fish habitat. University of Colorado Denver and USGS have developed a mobile laboratory/water-quality characterization approach to assess endocrine disruption and other biological effects in surface-water systems.

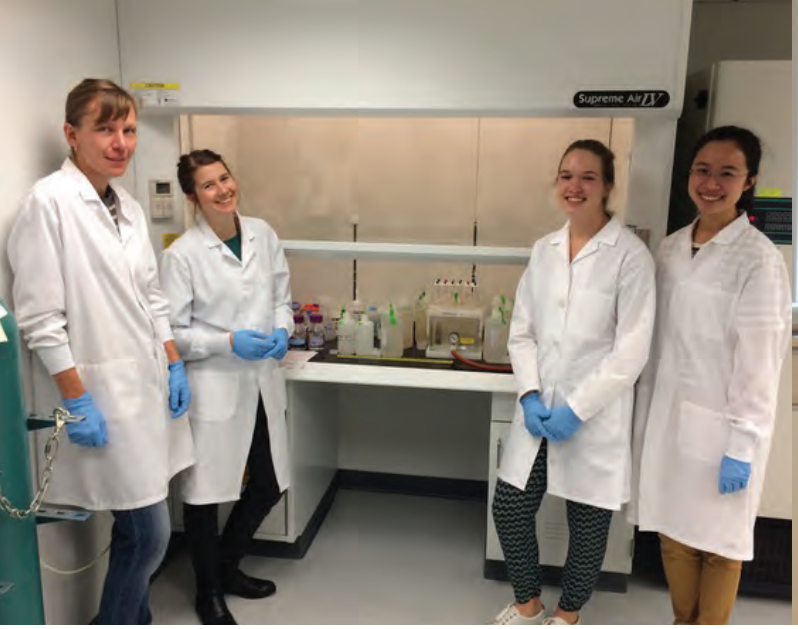
One of the major expected outcomes of this work is a better understanding of the spatial extent of elevated PFAS concentrations in fish and drinking water from contaminated sites, which will improve our understanding of exposed communities' risks.

Progress to date

Research highlight: Modeling human exposure to poly- and perfluoroalkyl substances (PFASs) from source to dose

Traditional approaches in exposure assessment rely on bottom-up estimates including contact frequency and environmental concentrations and are data intensive, which can result in large uncertainties. Xindi (Cindy) Hu and co-authors in the Sunderland Lab developed a source tracking approach that uses correlations among multiple chemical homologues in environmental samples to derive information on their origin. This process is referred to as "chemical fingerprinting" and has been applied to polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). In their recent publication on Environmental Health, Hu et al. (2018) contrasted unique serum PFAS profiles in whaling men, children, and pregnant women, and associated dominating exposure sources with elevated compositions of certain PFAS tracers. This method can be further enhanced with the expanded list of PFASs measured in multiple sources (such as food, drinking water, indoor air, and dust) under other ongoing STEEP projects. Comprehensive data combined with this innovative source tracking approach will help impacted communities understand their major exposure source and help policy makers design the most effective public health intervention to prevent harmful health impacts of PFASs.

Clifton Dassuncao and co-authors in the Sunderland Lab developed statistical and toxicokinetic models to better understand how PFAS exposures of children from populations that frequently consume seafood were affected by changes in the use and release of legacy PFASs around the year 2000. Principal component analysis (PCA) identified two groups of PFASs that likely reflect exposures from diverse consumer products and a third group that consisted of perfluorocarboxylic acids (PFCAs) with nine or more carbons that were strongly associated with mercury in children's hair, a well-established proxy for seafood consumption. We found that even in this remote



population of frequent seafood consumers, rapid declines in PFASs measured in children's serum between 1993 and 2012 parallel those reported in other parts of the world, indicating the ubiquitous role of consumer products to overall exposures.

Research highlight: Determining PFAS fate and transport in groundwater and surface-waters

PFASs have been shown to be highly mobile in groundwater and surface-water, resulting in frequent contamination of drinking water supplies located near PFAS point sources. The geochemical mechanisms that dictate PFAS fate and mobility are not well understood. Andrea Tokranov and co-authors in the Sunderland Lab at Harvard and in the U.S. Geological Survey are investigating associations between chain length, head group, and geochemical tracers at a field site located on Cape Cod, MA. They found that perfluoroalkyl acid (PFAA) precursors can be highly mobile in the field, suggesting that conventional methods significantly underestimate total PFAS exposure. Further, they found evidence suggesting these mobile precursors are highly persistent in both oxic and anoxic conditions and are transported across groundwater/surface-water interfaces. Ongoing and future work will focus on how groundwater/surface-water interactions can influence PFAS concentrations, which is relevant for many drinking water supplies.

PROJECT 1 TRAINEES

Bridger Ruyle, PhD Candidate, Harvard SEAS
Andrea Tokranov, PhD Candidate, HSPH
Clifton Dassuncao, PhD (May 2018), HSPH
Xindi (Cindy) Hu, PhD (May 2018), HSPH

Plan for upcoming year

- Characterization of factors controlling the spread and concentrations of PFASs surrounding the groundwater-fed seepage lake downstream of the JBCC site and adjacent rivers.
- A mass budget for the fraction of PFASs in the contaminated plume at the JBCC transported in river networks away from the site.
- Dr. Alan Vajda and colleagues at UCD and the USGS will apply the mobile laboratory approach to assess PFAS uptake and potential biological implications of exposure to contaminated groundwater along a PFAS contamination gradient at the fire training area on Joint Base Cape Cod. This research will provide information relevant to potential human exposure from contaminated drinking water as well as aquatic organisms in contaminated surface waters.

SELECTED ACCOMPLISHMENTS

Dassuncao C, **Hu XC**, Zhang X, Bossi R, Dam M, Mikkelsen B, & Sunderland EM (2017). Temporal shifts in poly-and Perfluoroalkyl substances (PFASs) in North Atlantic pilot whales indicate large contribution of atmospheric precursors. Environmental Science & Technology, 51(8), 4512-4521.

Hu XC, **Dassuncao C**, Zhang X, Grandjean P, Weihe P, Webster GM, et al. (2018). Can profiles of poly-and perfluoroalkyl substances (PFASs) in human serum provide information on major exposure sources? Environmental Health 17:11.

Sunderland EM. Understanding the Relative Importance of Diverse Exposure Pathways for Poly- and Perfluoroalkyl Substances (PFASs). Invited seminar for the Agency for Toxic Substances and Disease Research (ATSDR), Atlanta, GA, May 10, 2018.

Project 2: Childhood Risk

Epidemiological Study: Inflammation and metabolic changes in children developmentally exposed to PFASs

CENTRAL HYPOTHESIS:

Dietary exposure to PFASs during fetal development and childhood can interfere with immune system development and metabolism and thereby pave the way for later disease development.

Lead: **Philippe Grandjean**, Harvard T.H. Chan School of Public Health, Department of Environmental Health (HSPH)

Clinical Lead: **Pál Weihe, MD**, Adjunct Professor at The University of the Faroe Islands and Head of the Department of Occupational Medicine and Public Health

Overview

Poly- and perfluoroalkyl substances (PFASs) are widely used industrial chemicals, but widespread human PFAS exposures from contaminated sites and bioaccumulation in food-chains were discovered less than 20 years ago, and the full range of adverse health effects is not completely known. Recent evidence suggests that current PFAS exposures may cause adverse effects on the immune system and other sensitive tissues and organs, even at exposures far below provisional exposure limits. Early-life exposure to PFASs may contribute to the development of metabolic diseases, including obesity and type 2 diabetes. PFASs can also decrease antibody response to certain childhood vaccinations, and most PFASs are transferred through breast milk.

Relying on an already established birth cohort in the Faroe Islands that has been supported by NIEHS, this project will efficiently utilize exposure and outcome

data covering a 9-year span to determine possible links between PFAS exposure profiles, immune dysfunction, and metabolic abnormalities. Due to the homogeneity of the Faroese population, the wide range of exposures, and the high participation rate in the clinical follow-up, this epidemiological setting represents advantages that would be nearly impossible to match anywhere else.

The data analysis will take into account additional factors, including exposures to other environmental chemicals, sex of the child, and diet. Overall, this will allow us to calculate benchmark doses for possible use in risk characterization in U.S. populations exposed to PFASs.

Progress to date

Through interdisciplinary collaboration and a shared commitment to bettering the health of communities impacted by environmental PFAS contamination, the STEEP Center team has made steady and promising progress in Year 1 in upholding the commitment to the Cape Cod and Faroe Island communities while advancing the science on PFAS exposure.

This project is an epidemiological study which takes advantage of a prospective birth cohort (N = 490) established in the Faroe Islands, a North Atlantic fishing community where early-life exposures to persistent environmental pollutants, such as PFASs, have been linked to obesity and related metabolic conditions in previous epidemiological studies. Our cohort was generated from consecutive births between 2007 and 2009. This cohort will be the largest and most thoroughly examined group of PFAS-exposed children followed since birth.

- Completion of all clinical exams and blood work of the 490 cohort members (8-9 years) who accepted the invitation to participate and reconsented (N = 407, 210 boys and 197 girls; 83% participation). Also, 385 DEXA scans have been completed and the remaining children will be re-invited.
- Data are currently being entered into the database. Routine blood tests have been completed, and preliminary results show (anticipated) low vitamin D concentrations.
- Samples have been transferred to the analytical laboratories, where exposure biomarkers and inflammation/ immune function variables will be determined.

- Serum-PFAS analytical methods are being upgraded and optimized on a new and more sensitive UPLC-MS/MS system comprising a Thermo Scientific EQuan MAX module for online solid-phase extraction and a TSQ Quantiva triple quadropole mass spectrometer.

Plan for upcoming year

- Completion of data entry for all clinical examinations of Cohort 5 participants.
- At least partial completion of biomarker analyses of cohort biological samples, including serum analyses for vaccine antibodies, and other blood-based biomarkers of metabolism and immune function and inflammation.
- Commence statistical data analyses, including calculation of derived parameters, in collaboration with subcontractors.

PROJECT 2 TRAINEES

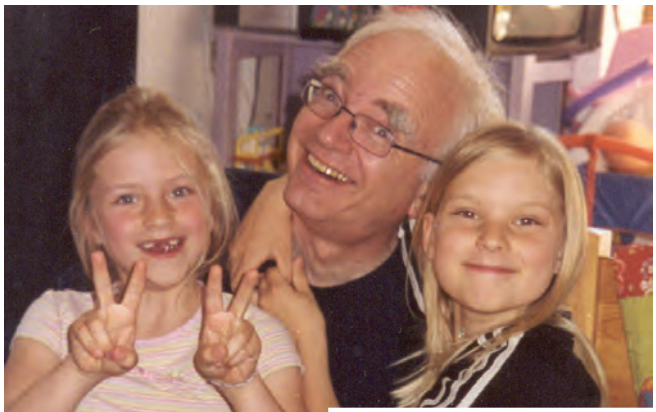
Damaskini Valvi, Research Associate, HSPH

SELECTED ACCOMPLISHMENTS

Grandjean P. Delayed discovery, dissemination, and decisions on intervention in environmental
health: A case study on immunotoxicity of perfluorinated alkylate substances (editorial). Environ Health 2018; 17: in press. https://ehjournal.biomedcentral.com/articles/10.1186/s12940-018-0405-y.

Grandjean P. Do PFASs harm our health and that of the next generation? Capitol Hill briefings along with colleagues Robert Billock, Arlene Blum and Tom Bruton of the Green Science Policy Institute (http://greensciencepolicy.org/) held for staff at the House of Representatives and the Senate, Washington, DC, June 11-12, 2018.

Philippe Grandjean and Pál Weihe, co-Chairs of the multidisciplinary International Conference on Prenatal Programming and Toxicity (PPTox) successfully oversaw this year's sixth conference, with close to 200 attendees from around the globe, in Tórshavn, the capital of the Faroe Islands, a STEEP community research site, where the focus was on the impacts of toxic chemicals – including PFASs – on prenatal health and development.



Project 3: Metabolic Effects

PFAS compound effects on metabolic abnormalities in rodents

CENTRAL HYPOTHESIS:

PFAS exposure leads to metabolic abnormalities in rodents, and can be linked back to preferential sorption of PFASs to biomolecules.

Co-lead: **Angela Slitt**, URI College of Pharmacy (Pharm)

Co-lead: **Geoffrey Bothun**, URI College of Engineering (COE)

Overview

Human exposure to poly- and perfluoroalkyl substances (PFASs) has been linked to immunotoxicity and cancer as well as metabolic disorders and cholesterol levels. Specific to metabolic disorders, PFASs are known to concentrate in the liver and links have been established between PFAS serum levels, specifically perfluorooctanoic acid (PFOA) and perfluorosulfonic acid (PFOS), and liver injury. While insightful, these two common PFASs represent only a fraction of PFASs that exist within the contaminated sites. Mechanisms driving biological response to PFASs are still being investigated.

This project will work to better understand the properties of PFASs that allow for membrane partitioning and protein binding, and subsequent biological effects. The project will connect chemical properties of PFASs related to the other STEEP Projects with biological effects in cultured human hepatocytes and adipocytes. Lastly, Project 3 will also connect the chemical properties of PFASs with in vivo developmental effects in mice exposed to a high fat high fructose diet during development.

This project will:

- Address whether environmental exposure to PFASs contributes an additional increase risk for obesity-induced fatty liver disease and metabolic disorders.
- Identify the physicochemical and partitioning behavior of PFASs that contribute to bioaccumulation.
- Test the hypotheses that (1) PFAS exposure increases diet-induced fatty liver disease and inflammation, and (2) that the biological changes in the liver can be correlated with the body's response to PFASs.

These project results will inform how PFAS exposure impacts risk factors common in the U.S. population (e.g., diet and obesity).

Progress to date

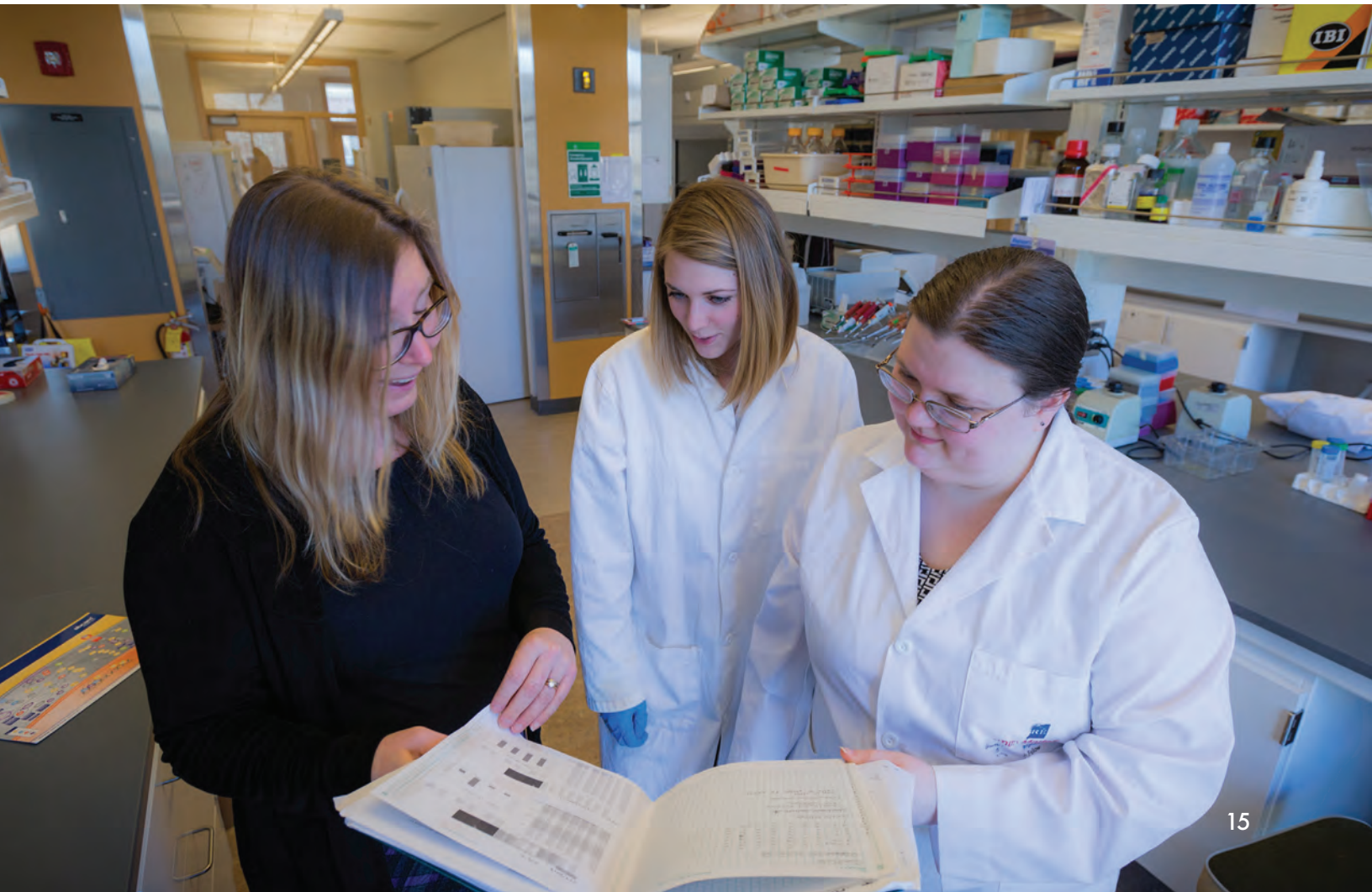
Slitt Lab

- Established adipocyte and hepatocyte assays and completed more than 50% of the screening efforts.
- Contacted the EPA (Ron Hines) and NIEHS (Sue Fenton) to ensure consistency of methodologies (i.e., source of cells, differentiation conditions), resulting in a slight modification to the study design compared to what was initially proposed.

- Completed treatments of human hepatocytes and measurements of gene expression of proposed pathways, including consultations with other STEEP Projects as to additional emerging PFASs to test.
- Set up and tested conditions to measure lipid deposition in hepatocytes in a 96-well high throughput platform.
- Near completion of screening studies for mouse adipocytes with human pre-adipocyte screening to follow.
- Tested and identified conditions needed to measure IL-6 and adipokine secretion from mature adipocytes.
- Traveled to Boston University's Nutrition Obesity Research Center to access additional resources for the adipocyte work; Dr. Slitt now a faculty member of that center.
- Validated methods for measurement of PFASs in tissues by LC-MS—developed in collaboration with 3M colleagues who are members of the Society of Toxicology.
- Established an automated pipeline for analysis of genomic data (RNA-seq) from source files to IPA pathway software.
- Set up additional methods in untargeted proteomics to generate novel data using a state-of-the art and innovative platform; now able to detect and quantify >1000 proteins, and detect induction of proteins known to be induced in mouse liver with PFOS treatment.

Bothun Lab

The focus of this Project 3 research has been on method development for determining physicochemical properties, such as critical micelle concentration, and for conducting in situ measurements of PFAS binding to bovine serum albumin (BSA), which is used as a model blood serum protein. This has included developing procedures based on fluorescence spectroscopy, differential scanning calorimetry (DSC), circular dichroism (CD) and nuclear magnetic resonance spectroscopy (NMR) to investigate the interaction between PFASs and BSA. Ultimately, the goal is to examine physicochemical properties, protein binding, and lipid partitioning as functions of salt concentration, pH, and temperature.



Plans for upcoming year

- Complete experiments on human hepatocytes, adipocytes, and adipose tissue explants, including performing PFAS treatments with human pre-adipocytes and also performing studies that evaluate PFAS impact on insulin sensitivity in adipocytes and adipokine secretion.
- Start in vivo rodent exposure studies to determine whether PFAS exposure is a risk factor for developmental effects to the offspring when the mother is consuming a high fat fructose diet. Mothers will be exposed to single PFASs of interest during gestation and lactation, and then mothers will be exposed to groups of selected PFASs for comparison with single PFASs of interest.
- Complete PFAS binding studies involving serum proteins, both human and bovine, as a function of PFAS chain length, PFAS head group functionality, temperature, salt concentration, and pH. The variables greatly affect the chemical properties of PFASs in solution, including their charge, ability to self-assemble, and lipophilicity. Complementary experiments will be conducted by fluorescence spectroscopy (indirect measurement) and NMR (direct measurement).
- Complete critical micelle concentration (CMC) and LogP measurements as a function of PFAS chain length, head group functionality, temperature (above the Krafft temperature), salt concentration, and pH.

PROJECT 3 TRAINEES

Michael Fedorenko, PhD Student, COE URI
Timo Küster, PhD Student, COE URI
Emily Martell, PhD Student, Pharm URI
Jessica Orr, PhD Student, COE URI
Marisa Pfohl, PhD Student, Pharm URI

SELECTED ACCOMPLISHMENTS

Salter DM, Wei W, Nahar P, and **Slitt A**. Perfluorooctanesulfonic acid (PFOS) thwarts the beneficial effects of caloric restriction and metformin. Submitted to Toxicological Sciences, August 2018.

Slitt A. Evaluation of PFAS Interaction with Moderate and High Diet Fats in Mouse Models of Obesity. Oral presentation at Federal Exchange on PFAS, February 2-6, 2018.

Pfohl M*, Ma H, Aubustan M, **Martell E**, Seeram N, **Slitt A**. Low Dose Perfluorooctane Sulfonate (PFOS) is Associated with Induction of Fatty Acid Uptake Mechanisms in Diet-induced Non-alcoholic Fatty Liver Disease (NAFLD). Poster presentation at the Northeast Society of Toxicology Regional Chapter Meeting, Shrewsbury, MA, October 20, 2017. *Winner of NESOT poster presentation

Fedorenko M, **Orr J**, Bizer M, Cho B, **Bothun GD**. Binding of Per- and Polyfluorinated Compounds (PFAS) to Bovine Serum Albumin (BSA). Poster presentation at 2018 Northeast Superfund Research Program Meeting, Woods Hole, MA, March 26-27, 2018.

Project 4: Detection Tools

Environmental Engineering: Develop passive samplers for the detection and bioaccumulation of PFASs in water and porewater

CENTRAL HYPOTHESIS:

Passive sampling can be used to detect PFASs and their precursors in water and porewater.

Lead: **Rainer Lohmann**, Graduate School of Oceanography, University of Rhode Island (GSO)

Key Personnel: **Laurel Schaider**, Silent Spring Institute (SSI)

Overview

This project is developing, validating, and deploying novel passive samplers for the detection of poly- and perfluoroalkyl substances (PFASs) in water and porewater (water in the sediment). At contaminated sites, as the extent of a PFAS plume is investigated, benefits of field-validated passive sampling approaches include ease of handling, shipping, and analysis; reduced potential for contamination; and lower detection limits that will be needed as regulatory agencies adjust their references doses.

This project will:

- Develop a porewater fiber for measuring PFAS concentrations.
- Collaborate with U.S. Environmental Protection Agency to determine PFAS accumulation in bivalves (e.g., mussels and oysters), and compare these results to the novel passive samplers.
- Validate PFAS passive sampling tools.

Sites for field validation and application are located on Cape Cod, MA, including in ponds near Joint Base Cape Cod, where groundwater is contaminated by aqueous film forming foams. Researchers are engaging residents and stakeholders to address concerns about long-range PFAS transport and characterizing the extent of impacted ponds, creeks, and estuaries.

Progress to date

- Performed first laboratory experiments on how to sample PFASs with thin fibers. Data show promise in using these thin fibers to investigate the presence and bioavailability of PFASs at contaminated sites (Jitka Becanova, trainee).
- Field-tested passive sampling tubes for PFASs in Narragansett Bay and two local wastewater treatment plants. During two deployments, grab water samples and passive samplers were exposed and analyzed (Christine Gardiner, trainee).
- Together with the Center for Coastal Studies, researchers analyzed PFASs in water and passive samplers deployed in Cape Cod estuaries. Total PFAS concentrations were correlated with dissolved inorganic nitrogen and inversely associated with salinity, suggesting that groundwater impacted by septic systems is the primary source of PFASs in these systems.
- Collected coastal and offshore seabirds for investigating the presence of legacy and new PFASs in wildlife. She has optimized an extraction method for bird livers (Anna Robuck, trainee).
- Initiated local reconnaissance work on the presence of PFASs in soil and streams around a plastic manufacturing site in industrial park, Narragansett, RI.

PROJECT 4 TRAINEES

Jitka Becanova, Postdoctoral Researcher, GSO URI
Matt Dunn, PhD Student, GSO URI
Christine Gardiner, Masters Student, GSO URI
Maya Morales-McDevitt, PhD Student, GSO URI
Anna Robuck, PhD Candidate, GSO URI

Plans for upcoming year

- Investigate the presence of legacy and emerging PFASs in coastal and offshore seabirds from the US East Coast in collaboration with NC State (Anna Robuck, trainee).
- In collaboration with STEEP Project 1, field-test passive samplers for PFASs in fresh and marine waters on Cape Cod to evaluate their performance under a range of conditions and identify potential sources of PFAS contamination into Cape Cod aquatic systems.
- Collaborate with Brown University (Dr. Hurt) on testing nanographites as potential sampling tools for PFASs (Jitka Becanova, trainee, KC Donnelly Externship Award).

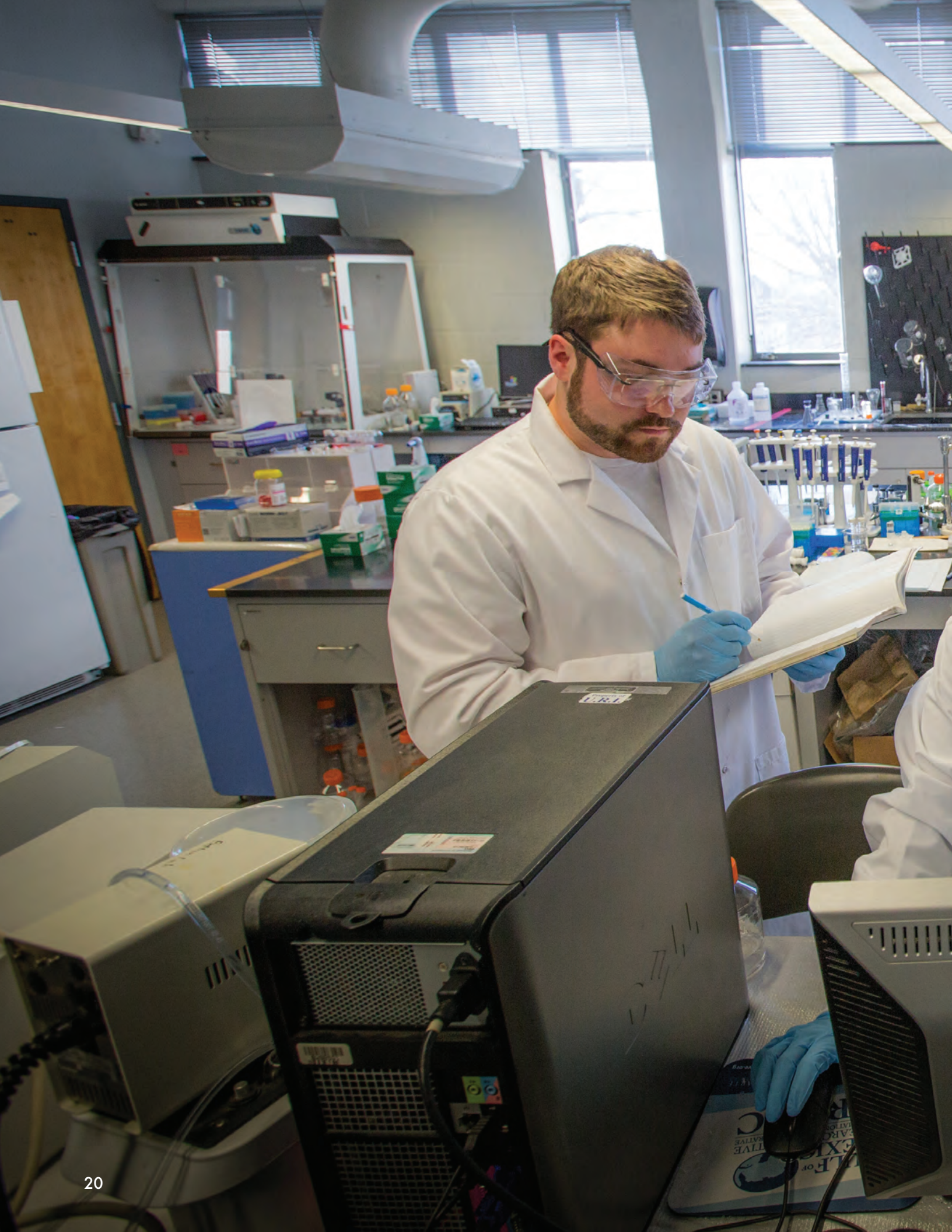
SELECTED ACCOMPLISHMENTS

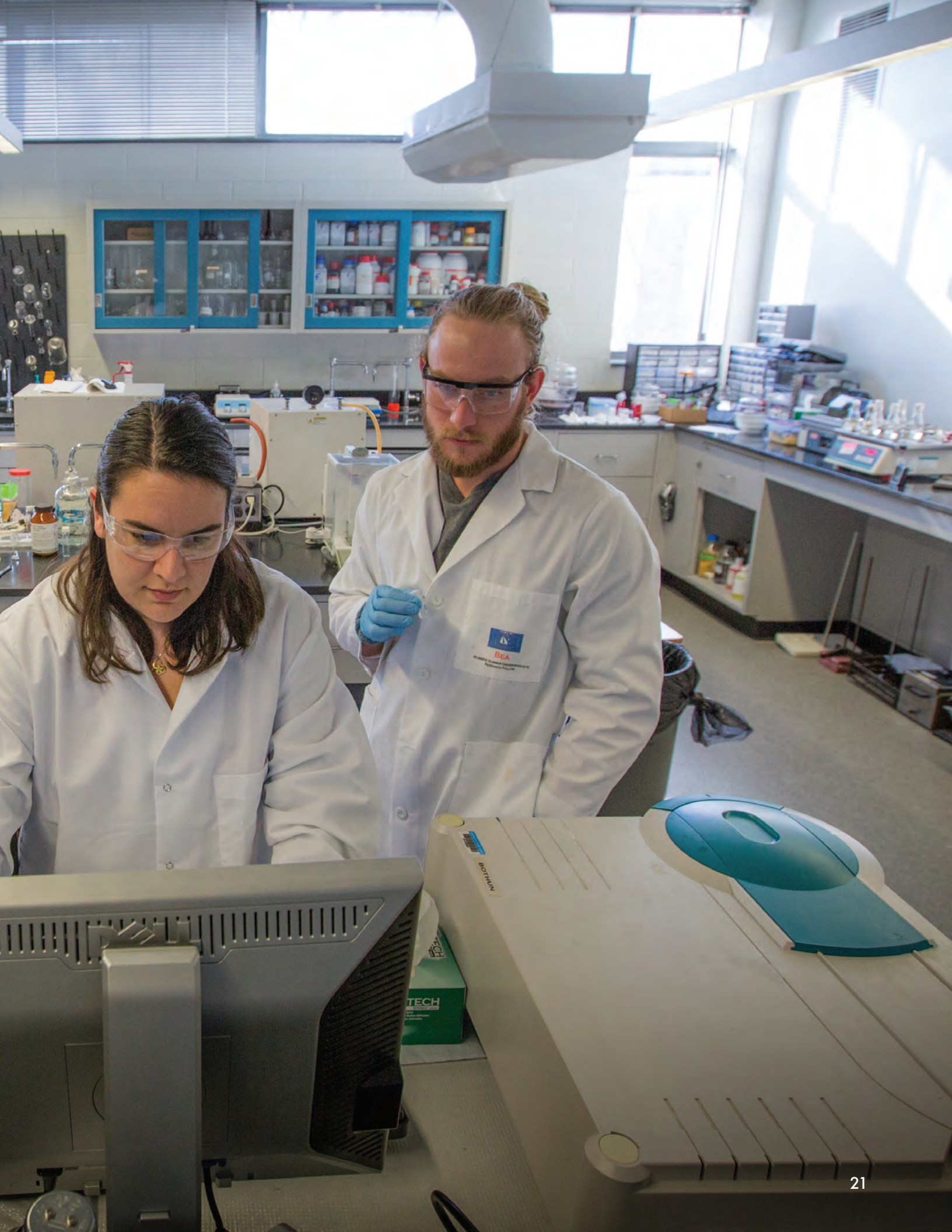
Zhang X, Zhang Y, Dassuncao C, **Lohmann R**, Sunderland EM. (2017) North Atlantic Deep Water Formation Inhibits High Arctic Contamination by Continental Perfluorooctane Sulfonate Discharges. Global Biogeochem. Cycles, 31, 1332–1343. doi:10.1002/2017GB005624.

Lohmann R. From PCBs to PFASs–A global cruise in persistence, long-range transport and novel detection tools. Keynote address at 2018 Emerging Contaminants in the Aquatic Environment Conference, University of Illinois at Urbana-Champaign, June 2018.

Schaider L. Federal Health Study on Drinking Water Contaminants Calls into Question Safety of Nation's Drinking Water Supply. Contributed guest blog to the Union of Concerned Scientists Science Network, July 27, 2018.

R Lohmann appointed to U.S. EPA's Board of Scientific Counselors sub-committee on sustainable and healthy communities.




BEA
BOTHUN

Administrative Core

Director: **Rainer Lohmann**, Graduate School of Oceanography, University of Rhode Island (GSO)

Co-director: **Philippe Grandjean**, Harvard T.H. Chan School of Public Health, Department of Environmental Health (HSPH)

Project Coordinator (outgoing): **Martha McConnell**, Graduate School of Oceanography, University of Rhode Island (GSO)

Project Coordinator (incoming): **Wendy Lucht**, Graduate School of Oceanography, University of Rhode Island (GSO)

Overview

The Administrative Core (AC) is the central hub of STEEP, responsible for oversight and management of the Center. Its main role is to ensure STEEP runs well and produces integrated science, training, communication, and engagement of benefit to the Superfund Research Program and stakeholders. The AC provides financial management and is integrated with the rest of the Center through the Director and Co-Director leadership and role in active STEEP project research, communication, and outreach. The AC, supported by a Coordinator, works closely with the STEEP Internal Advisory Committee (IAC), and the External Advisory Committee (EAC).

This core will:

- Ensure successful integration of research projects and cores through regular meetings and evaluations from internal and external advisory committees.
- Provide relevant operational insights and tools for stakeholders and communities.
- Create a STEEP center that responds in a timely fashion to opportunities, challenges, and evaluations.

Completed and ongoing activities

- Administers the grant and subcontracts serving as the liaison between the University of Rhode Island, Harvard T.H. Chan School of Public Health, Silent Spring Institute, and the National Institute of Environmental Health Studies.
- Provides financial oversight and support to each project and core.
- Manages reporting to NIEHS: Research Performance Progress Report (RPPR), Annual Update, fiscal reporting, updates to CareerTrac, and SRP Data Collection Tool.
- Leads content development of bi-annual STEEP newsletter.
- Manages STEEP team calendar.
- Coordinates STEEP-wide interaction with federal and state agencies and stakeholders; supports Administrative Core leads in maintaining comprehensive interactions with national and international leaders in the field. Highlights from the Center leadership include:
  - » STEEP comments on ATSDR's Toxic Profiles of PFASs.

- » Rainer Lohmann appointed to U.S. EPA's Board of Scientific Counselors.

- Ensures contributions to other peer SRP Centers including:

  - » Northeastern's Social Science Environmental Health Institute (SSEHRI)'s PFAS newsletter.

  - » Engaging with Brown University in communications with Rhode Island Congressional Delegation regarding NIEHS budget and language being considered in federal legislation.

  - » Participating in NIEHS SRP National Meeting in Philadelphia, PA, and the Northeast Superfund Research Program meeting in Woods Hole, MA.

National and International Collaborations

Center lead Rainer Lohmann and co-lead Philippe Gradjean engage in high-level meetings at both the national and international level as well as meeting with Congressional staff, serving as expert witnesses, and penning incisive editorials about the threats to public health. This provides STEEP with an important voice in the international emerging contaminants community, most specifically with regard to PFASs and next generation chemicals. Their work also ensures that STEEP is on the cutting edge of discovery and subsequent regulatory action.

- Philippe Grandjean and Pál Weihe, co-Chairs of the multidisciplinary International Conference on Prenatal Programming and Toxicity (PPTox) successfully oversaw this year's sixth conference, with close to 200 attendees from around the globe, in Tórshavn, the capital of the Faroe Islands, a STEEP community research site, where the focus was on the impacts of toxic chemicals – including PFASs – on prenatal health and development.

- Philippe Grandjean took STEEP's message to Capitol Hill in Washington DC on June 11-12, 2018, in tandem with colleagues Robert Billock, Arlene Blum, and Tom Bruton of the Green Science Policy Institute. They provided briefings to US Senate and House of Representatives staff on how PFASs harm our health and that of the next generation.

- Philippe Grandjean served as a medical expert for the State of Minnesota in a lawsuit against the company 3M for environmental PFAS pollution, a case that was settled in February 2018 on the eve of trial. He has since advised on water pollution problems in New Hampshire, Vermont, and Michigan.

- Rainer Lohmann joined with recent STEEP Trainee graduate Dr. Xindi (Cindy) Hu of Harvard T.H. Chan School of Public Health and Dr. Jonathan Benskin of Stockholm University to co-chair a session at the EU Society of Environmental Toxicology and Chemistry (EU-SETAC) entitled "From detection to action: advancements in assessing and managing highly fluorinated compounds." Held in Rome, Italy, in May 2018, this convocation of scientific leaders from over 100 countries dedicated to sustainable environmental quality and ecosystem integrity provided STEEP leadership with opportunity to exchange research findings and further develop collegial lines of communication.
- Rainer Lohmann was a member of the first meeting of Global PFAS Science Panel in Zurich in June 2018. The Global PFAS Science Panel is assessing the global state of PFAS production, use and impacts on the environment and humans. Its aim is to exchange information globally and help regulators make sound decisions on legacy and emerging PFASs. It will enable STEEP leadership to stay abreast of critical advances in PFASs research and regulation in other countries, and will benefit STEEP's stakeholders.

Internal Advisory Committee (IAC)

- Rainer Lohmann, PhD, Center Director, University of Rhode Island
- Philippe Grandjean, MD, DMSc, Center Co-Director, Harvard University
- Judith Swift, Research Translation Core, University of Rhode Island

Recent IAC activity includes the establishment and first award of a STEEP Trainee Diversity Fellowship, the initiation of a Trainee Rotation opportunity, and the nomination of Dr. Jitka Becanova for a SRP KC Donnelly Externship Award which she will begin in Spring 2019.

External Advisory Committee (EAC)

- Kim Boekelheide, MD, PhD, Brown University, Associate Director of Superfund Research
- Jane Crowley, RS, MS, Eastham Health Agent, Director of Health and Environment
- Chris Higgins, PhD, Colorado School of Mines, Associate Professor Civil and Environmental Engineering
- Gary Ginsberg, PhD, New York State Department of Health, Director, Center for Environmental Health
- Marc A. Mills, PhD, United States Environmental Protection Agency, Office of Research and Development

The primary goal of the EAC is to provide guidance, feedback, and resources to STEEP with a focus on the scientific merit of the research; the relevance and importance of the individual components to the goals of the Center; the integration of research across disciplines; the effectiveness of research translation activities in linking projects and stakeholders; and the appropriateness of community engagement and training activities. STEEP year 1 evaluation will take place at the EAC meeting in August 2018.

Research Translation Core

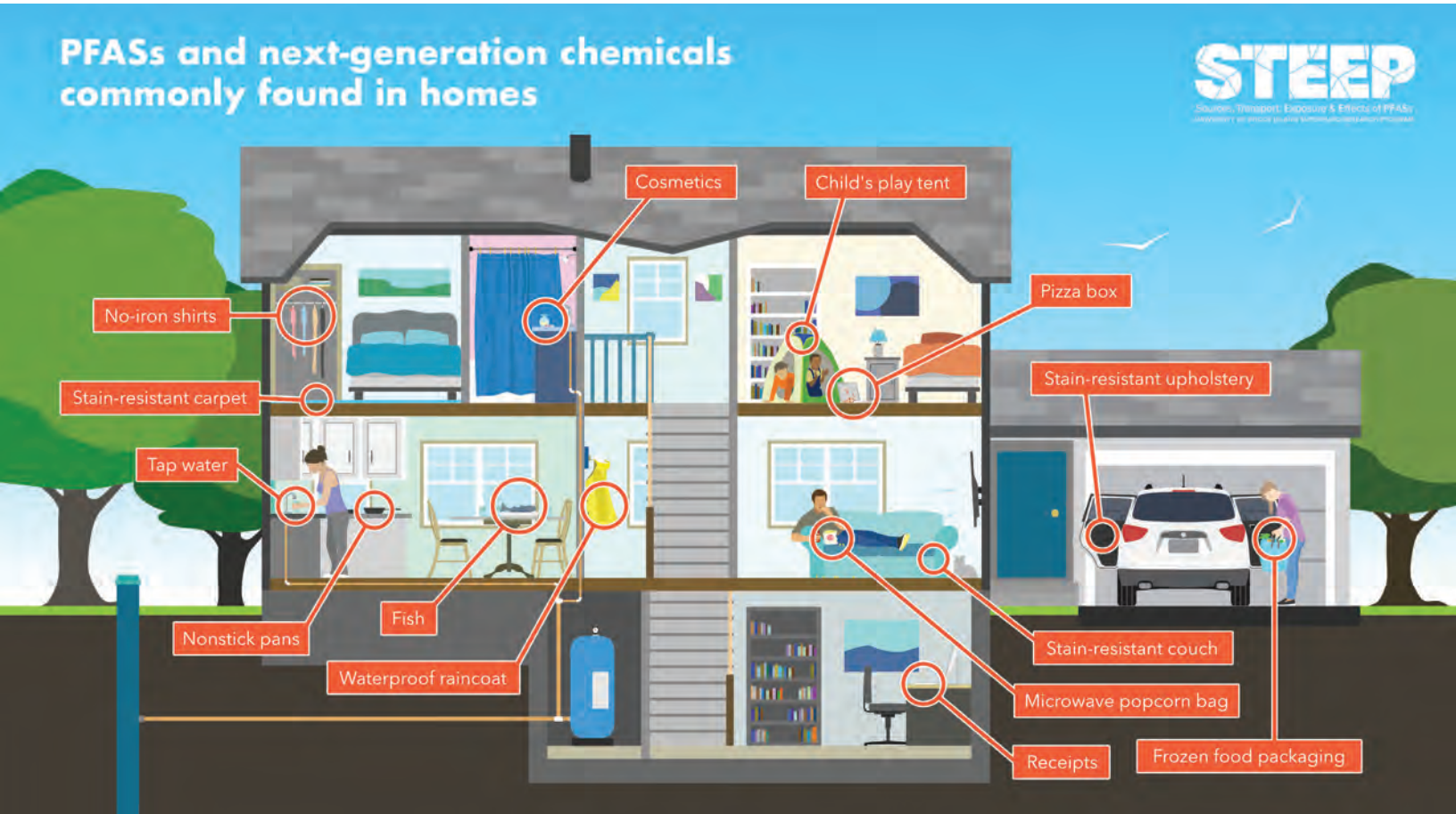
Core Lead: **Judith Swift**,
Coastal Institute at URI

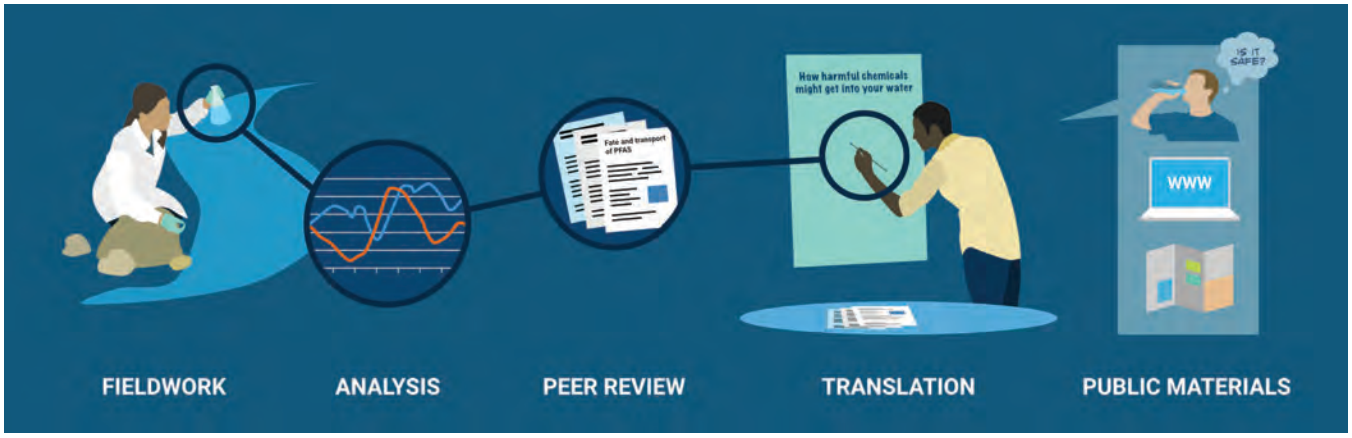
Co-lead: **Nicole Rohr**,
Coastal Institute at URI

Co-lead: **Amber Neville**,
Coastal Institute at URI

Overview

The Research Translation Core (RTC) is leveraging and building upon already existing relationships and communication networks to disseminate information on PFASs and their human health impacts and STEEP's scientific accomplishments to its stakeholders. The RTC will make STEEP's research results and the implications of these findings readily accessible to stakeholders to assist them in understanding PFASs' effects and characterizing risk. As part of the iterative process, RTC is embedding in the overall communication strategy opportunities for stakeholders to provide feedback to the SRP researchers at regular intervals, and a clear timeline for researchers to provide updates in response to community concerns. As this iterative process continues, stakeholders and researchers will continue to narrow in on scientific questions and research strategies that are essential to management and regulatory applications.





To accomplish the overarching goal, RTC is developing targeted messages for: 1) researchers within STEEP and the broader SRP network; 2) state and federal agencies including the National Institute of Environmental Health Sciences, U.S. EPA, Agency for Toxic Substances and Disease Registry (ATSDR), and Tribal Councils; 3) other end-users with a focus on communities on Cape Cod, MA, and the Faroe Islands; and 4) additional groups as identified.

This core will:

- Ensure STEEP's results are widely disseminated guided by principles of the Transtheoretical Model of behavior change (TTM).
- Provide information to state and federal regulators as well as industry leaders to influence the mitigation of PFAS use to protect human health.
- Facilitate technology transfer where appropriate.
- Synergize relationship with Community Engagement Core (CEC) to ensure dissemination of information to affected communities, and improve communication techniques of STEEP trainees, scientists, and researchers.
- Coordinate broad-spectrum outreach and communication efforts in partnership with CEC and Training Core (TC).

RTC will adapt the message complexity to suit individual target audiences without jeopardizing the scientific rigor demanded by the investigation of emerging contaminants.

Progress to date

- Supported PI Lohmann until Program Coordinator was hired.
- Coordinated the STEEP press conference and community kick-off event on December 4, 2017, that resulted in a dozen media stories including newspapers to radio; wrote introductory remarks.
- Developed and launched website—www.uri.edu/steep—including conceptual design of infographics, illustrations, and mixed-use communication tools to stimulate intellectual and emotional response to engage affected communities; providing oversight of website transition to new URI platform.
- Created STEEP branding with logo, partner, and funding agency use on bookmarks, letterhead, folders, business cards, notepads, PowerPoint template, t-shirts, one-pager, visual placards, hashtags, etc.
- Set up and ran ongoing social media campaigns on Facebook, Twitter, Instagram, and LinkedIn.
  - STEEP Superfund
  - @STEEPSuperfund
  - STEEPSuperfund
  - STEEP Superfund
- Presented on RTC/CEC monthly webinar hosted by NIEHS SRP.
- Developed concept for design layout of biannual STEEP newsletter with email and website presence.

Plans for upcoming year

- Develop three 10-minute podcasts focused on the history of PFAS, the health risk of PFAS, and the regulation and remediation of PFAS. Each will feature interviews with STEEP researchers and other experts as well as professional recording, editing, and underscoring designed to attract and hold listeners' attention.
- Develop three 5-7 minute videos: (1) exploring the dynamic between a researcher's role as scientist and humanist and the ongoing conflict between objectivity and outrage; (2) observing the passion that drives a researcher in his quest for remediation of PFASs' impact on children, their development, and the legacy created for their future health; (3) storytelling that captures the unfolding of the dangers of GenX and its newly recognized impact on human and ecosystem health.
- Launch WebEx seminar series to foster a dialog between STEEP scientists and PFAS researchers at academic institutions, government agencies, and nonprofits in order to update this collective cohort of dedicated professionals on STEEP developments and garner their feedback regarding their pending research needs which STEEP may be able to address alone or in partnership.
- Continue to work with CEC to promote their current efforts and develop additional programming to reach target groups with specific interests and concerns, including "translated" PFAS information to include in report backs to volunteers in the private well testing program as well as associated media reports.
- Develop outreach events to complement CEC study site community engagement, focusing on a range of audiences including other SRPs, government agencies, the university communities, and environmental groups with which the Coastal Institute partners on a regular basis.

SOCIAL MEDIA OUTREACH

Twitter stats:
14,900 impressions in last quarter

STEEP Science Day:
1,523 impressions, 26 engagements

Becanova KC Connelly Externship:
1,159 Impressions, 27 engagements

Northeast SRP Regional Meeting:
2,918 impressions, 27 engagements

SELECTED ACCOMPLISHMENTS

Lohmann R, Grandjean P, Bothun G, Cho B, McCann A, **Neville A**, **Rohr NE***, Schaider L, Slitt A, Sunderland EM, **Swift J** (authors in alphabetical order, *presenting author). Introduction to Sources, Transport, Exposure & Effects of PFASs: University of Rhode Island Superfund Research Program. Poster presentation at 2017 NIEHS Superfund Research Program Annual Meeting, Philadelphia, PA, December 6-8, 2018.

RTC-created social media campaign

Community Engagement Core

Co-lead: **Alyson McCann**, College of the Environment and Life Sciences, University of Rhode Island (CELS)

Co-lead: **Laurel Schaider**, Silent Spring Institute (SSI)

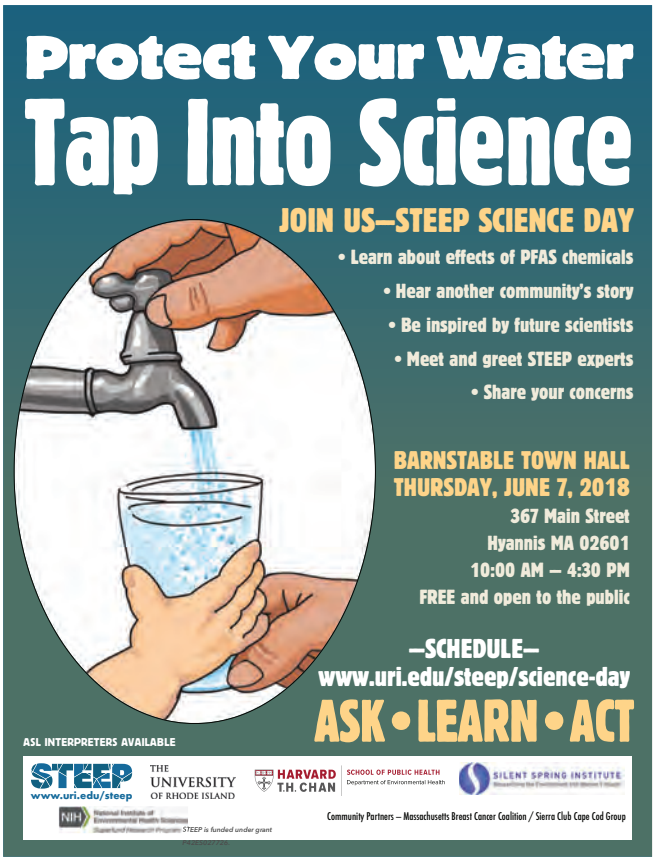
Overview

Community Engagement Core (CEC) activities will be centered on Cape Cod, MA, a region where groundwater and drinking water have been impacted by poly- and perfluoroalkyl substances (PFASs). The CEC will engage with residents, local officials, non-profit organizations, and regulators to protect human health and support local water quality protection.

This core will:

- Develop a PFAS testing and report-back program for private well owners on Cape Cod, focused on areas near likely sources.
- Host an annual STEEP Science Day on Cape Cod for researchers and trainees to share research findings and for stakeholders and community members to ask questions and inform research and engagement activities.
- Participate in community events and be responsive to the community's needs by providing scientific expertise in response to local questions and concerns.
- Promote and implement prevention and intervention strategies to reduce exposures to PFASs.

RTC-created recruitment flyer



RTC-created promotional flyer

The CEC will collaborate community partners such as the Massachusetts Breast Cancer Coalition as well as the Sierra Club Cape Cod Group to expand community outreach by engaging a broader base of each community partners' constituents. The CEC's activities on Cape Cod are connected to STEEP research projects. Private well testing results will inform chemical "fingerprinting" as part of the Environmental Fate & Transport research, and input from Cape residents and stakeholders will inform site selection as part of the Detection Tools research.

Progress to date

Well water testing

The CEC is conducting a private well testing program to evaluate PFAS exposures from drinking water, report results back to individual participants, and identify sources of PFAS contamination to groundwater. Fifty private wells will be tested each year over five years. CEC worked with RTC to prepare recruitment materials, and received approval from the URI IRB for recruitment and sample collection protocols. To date, CEC has nearly 150 volunteers from 10 towns throughout Cape Cod. The locations of volunteer wells and potential PFAS sources have been mapped using GIS, and CEC will select and test 100 wells by the end of 2018.

STEEP Science Day

CEC coordinated an all-day event on June 7, 2018, at Barnstable Town Hall to update community members on STEEP's progress. Featured were a screening of the film, The Islands and the Whales, set in the Faroe Islands, presentations by STEEP team members, a trainee poster session, and a tour of the Hyannis Water System PFAS treatment system.

Collaboration with community groups

Held in-person and phone meetings with Cape Cod Advisory Committee (CCAC) to gain input on the design of the private well study and community events and to share information about STEEP research. CEC partnered with CCAC, the Massachusetts Breast Cancer Coalition, and the Sierra Club Cape Cod Group, as well as with other residents, non-profit organizations, and town and county officials.

Plan for upcoming year

- **Private Well Testing and Report-Back.** CEC will collect water samples from 100 private wells on Cape Cod before the end of 2018. These will be tested for ~30 PFASs in Dr. Sunderland's laboratory. Water samples will also be tested for nitrate and boron as markers of septic system impacts to help distinguish potential sources of PFASs. Silent Spring Institute's DERBI (Digital Exposure Report-Back Interface) will be adapted to develop individualized reports for private well owners.
- **Private Well Owner Focus Groups.** CEC will conduct focus groups with private well owners and community leaders on Cape Cod to identify barriers to private well water testing and treatment. Protocol will be submitted to IRB for review and, upon receiving approval, CEC will hold at least one focus group. Focus groups will improve CEC's understanding of key behaviors that influence well water testing and treatment by Cape Cod private well owners.
- **Cape Cod Community Advisory Committee.** CEC will continue to build the CCAC and will hold two in-person meetings and two conference calls.
- **Community events.** The annual STEEP Science Day will be held on Cape Cod in 2019 and will include findings from the initial private well water testing as well as other updates from the STEEP team. CEC will work with our community partners to organize other events, such as a screening of the film, The Devil We Know, which documents a community harmed by PFAS drinking water contamination, and is working to build new partnerships with other organizations, such as the Mashpee Wampanoag Tribe.

SELECTED ACCOMPLISHMENTS

CEC team members participated in interviews and outreach with local Cape Cod media to promote STEEP events and the private wells study:

- "Drinking water research launched on Cape Cod." Cape Cod Times. December 4, 2017. http://www.capecodtimes.com/news/20171204/drinking-water-research-launched-on-cape-cod
- "Free Cape well testing program launched." Cape Cod Times. April 25, 2018. http://www.capecodtimes.com/news/20180425/free-cape-well-testing-program-launched
- "Non-Stick Products Make Life Easier, But Their Chemicals Are Showing Up in Drinking Water." Interview with A. McCann. WCAI, Local NPR station for Cape Cod and the Islands. June 4, 2018. http://capeandislands.org/post/non-stick-products-make-life-easier-their-chemicals-are-showing-drinking-water#stream/0

Schaider L. Emerging Contaminants in the Waters of Cape Cod. Participated in Brewster Water Quality Forum, Sierra Club Cape Cod Group, Brewster, MA. April 2018.

McCann A, **Schaider L**. Highly Fluorinated Chemicals in Drinking Water: Update on regulations and new research. Presented at Mass. Breast Cancer Coalition Webinar, May 22, 2018. http://mbcc.org/breast-cancer-prevention/highly-fluorinated-chemicals-in-drinking-water-may-22-webinar/

Training Core: Next Generation

Lead: **Bongsup Cho**, College of Pharmacy, University of Rhode Island (Pharm)

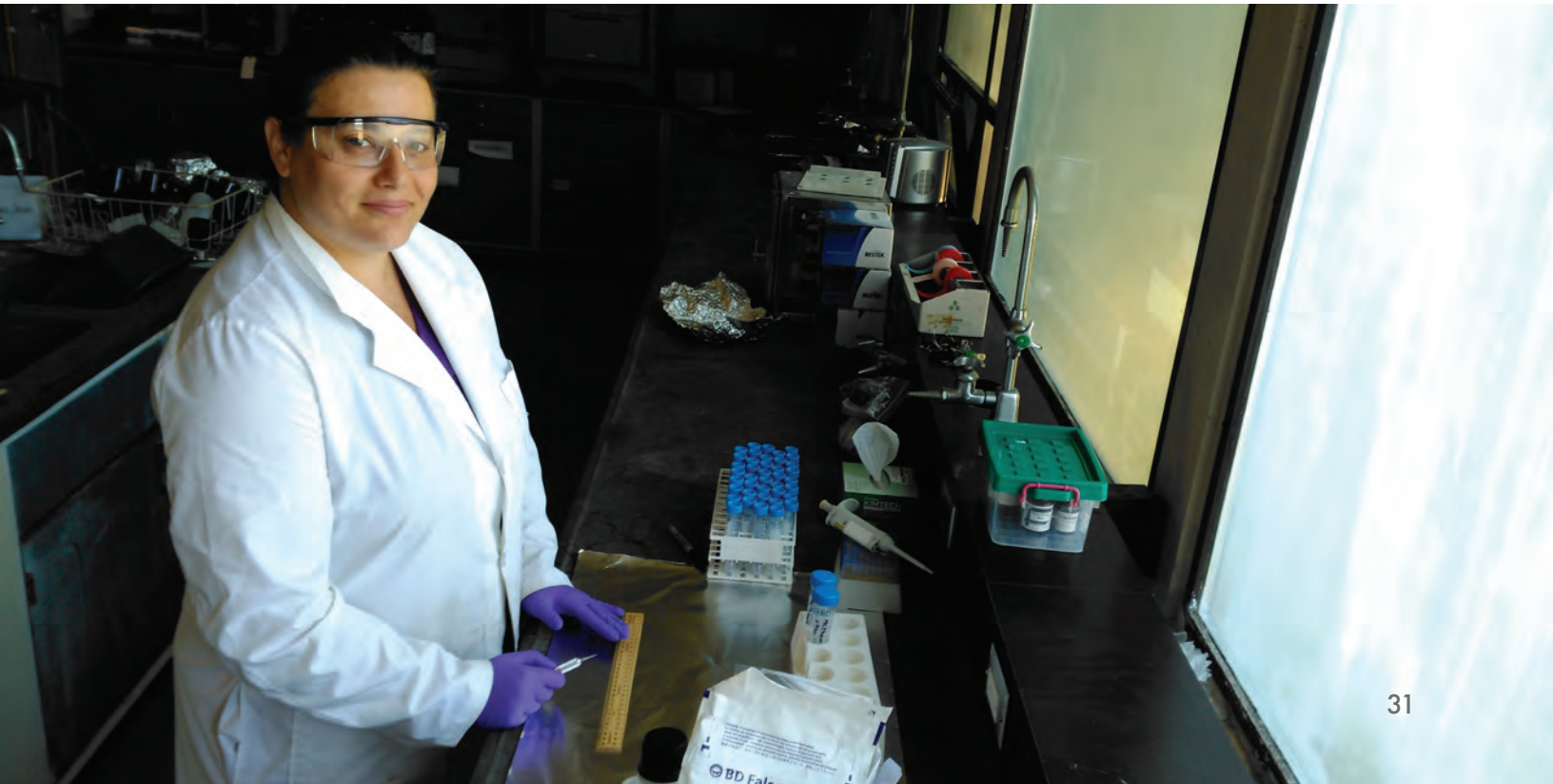
Assessment Coordinator: **John Stevenson**, Professor Emeritus of Psychology, University of Rhode Island (PSY)

Overview

The STEEP Training Core is responsible for shaping the next generation of environmental health scientists into well-rounded researchers with an inter-disciplinary approach and the professional skills necessary to succeed after graduate school. TC will provide pre- and post-doctoral level STEEP trainees with additional resources and opportunities to become skilled scientists and engineers. They will be able to address various aspects of emerging contaminants, specifically empirical research, practical remediation, community engagement, and research translation facets of PFASs.

This core will:

- Promote and coordinate inter- and intra-institutional as well as interdisciplinary cross-training experiences.
- Provide professional development opportunities to enhance leadership, peer-to-peer mentoring, outreach, and communication skills.
- Collaborate with Research Translation and Community Engagement Cores to provide skills often not addressed in traditional PhD programs.



- Connect trainees through social media to create a cohesive and integrated team.
- Support intra-STEEP lab exchanges and participation in professional conferences.

The TC is capitalizing on STEEP's multi-institutional strength by focusing on innovative and interdisciplinary training activities. The TC supports three distinct groups of research trainees over the entire five-year grant cycle: 10 to 12 fully supported pre-doctoral trainees, 8 to 12 fully supported post-doctoral trainees, and additional partially STEEP-funded graduate students. In addition, two STEEP fellowships for students from underrepresented groups are being supported through the URI Graduate School Diversity Program. All graduate trainees will be fully immersed in their rigorous interdisciplinary training activities.

Progress to date

- The TC organized STEEP's first semester-long PFAS Colloquium at URI in Spring 2018. The main objective of the PFAS Colloquium was to provide trainees unique opportunities to explore all aspects of PFASs in one course sequence. It focused on sharing PFAS knowledge and research ranging from physicochemical properties, detection and remediation, toxicology, and other scientific findings to community engagement, communicating science to affected communities, social justice, and policy. Speakers included STEEP program faculty and core leads, as well as invited guests from the PFAS community. All lectures were broadcast live via WebEx conferencing.
- Trainees rated each of the Spring 2018 colloquia on eight structured items representing the training outcome objectives specified in the grant proposal with responses from strongly disagree to strongly agree. The PFAS Colloquium will be held every other semester, continuing in Spring 2019.
- The TC initiated its trainee lab rotation program with an associated award of $2000 to conduct a PFAS-related project in an area outside of their own interests, with the goal of promoting interdisciplinary research experience. To date, the TC has provided one lab rotation award to Anna Robuck.
- Trainees met once a month—and will continue to do so—to update each other on their research, discuss recent developments in PFAS analysis and regulation, and provide feedback on each other's professional development.

Plan for upcoming year

- Developing Fall 2018 trainee opportunities, which includes inviting three expert guest speakers.
- Partnering with RTC, trainees will emcee Q&A sessions associated with a URI public screening of The Devil We Know, a documentary on PFAS in West Virginia.
- Hosting PFAS journal club in Fall 2018 led by Dr. Angela Slitt.
- Continuing PFAS Colloquium in Spring 2019 with a slightly different format: guest speakers will alternate with trainee research presentations; in process to make the PFAS Colloquium an official URI graduate course for credit.

Learning outcomes and assessment

There are three major learning outcome goals for the TC:

- Interdisciplinary cross training, including increased knowledge of complementary disciplines and ability to work collaboratively;
- Professional development for leadership, effective communication across audiences, and ethical research practices; and
- Translation of research for community engagement and policy development.

In order to ensure quality and effectiveness of the TC in accomplishing these goals, there are three planned levels of evaluation:

- Direct trainee evaluations tied to elements of the training program and milestone achievement;
- Annual feedback from trainees, mentors, and core leaders on the usefulness of the individual elements of the training and the overall experience; and
- Monitoring of NIH CareerTrac metrics to document professional accomplishments both in the program and after completion.

TC TRAINEE

Alicia Crisalli, PhD Student, Pharm URI

SELECTED ACCOMPLISHMENTS

Jitka Becanova, a postdoctoral researcher, was awarded the SRP KC Donnelly Externship Award this spring. For her externship, she will work with Dr. Robert Hurt at the Brown University SRP Center in Providence, RI, to study the sorption behavior of PFASs on advanced graphite-based nanomaterials to develop and test different nanographenes as passive samplers for detecting PFASs.

Anna Robuck was awarded the first lab rotation award to work with Dr. Detlef Knappe–an invited Colloquium speaker who sparked her interest–and colleagues at the US EPA National Exposure Research Lab (NERL). She will identify emerging PFASs, such as GenX, in birds procured from the Cape Fear River Estuary, Massachusetts Bay, and Narragansett Bay.

At the Northeast Society of Toxicology Regional Chapter Meeting in Shrewsbury, MA, on October 20, 2017, Emily Martell was selected for a Regional Chapter Travel Award to attend the 2018 annual meeting, and Marisa Pfohl was winner of the poster presentation.

TC awarded a URI Graduate Minority Fellowship (tuition and stipend) to Maya Morales McDevitt, PhD student. This is the first of two minority scholarships provided by the URI Graduate School, an important institutional commitment. To support that commitment, TC provided partial support for Dr. Alicia Mosley, Director of Graduate Recruitment and Diversity Initiatives, to attend a national diversity recruitment meeting.

Each trainee developed and presented a research poster at the Regional SRP Meeting in Woods Hole, MA, held March 26-27, 2018. Trainees then edited these posters based on feedback from the Research Translation Core and presented them at STEEP Science Day on Cape Cod on June 7, 2018.

Trainees

Jitka Becanova
Postdoctoral Researcher
Graduate School of Oceanography, URI
Lohmann Lab

Alicia Crisalli
PhD Student
College of Pharmacy, URI
Cho Lab/TC Grad Assistant

Clifton Dassuncao
PhD (May 2018)
Harvard T.H. Chan School of Public Health
Sunderland Lab

Matt Dunn
PhD Student
Graduate School of Oceanography, URI
Lohmann Lab

Michael Fedorenko
PhD Student
College of Engineering, URI
Bothun Lab

Christine Gardiner
Masters Student
Graduate School of Oceanography, URI
Lohmann Lab

Xindi (Cindy) Hu
PhD (May 2018)
Harvard T.H. Chan School of Public Health
Sunderland Lab

Timo Küster
PhD Student
College of Engineering, URI
Bothun Lab

Emily Martell
PhD Student
College of Pharmacy, URI
Slitt Lab

Maya Morales-McDevitt
PhD Student
Graduate School of Oceanography, URI
Lohmann Lab

Jessica Orr
PhD Student
College of Engineering, URI
Bothun Lab

Marisa Pfohl
PhD Student
College of Pharmacy, URI
Slitt Lab

Anna Robuck
PhD Candidate
Graduate School of Oceanography, URI
Lohmann Lab

Bridger Ruyle
PhD Candidate
School of Engineering and Applied Sciences, Harvard
Sunderland Lab

Andrea Tokranov
PhD Candidate
Harvard T.H. Chan School of Public Health
Sunderland Lab

Damaskini (Dania) Valvi
Research Associate
Harvard T.H. Chan School of Public Health
Grandjean Lab

THE UNIVERSITY OF RHODE ISLAND

HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH Department of Environmental Health

SILENT SPRING INSTITUTE Researching the Environment and Women's Health

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Cover photo: M. Salerno

Product of STEEP Research Translation Core

NIH National Institute of Environmental Health Sciences
Superfund Research Program

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