2019 Annual Report of Accomplishments and Results

Rhode Island
University of Rhode Island

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your Plan of Work. Use this space to provide updates to your state or institutions as needed.

1. Executive Summary (Optional)

This report describes outcomes of selected programs carried out by faculty and staff of the URI College of the Environment and Life Sciences, Cooperative Extension and the Agricultural Experiment Station. Outcomes for planned programs from the FY 2019 Plan of Work are reflected here, and are as follows:

Food Safety and Nutrition: Outcomes for the Expanded Food and Nutrition Education Program (EFNEP) and URI's Food Safety Education program are included. EFNEP seeks to improve diet quality and physical activity; food resource management, food safety, and food security for low-income parents and caregivers with young children and youth. The Food Safety Program serves several audiences; below we describe our work with growers, processors, and foodservice personnel.

Food Production and Sustainability: We have included outcomes for our programs in fruit and vegetable production, biological control, and the Master Gardener program. We provide a variety of support services to farmers through the fruit and vegetable production program, address exotic insects and introduced invasive plants through the biological control program, and educate the public about sustainable gardening practices through the Master Gardener program.

Sustainable Energy, Climate Change and the Environment: Outcomes for our TickEncounter Resource Center, and for three water quality programs are included. The TickEncounter Resource Center provides tick and tickborne disease prevention information. The Home*A*Syst program teaches private well owners to protect and test the water in their wells. The Watershed Watch program monitors more than 220 waterbodies throughout RI and other locations in the region. The Onsite Wastewater Treatment System program performs research and education related to septic systems, which are commonly used in New England.

Youth, Family and Communities: We have included outcomes for the 4-H youth development program and a behavioral economics study of healthcare and financial decision making.

International Programs: Our work to improve food security in Ghana by strengthening leaders in the fisheries sector is included.

CELS-CARES: Not reporting on this planned program.

II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates
1. The Merit Review Process	No updates to report.
2. The Scientific Peer Review Process	No updates to report.

III. Stakeholder Input

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Stakeholder Input Aspects	Updates
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	No updates to report.
2. Methods to identify individuals and groups and brief explanation.	No updates to report.
3. Methods for collecting stakeholder input and brief explanation.	No updates to report.
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	No updates to report.

IV. Planned Program Table of Contents

V. Planned Program Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). See Section V of the Guidance for information on what to include in the qualitative outcomes or impact statements. Add additional rows to convey additional accomplishments. You may expand each row as needed.

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	**Expanded Food and Nutrition Education Program**	Delivery of nutrition education through the URI Expanded Food and Nutrition Education Program (EFNEP) occurs across the state, but primarily targets the core cities of Providence, Pawtucket, Central Falls, and Woonsocket. These distressed communities have double the state-wide average poverty rate and are where one-fifth of the RI population resides. It is well documented that individuals living in poverty tend to have higher rates of obesity and chronic disease and will benefit from community-based programs that aim to improve their nutrition and physical activity behaviors. All individuals who qualify for SNAP benefits or other means-tested federal programs are eligible for these free programs. EFNEP uses a holistic nutrition educational approach based on four core messages: diet quality and physical activity, food resource management, food safety, and food security to improve the habits of low-income parents/caregivers with young children and youth (ages 5-18). A central emphasis of these programs is hands-on cooking opportunities for participants to build self-confidence in preparing healthy meals and snacks at home. Direct education program series are delivered by peer educators in various community settings. EFNEP outcomes from FY19 represent the fourth year of a five-year plan. EFNEP data are collected and reported for youth and adult audiences across four core priority areas including diet quality and physical activity, food safety, food resource management, and food security. Results for FY19 are as follows: 1) Diet Quality: 93% (71 of 76) of participants showed improvement in one or more diet quality indicators (i.e., eating fruits, vegetables, red and orange vegetables, dark green vegetables, drinking less regular soda (not diet), drinking	Food Safety and Nutrition

		less fruit punch, fruit drinks, sweet tea, or sports drinks, and cooking dinner at home). 2) Food Safety: 65% (48 of 74) of participants showed improvement in one or more food safety practices (i.e., washing hands before preparing food, washing all items and surfaces after cutting raw meat or seafood, not thawing frozen food at room temperature, or using a meat thermometer). 3) Food Security: 60% (43 of 72) of participants showed improvement in one or more food security indicators (i.e., not eating less than you wanted so there was more food for your family or having enough money to get food for your family). 4) Food Resource Management: 60% (45 of 75) of participants showed improvement in one or more food resource management practices (i.e., cook dinner at home, compare food prices, plan meals before shopping, look in refrigerator or cupboard before shopping, or make a list before shopping).	
2.	**Food Safety Education Program**	Specialized training is critical for ensuring that Rhode Island's diverse community of growers, processors, and foodservice personnel comply with federal and state food safety regulations. Also, participation in voluntary food safety programs such as Rhode Island's Good Agricultural Practices (GAP) is become an expectation for businesses and non-profits in the state. The URI Food Safety Education Program provides training in seafood, meat and poultry, produce and certain processed commodities by partnering with food safety experts in southern New England, who work together to fulfill food safety needs across the region. During the reporting period, we provided the following training sessions and workshops: 1) RI GAP voluntary on-farm food safety and Produce Safety Alliance training (for produce rule compliance farmer training); 2) Preventive Controls for Human Food for regulatory compliance for processors; 3) Seafood processors for regulatory compliance; and 4) meat/poultry processors for regulatory compliance. We have also worked with the RI Food Safety Task Force to offer a conference and training (such as the newly adopted Retail HACCP curriculum) targeted to the retail foodservice industry. Other ongoing activities include the provision of resources and informational presentations on food safety for Farmers Market managers and vendors.	Food Safety and Nutrition

		We evaluate the effectiveness of our outreach activities using a 5-point Likert scale (1=strongly disagree, 5=strongly agree). The evaluation includes determination of knowledge gained or determination of understanding of key topic areas presented. Evaluation results indicated that training to the target audiences have been successful. For the combined RIGAP/Produce Safety Alliance training, farmers (N=26) rated knowledge gain, implementation and instructor effectiveness at 4.7 on a scale of 5.0. For Preventive Controls for Human Food training (N=76), evaluations rated the overall knowledge gain and usefulness at 4.6 on a scale of 5.0. For Seafood HACCP training (N=76), evaluations rated the understanding of key concepts and usefulness at 4.6 on a scale of 5.0.	
3.	**Fruit and Vegetable Production Program**	This program supports Rhode Island farmers with useful, up-to-date science-based information that will enhance the economic, environmental, and social sustainability of their businesses. Agriculture is resource intensive; inputs are required in order to obtain the valuable outputs, which are crops and their byproducts. A central problem is to identify agricultural practices that minimize resource consumption and environmental impact while maximizing productivity and business profits. A complex underlying issue is a cultural one. Practices that have been identified as beneficial may not be readily adopted for a variety of reasons. Furthermore, practices that are popular may not incur any benefit or may be detrimental, yet they are deemed essential within the grower community. The research we perform follows directly from these problems that we witness firsthand in our outreach work A significant part of our everyday work is to address farm viability by assisting in identification of production problems and recommending multi-level solutions. We have hundreds of interactions every year related to a broad range of crops, farm operations, and their associated and often unique problems. In fact, Rhode Island may be among the more distinctive cases in terms of its diversity of enterprises, with operations ranging from greenhouse microgreens, market gardens, vineyards and orchards, to a 400-acre row-crop vegetable farm. Our work takes place year-round, with the greatest activity	Food Production and Sustainability

		during the growing season (March through October) in the form of direct contacts with traditional stakeholders at their farms, of which there were over 300. Regular contacts with these stakeholders were also maintained through 30 newsletters and innumerable emails, phone calls, and text messages. Cooperative Extension also offered 16 educational meetings to local growers. We monitor and advise on a variety of issues faced by local producers, including opportunities for producing and marketing specialty crops, which can be successful due to Rhode Island's proximity to diverse markets. Below are examples of our work: 1) Education in management practices of insect pests and disease management of vegetable crops continues to be the knowledge area in greatest demand, according to a recent stakeholder survey. Identification and management recommendations are regularly sought by stakeholders several times per week throughout the seven-month growing season and are handled through direct contacts, either in person or electronically. Cultural management, biological controls and least toxic pesticidal materials are recommended, unless efficacy is questionable. Growers who use certified organic methods (or strive to comply without maintaining formal certification) are advised of options that fall within that realm. 2) Management of nutrient availability in vegetable and fruit crops in the field is critical to production success and is an ongoing effort. With increasingly common use of products allowable for certified organic practices, the knowledge gap in appropriate application rates and application timing has become apparent. Use of these more complex forms of nutrients (as opposed to synthetic forms) is a subject of much unscientific recommendation from unsubstantiated internet resources. Honing these practices is the subject of our regular consultations with growers. Optimal use of nutrient sources, whether synthetic or organic, is an ever-evolving area of knowledge due to the complexity and local variation of soil processes. Regular communication with growers about this subject is a give-and-take and mutually educational experience. The result has been improved production and plant health, and deepened relationships with stakeholders. 3) The high tunnel environment is a special case of nutrient management, and one not well understood despite their tremendous popularity and successful production record. URI engaged in an informal collaboration with three other	

		New England institutions to gauge high tunnel tomato production practices in order to more accurately formulate nutrient recommendations. One result of this information gathering was the discovery that many growers are applying excessive quantities of nutrients. A concern is that there may be leaching and lateral movement of excessive nutrients into ground and surface water, although no one has studied if this is taking place. Another concern is the possibility of poor plant performance with excessive fertilization, including increased susceptibility to diseases and insect pests, ripening disorders, and imbalance between vegetative and fruit production. 4) Vegetable crop variety selection is always a concern to growers. Varieties are trialed at the URI Agronomy farm every year and results are shared through our online publications. Variety trial reports for basil and naked seeded pumpkins were provided in FY 19. 5) Rhode Island's largest vegetable producer has experienced a chronic disease problem in their tomato crop. This year we conducted a field study using a relatively new phage product that specifically targets this bacterial disease. While results appeared to be excellent in one field, disease was rampant in another. We plan to carry out this trial again in 2020. 6) Container media ("potting soils") are used in the agricultural industry in great quantities. Many growers are seeking alternatives that are locally produced and are suitable for organic certification. We carried out a study to screen several combinations of ingredients and proportions of locally made compost in order to develop a quality media for southern New England growers. Existing compost-based media have had inconsistent or problematic results. Our study was systematic and candidate mixes were tested on a variety of plant types and production circumstances. Results of the study will be shared with RI producers of containerized plants. 7) Ongoing outreach to RI urban growers continues to expand through workshops on season extension using field tunnels and soil and pest management education. Numerous direct relationships have been established and growers are now asking for access to materials for season extension.	
4.	**Biological Control Program**	A full description is below and please see a recent article in Connecticut Magazine about this work: Biocontrol	Food Production and Sustainability

		Classical biological control addresses the problems of exotic insects and introduced invasive plants by reuniting these pests with their natural enemies. It offers the potential for long-term sustainable management of pests across widespread areas and may reduce pesticide usage. Swallow-wort biocontrol: We focused our swallow-wort biological control research on the biocontrol agent, *Hypena opulenta*. Swallow-worts are the only host plant for this moth species, and the caterpillar feeds on swallow-wort foliage. We developed new rearing methods for *H. opulenta* to support field release experiments. We conducted releases of caged adults in Rhode Island, Massachusetts and Connecticut in seven sites. All release sites were monitored for feeding damage; cages were released, and the cages were removed to allow movement of larvae into the surrounding plants. Percent damage reached 55 - 100% at all release sites. In spring 2020 we will visit all release sites to look for establishment of *Hypena opulenta.* The approval by USDA for release of *Hypena opulenta*, in addition to the successful rearing of *H. opulenta* in the URI biocontrol lab finds us at the beginning of a highly anticipated biological control program for swallow-worts. We have a large network of cooperators in Rhode Island, and throughout the northeast for biological control of swallow-worts. We have been educating stakeholders about the project and preparing for releases of *H. opulenta* in many states. In 2019 we succeeded in making releases in three states. The implementation of this biocontrol program will lead to a decrease in herbicide use for control of swallow-worts in many states. Lily leaf beetle biocontrol: We collaborated with research and outreach personnel from Connecticut, New York and Washington to introduce three lily leaf beetle biocontrol agents to these states. Each year undergraduate researchers collect parasitized larvae of these biocontrol agents from Rhode Island and Massachusetts and rear them until parasitized cocoons are removed from rearing containers. These are kept overwinter in incubators and in the spring, adult parasitoids can be sent to our collaborators for release. We also received larvae from Connecticut and New York to dissect to detect parasitism. Releases of lily leaf beetle parasitoids have resulted in a decrease in the lily leaf beetle populations in many neighborhoods throughout Rhode Island and	

		Massachusetts, as referred to us anecdotally by homeowners. Lily growers who had pulled up their bulbs due to the lily leaf beetle are now growing them again. We are also working with other states that have the lily leaf beetle as a new pest, and they are initiating biological control in the early stages of the infestation, which should lead to earlier management of the pest. Phragmites biocontrol: In 2019 we evaluated currently existing insect herbivores on invasive Phragmites in Rhode Island and surrounding states. This work was done to prepare for future releases of biocontrol agents for *Phragmites australis* (*Archanara geminipuncta* and *Archanara neurica*). The host specificity work for two agents for *P. australis* is complete and the Petition for release request has been approved by the Technical Advisory Group. Winter moth biocontrol: Winter moths were first detected in Rhode Island in 2004 in Warwick. Winter moths continued to spread throughout RI and were found throughout the state by 2012. We previously released *Cyzenis albicans* as a biocontrol agent of winter moth and each year we collect winter moth larvae and examine them for parasitic fly pupae. In 2014, 2015, and 2016, flies were recovered from the 2011 release site in Warwick. In 2016, flies were recovered from one 2013 release site, and in 2017 they were recovered from the second 2013 release site. 2018 and 2019 results are pending. We anticipate a successful outcome from this project, as this fly is providing very good control of winter moth in southeastern Massachusetts. Emerald ash borer: Emerald ash borer was first found in Rhode Island in 2018. In 2019 we identified one promising release site for emerald ash borer parasitoids and released three species of parasitoids from August through September. This is a USDA sponsored program that is intended to protect regenerating ash from the emerald ash borer. Mile-a-minute: We also conducted outreach/implementation activities for mile-a-minute biological control. In 2019 we released 4,000 *Rhinoncomimus latipes* weevils in Rhode Island as biological control agents for mile-a-minute weed, for a total over 78,000 released during the last eight years. Each year we visit and monitor the plants and insects at each release site.	

5.	**Master Gardener Program**	Use of sustainable gardening practices will help improve the quality of wildlife habitat, ecosystem health, and water quality and quantity in Rhode Island, the country's second most densely populated state. By connecting Rhode Island residents to the environmental impact of their gardening behavior, they become more active stewards of the land, leading to improvements in environmental quality and quality of life. Additionally, with the popularity of social media and the accessibility of misinformation via the internet, it is more important than ever to connect people to unbiased sources of research-based information to ensure that they are making the best possible decisions. Over the past three years, the URI Master Gardener Program adopted a "land stewardship" focus area (priority) in which URI Master Gardener volunteers were trained and deployed to serve as educators within the community, teaching residents about land stewardship practices through partnerships and educational services. This focus area, which was identified via a needs assessment, included behavior change goals related to integrated pest management practices, creation of wildlife habitat in yards, practices to reduce stormwater pollution, reduction in pesticide use, and adoption of research-based practices. Specially trained School Garden Mentors gave technical guidance and support to 70 public and private K-12 schools educating over 10,000 youth and 1400 adults. This occurred through our demonstration gardens in 40 locations throughout the state, providing over 90 free in-garden workshops on a variety of topics, in partnership with educational nonprofits. Large public outreach events such as the Gardening with the Masters Tour, Spring Festival and Garden Symposium also educated over 4,000 adult learners about sustainable gardening practices. Educational services offered free to the public included 80 public workshops given within libraries, businesses and other community locations, 52 "Ask a Master Gardener" kiosk events serving over 4,000 people, and 123 soil testing events serving 1,087 people. This year's free seed program, in which donated seeds are distributed to community groups, had its widest reach ever, serving 49 states across the U.S., with 1,702 groups and individuals receiving donations of over 174,000 seed	Food Production and Sustainability

		packets. In addition, 8,000 seedlings were donated to 80 schools and community groups and over $11,800 worth of curricula and school garden teaching materials were distributed to 50 schools throughout the state. Newspaper articles and social media posts related to these events and projects also indirectly educated the public about sustainable gardening. Based on the results of our year-end survey, with 800 responses and a 20% response rate, 89% of clients learned something new from URI Master Gardeners. In 2019, the top behavior reported by clients of URI Mater Gardener volunteer educators, was to create or enhance the garden environment for beneficial insects, pollinators and birds, with 38% of clients indicating that they began or increased this behavior. The #2 behavior change at 33% was to choose native plants, and the #3 behavior change at 31% was to identify plant problems before taking actions, one of the most important steps in adopting an integrated pest management strategy. At least 13 additional behavior changes were indicated by clients of URI Master Gardener volunteers related to sustainable gardening, including integrated pest management and pesticide reduction, creating wildlife habitat in residential gardens, reducing sources of stormwater pollution, water conservation, testing and amending soil properly, and gardening in a school setting.	
6.	**Tick Encounter Resource Center**	The high incidence of Lyme disease, now infecting >340,000 people each year in the United States, along with increasing rates of other dangerous tick-transmitted infections, is a critical and growing public health problem for communities especially across the Northeast, mid-Atlantic, and upper mid-Western states. In the United States, estimated costs for the impact of Lyme disease alone exceeds $1.3 billion annually. Moreover, the tick problem in the U.S. is continuing to grow in geographic scope, scale, and costs. To help raise tick bite protection awareness, we managed the TickEncounter website and its Facebook, Twitter, Instagram, and YouTube social media channels. Several features of our outreach program make it unique and one of the most widely used tick and tickborne disease prevention resources in America. Perhaps the most unique aspect of TickEncounter is our focus on seasonal and geographical relevance and how that relates to tick encounter	Sustainable Energy, Climate Change and the Environment

		risk. During this reporting period, TickEncounter hosted >1,000,000 user sessions by >900,000 unique users viewing >2.5 million pages. We added 70 posts to our Facebook page that reached 520,000 people and were shared by 5400. Our Twitter, Instagram and YouTube channel combined for more than 600,000 additional people reached. During this reporting period our TickSpotters crowdsourced tick survey and riskiness assessment, promoted as our "free & fast portal to a tick expert," received nearly 8,000 submissions which came from all 50 United States, every Canadian province, several Mexican states, as well as several foreign countries. Each submission received an auto-reply message with tick generic TickSmart tips and next best actions. All submissions received at least one additional email providing a customized confirmation of the tick identification, riskiness assessment based on geography, stage of development, and state of engorgement. Additionally, these customized responses provided a more tailored best next action response for preventing disease and future tick encounters. We have now serviced almost 70,000 TickSpotters submissions in 6 years of operating this popular crowdsourced, citizen-scientist activity. We completed implementation of our TickSpotters 2.0 platform, a cloud-based CRM system with over 250 potential customized responses. We continued our Continuing Education (CE) program with certification (TickSmart Certified) and CE credits, targeting veterinary clinics and public health practitioners. During this reporting period, we developed and conducted seven 3-hour in person training workshops and have now certified 110 veterinarians/veterinary technicians representing 35 clinics in Rhode Island, Massachusetts, New Hampshire, Michigan, Pennsylvania, and Connecticut. We continued offering our 1-hour veterinary clinic online webinar training that provided an estimated 250 veterinary staff CE credits in states from Ohio to New England in 3 webinar offerings. We helped organize and administer the first Tick Academy, a 2-day intensive training workshop co-sponsored by the North-Central IPM Center, the IPM Institute, and the Upper-mid West Vector borne Disease Center of Excellence. The course was held at the University of Wisconsin; 24 attendees came from WI, MI, MN, UT, AZ, and Washington DC and represented a wide range of stakeholder groups, including local and state public health, pest control, veterinary pharma, consulting, and US military. We conducted numerous TickSmart lectures and workshops to various stakeholder groups,	

		including schools, public citizen groups, Master Gardeners, and outdoor workers in MA, RI, NH, NY, PA with an estimated direct reach of 1,800 adults and 400 school children. We also had more than 60 direct media contacts, resulting in significant national and local coverage of tick awareness and the need for improving tick literacy. Our TickSmart products program continued to provide users with high-quality tick images, daily tick check learning kits, daily tick check reminder cards, tick identification magnets, and awareness posters. For the first time, we were able to set up on on-line store capable of accepting credit card purchases, greatly facilitating the customer experience and service.	
7.	**Home*A*Syst Program**	Protection of municipal drinking water receives increased attention as water suppliers are now required to test, report and treat for numerous water quality contaminants. Surprisingly, private wells, which serve 15% of the state's population, are not protected under the Safe Drinking Water Act or other federal programs. Private well owners are largely responsible to ensure that their well water is safe for them and their families to drink. These residents need to be aware of contaminant risks to their drinking water sources and how to protect against such risks. Changing property laws and regulations in the state have increased demand for well water testing and educational materials. Education and technical assistance about protecting private sources of drinking water is critical to the health and safety of families relying on private wells. Audiences include private well owners, scientists and researchers, educators, federal, state, and local policymakers, and non-profit organizations. Given the large number of Rhode Islanders (approximately 150,000) who rely on private wells, this Extension program has used a variety of methods to educate and provide technical assistance to the state's private well owners. The University of Rhode Island Cooperative Extension Home*A*Syst Program provides education and technical assistance to Rhode Island private well owners to help them make informed decisions to protect drinking water and human health. We partner with the Rhode Island Department of Health, the Rhode Island Department of Environmental Management, Rhode Island Association of Conservation Districts, Rhode Island Realtor's Association, local community boards and commissions, and other groups to provide these services.	Sustainable Energy, Climate Change and the Environment

		For this reporting period we held seven community workshops across the state that were attended by 316 private well owners. We facilitated the testing of well water for workshop participants by returning to the community after each workshop to pick up test kits and transporting the kits to the Rhode Island State Health Lab for processing. We conducted a Community Intercept Campaign at RI Farmers Markets, the RI Home Show and other community events to meet private well owners in their own community. We provided technical assistance and educational materials to 651 people at 32 events throughout this reporting period. We continued to update the program website at web.uri.edu/safewater, which contains a variety of resources including our community event calendar and a mechanism for people to sign up for workshops. The Program's quarterly email newsletter was sent to 1,445 private well owners during this reporting period. We also maintained an active and robust social media outreach on Facebook to build and sustain interest in program events. Each year we mail surveys to private well water workshop attendees to determine actions they took as a result of attending the program. This year's survey results show that 66% of workshop participants had their water tested, an outcome measure that has improved each year since we began facilitating testing at the RI State Health Lab in 2014. In addition, 68% of workshop attendees inspected their wellhead area for possible pollution problems, 71% shared workshop information with family members, and 37% shared workshop information with friends and neighbors.	
8.	**Watershed Watch**	Water quality monitoring creates the foundation for effective, cost-efficient and responsive water resource and watershed management. It helps us to target areas of concern, identifies sources of contamination, determine whether the implementation of BMPs, policies or regulations are effective and helps track water quality trends over time. It allows decisions to be data-based, resulting in both efficient and effective water resource and watershed management. Engaging volunteers in water quality monitoring expands the scope, frequency and area of monitoring in the most cost-effective way possible. It also helps to educate the public about water quality issues and	Sustainable Energy, Climate Change and the Environment

		creates more informed, and active watershed stewards. With more than three decades of water quality data on some sites, the value of these data is becoming ever more important as trends in response to land use changes, regulations and climate change are becoming apparent. Continued support ensures that communities have the information they need to restore, protect and preserve vital water resources. Working with more than 40 local partners and sponsors, as well as directly with individual volunteers, WW monitored more than 220 individual lake, pond, river, stream, salt pond, bay, harbor and ocean water sites throughout Rhode Island, southeastern Connecticut and Fishers Island, New York. We engaged and supplied approximately 350 trained volunteers, interacting with most of them at least once each season for training or when they dropped off samples. Classroom training sessions were held on campus, and field training sessions were held off campus, often at locations selected by our partners. Presentations on water quality, harmful algal blooms, aquatic invasive species and landscaping for water quality protection were made to several program partners, other organizations, schools or at conferences. In addition, in response to the water-based theme, we trained high school students via the Envirothon training workshop hosted by Cooperative Extension. This year, we worked with several of our organizations to support Shell Day, a snapshot monitoring event examining ocean acidification, which broadened the reach of that effort while increasing our coastal partners' understanding of the issue. We also educated our volunteers and others on harmful algal blooms via our participation in the Cyanobacteria Monitoring Collaborative (regional) and listed advisories (RI) on our website and sent out via our listserve. As a monitoring program, each year of additional data for a site or water body builds our understanding of that system and impacts to it. By sharing that information with our volunteers, sponsoring organization or other data users, communities are better able to respond to changes, address concerns or take other actions. Individuals are aware of their own impact to water quality, allowing them to make changes in their habits, landscapes or choices, and often encourage others to be better stewards as well. In addition, several communities and organizations used our water quality data in the successful pursuit of grant funding. From both our direct and indirect youth engagement	

		efforts, we know that students better understood water quality and their role in protecting it; and in several cases, students stated their interest in pursuing water resource studies in the future.	
9.	**Onsite Wastewater Treatment System Program**	Onsite wastewater treatment systems (OWTS) are used by 30 percent of Rhode Islanders to treat residential wastewater. OWTS can pollute groundwater and surface waters and pose public health risks. Understanding how conventional and advanced OWTS work and how to improve their performance is critical to protecting public and environmental health and providing sustainable and cost-effective treatment practices. This is particularly important as Rhode Island continues to deal with the effects of climate change which have direct impacts on the functionality of OWTS in at-risk areas of the state. Our work is described below: <u>Assessment of advanced nitrogen-removal onsite wastewater treatment systems in Charlestown, RI.</u> Advanced N-removal OWTS are designed to facilitate nitrification and denitrification of wastewater before final effluent is applied to the soil treatment area and percolates to the groundwater. In this study, we selected 48 advanced N-removal OWTS in the town of Charlestown, Rhode Island to determine the capacity of 6 different N-removal OWTS technologies (Orenco Advantex AX20, Orenco Advantex RX30, BioMicrobics MicroFAST, and Norweco Singulair Models TNT, 960, and DN) to meet the RI Dept. of Environmental Management's standard for final effluent total N (TN) concentration of 19 if seasonal systems require any microbial "ramp-up" time before they are capable of N removal. The year-round systems are sampled quarterly, and the seasonal systems are sampled four times (monthly) over the summer (June through September) occupancy period. We have found that home occupancy pattern does not influence TN concentrations in the final effluent from advanced N removing technologies in our study. Contrary to our initial beliefs, there does not appear to be any sort of microbial ramp-up time mg/L or less. Twenty-one of the systems serve houses occupied year-round, while 27 serve seasonally occupied houses.	Sustainable Energy, Climate Change and the Environment

		Investigating the impact of home occupancy pattern on effluent TN will allow us to assess associated with seasonally used systems. However, technology type does significantly influence effluent ammonium and TN concentration; it does not influence nitrate concentrations. Specifically, Norweco systems reported higher NH4+ and TN concentrations than all other technologies. This, in combination with the significantly higher alkalinity and BOD5 values reported by Norweco systems, suggests that Norweco systems are not nitrifying sufficiently. Sixty-four percent of AX20 systems, 44% of RX30s, 100% of FASTs, and 0% of Norweco systems have final effluent median TN values less than RIDEM's standard of 19 mg/L. Assessment of Non-proprietary Passive Nitrogen Removal Septic Systems. In collaboration with partners in Massachusetts (MASSTC), we are conducting experiments to test the nitrogen removal potential of layered soil treatment areas (STA). These leaching systems increase sequential nitrification (in a sand layer) and denitrification (in a sand layer mixed with sawdust) as septic tank effluent percolates through to groundwater. We are monitoring three residential layered systems for (1) N removal (2) microorganisms involved in N transformations, and (3) greenhouse gas emissions. All STA were constructed with a control (conventional) STA beside them filled only with sand and receiving the same wastewater; this design allowed us to make comparisons with a STA like those currently installed in Massachusetts. We collected monthly subsurface greenhouse gas concentrations from this site from May 2018-July 2019. During the reporting period we collected greenhouse gas emission data from each site during the spring and summer of 2019; during these sampling events we also collected four soil cores (2 control and 2 layered STA) at each site. Analysis of the final effluent nitrogen removing performance data indicates that the layered soil treatment areas meet state N regulations in 80% of samples collected, compared to 20% of control samples. We observed no significant differences between greenhouse gas emissions from the layered	

		and control STAs. The microbial community DNA extracts for initial media material, native soil, and all sampling events have been performed. During the reporting period, we completed all the lab analyses necessary for this part of the project and are currently performing data analysis. Quantifying threats to coastal septic systems posed by rising groundwater tables. Using long-term groundwater monitoring wells, coupled with ground-penetrating radar surveys of 10 different drain fields, we investigated how groundwater tables along the southern RI coast are impacting drain field separation distance (the distance from the drain field's infiltrative surface to the groundwater table) in near-shore areas. A reduction in drain field separation distance reduces the hydraulic detention time and the volume of soil that wastewater moves through before reaching the groundwater table. This will have a negative effect on wastewater treatment potential and increase the contamination risk to the environment and public health. Analysis of long-term groundwater monitoring wells, coupled with ground-penetrating radar surveys of 10 different drain fields, determined that 20% of the study sites had adequate separation distance throughout the year, while 50% had inadequate separation distance at least some of the time, and 30% never had adequate separation distance. At one site, during a small coastal storm event, the water table reached the infiltrative surface of the drain field. These findings corroborate research performed by our group on historic near-shore groundwater tables, which indicated that over time, groundwater tables appear to be rising. Next steps are to share this information with regulatory agencies to inform a discussion on improving the regulation-specified method of groundwater table elevation determination, as current methods are not accurate in near-shore areas. Modeling the effects of storm damage to near-shore septic systems along southern RI coast. We created a model using existing flood maps for different storm recurrence interval probabilities and mean parcel elevation to predict which septic systems would be affected/damaged to varying extents along the	

		southern Rhode Island coast should a storm affect the area. Septic systems were predicted to face serious impacts (extensive repairs / complete replacement required in the aftermath of a storm event), moderate impacts (minor repairs required to restore full system functionality) or ephemeral impacts (no lasting impacts once storm waters recede), based on proximity to the Atlantic Ocean and mean parcel elevation. Repairs to these impacted systems could cost anywhere between $1 to over $30K per system, depending on the nature of the damage. The model was validated using damage description reports for systems that sustained damage during Hurricane Sandy in 2012 in Charlestown and Westerly, RI. The storm damage to near-shore septic systems model we developed predicts damage to systems with ~70% accuracy, underestimating damage on up to 20% of systems. The model could be improved by incorporating more parameters and details, including actual system elevation, surrounding microtopography, system type and better damage descriptions in the aftermath of storms. Current coastal community resiliency plans are not adequately addressing the threat posed by storms with respect to OWTS, which could result in significant environmental degradation and public health risks. <u>Using IRIS tubes as an indicator of denitrification.</u> Advanced onsite wastewater treatment systems (OWTS) and soil treatment areas are used to remove nitrogen from wastewater. These systems rely on sequential nitrification and denitrification to remove nitrogen in gaseous forms: N2 and N2O. Determining the extent to which denitrification takes place in these systems is a complex, time-consuming task. Manganese oxide reduction takes place at a redox value close to that for denitrification. We gathered preliminary data on the use of IRIS (indicator of reduction in soil) tubes coated with manganese oxide to assess the redox conditions in an advanced N-removal OWTS. We found that loss of color – indicative of Mn reduction – from IRIS tubes used as indicators of redox conditions took place in the anoxic and hypoxic	

		compartments after in situ incubation for 7 days, whereas no loss of color was observed in oxic compartments. Laboratory experiments shows that loss of color from IRIS tubes submerged in anoxic wastewater was evident after 30 min. Our results suggest that IRIS tubes coated with manganese oxide paint may be a quick, inexpensive indicator of redox conditions that support denitrification. Impact of soil water-filled pore space on greenhouse gas emissions. Microbial removal of C and N in soil-based wastewater treatment involves emission of CO2, CH4, N2O, and N2 to the atmosphere. Water-filled pore space (WFPS) can exert an important control on microbial production and consumption of these gases. We examined the impact of WFPS on emissions of CO2, CH4, N2O, and N2 in soil microcosms receiving septic tank effluent (STE) or effluent from a single-pass sand filter (SFE), with deionized-distilled (DW) water as a control. Our research into the impact of water-filled pore space on greenhouse gas emissions indicated that incubation of B and C horizon soil for 1 h (the residence time of wastewater in 1 cm of soil) with DW produced the lowest greenhouse gas (GHG) emissions, which varied little with WFPS. In B and C horizon soil amended with SFE emissions of N2O increased linearly with increasing WFPS. Emissions of CO2 from soil amended with STE peaked at WFPS of 0.5–0.8, depending on the soil horizon, whereas in soil amended with SFE, the CO2 flux was detectable only in B horizon soil, where it increased with increasing WFPS. Methane emissions were detectable only for STE, with flux increasing linearly with WFPS in C horizon soil, but no clear pattern was observed with WFPS for B horizon soil. Emissions of GHG from soil were not constrained by the lack of organic C availability in SFE, or by the absence of NO3 availability in STE, and addition of acetate or NO3 resulted in lower emissions in a number of instances. Emission of 15N2 and 15N2O from 15NH4 took place within an hour of contact with soil, and production of 15N2 was much higher than 15N2O. 15N2 emissions were greatest at the lowest WFPS value and diminished markedly as WFPS increased, regardless of water type	

		and soil texture. Our results suggest that the fluxes of CO2, CH4, N2O, and N2 respond differently to WFPS, depending on water type and soil texture. Outreach activities. The URI outreach team delivered 21 talks (12 of which were invited) and 3 posters to academic and professional audiences relative to OWTS and climate change at conferences in RI, CT, MA, NY, CA, ME, and Dublin, Ireland. Our audience consisted of scientists, wastewater practitioners, board of health officials, regulatory decision makers and coastal resource managers. In addition, we published 2 peer-reviewed papers, and one book, delivered a total of 22 workshops/ classes in two states in the region, reaching a total of approximately 500 practitioners, decision makers and students. These classes provided continuing education credits needed by nearly 325 licensed professionals to renew their professional licenses. Three of the classes had qualifying exams.	
10.	**4-H Youth Development Program**	Rhode Island needs productive, skilled, engaged citizens to lead us into the future. The 4-H program provides out-of-school experiences that increase life skills and support healthy lifestyles. A Tufts University study, *The Positive Development of Youth: Comprehensive Findings from the 4-H Study of Positive Youth Development*, found that effective youth development starts with engaging youth ages 5-18 in activities that build important life skills, provide sustained and positive relationships between youth and adults, and provide opportunities for youth to use their skills as participants and leaders in their communities. This same study found that participants in the 4-H program are twice as likely to participate in science, engineering, and computer programs than their peers. Girls participating in 4-H programs are twice as likely to participate in science programs than their peers belonging to other out-of-school programs. The URI 4-H program has focused on increasing scientific skills and interest among youth by providing workshops, activities, programs, educational materials, lesson plans and kits. We continued our special interest programs, partnering with other youth-serving agencies to engage under-served youth in science education. Youth/adult science workshops provided youth with	Youth, Family and Communities

		opportunities to increase their knowledge and skills and apply them in informal, adult-mentored settings where they received positive feedback and reinforcement. Through URI 4-H programs, workshops, and events, youth participants deepened knowledge of scientific knowledge, reasoning, and fields of study. Not only did youth become better scientists, they also became more interested in studying science. Youth who felt ambivalent/negatively about science learning showed more positive attitudes toward science after engaging with URI 4-H. URI 4-H youth also honed communication and teamwork skills, becoming better able to complete activities and challenges in consultation with their peers and can compromise with peers to reach a group solution. 4-H youth are also more comfortable expressing ideas and providing constructive feedback to groups of peers. We employed a variety of methods to collect data and evaluate. Enrollment and event registrations were used to show participation, while surveys of youth members, volunteers and agency partners were utilized to show change in knowledge and interest in science. Results for FY 19 are as follows: 60% of URI 4-H youth who participated in the URI Animal Veterinary Science Day reported increased interest in science. 96% of these youth reported they learned “some” or “a lot” about animal health as a result of these workshops. An increase in scientific knowledge was also demonstrated by 85% of youth who answered animal science knowledge questions correctly on the post workshop written assessment. URI 4-H club leaders reported that as a result of 4-H work, 70% of their club members have demonstrated increased knowledge in science and/or healthy lifestyles. We asked five URI 4-H agency partners to rate the effectiveness of our science learning kits, which are deployed to hundreds of additional youth throughout the state. 100% of agency respondents reported that the URI 4-H science kits were “very effective” in cultivating positive attitudes in youth toward STEM learning. Agencies also reported the kits were “very effective” in improving communication skills and teamwork among youth.	

11.	**Behavioral economics and the intersection of healthcare and financial decision making across the lifespan**	As research surrounding the rise in obesity, the prevalence of cancer and other sources of mortality continues, the debate over who should pay for the accompanying cost of healthcare is more heated than ever. Not unlike the tax code, the details of healthcare reform are buried in thousands of pages of legal documents no matter which side of the political aisle is proposing a change. As a result, patients and consumers of healthcare in general find themselves at the mercy of lawmakers when it comes to making financially prudent decisions regarding their health. As consumers increase health management decisions, financial decisions related to health care also increase. In addition, they must rely on their previous knowledge and understanding of healthcare-related terminology or have the fortitude to devote the energy (intrinsic cost) to learning enough about the products and services available to utilize their insurance resources optimally. It is paramount that consumers learn the basic functions and processes required to maximize the benefit they receive from their insurance provider. It is toward this maximization of benefits (or utility) that we focus the NC2172 group's attention. We are currently working on several projects related to healthcare and decision making under financial constraints. A key project reviews how the recent Medicaid expansion brought some people out of the woodwork and to the system even in non-expansion states. This work focuses on information dissemination for making better healthcare choices. Initial results suggest that there may be many Americans that qualify for Medicaid but fail to apply. Medicaid reforms generated a considerable amount of new information and media coverage that, apparently, turned out to be a factor leading some people to sign up for the benefit. In addition, we are in the process of creating a publicly available website to include both research and outreach projects from the group.	Youth, Family and Communities
12.	**Food Security**	The problems in Ghana's marine fisheries sector are complex, tragic, and too common. Severely overexploited fisheries put at risk tens of thousands of metric tons of local food fish supply and threaten the livelihoods of over 130,000 people and many more fisheries resource dependent households. Ghana's open access to fisheries resulted in extreme overcapitalization of fleets, exacerbated by poor	International Programs

		governance, weak enforcement of rules and a fuel subsidy. The University of Rhode Island has supported the Government of Ghana's fisheries development policies and objectives and aims to assist the country to end overfishing and rebuild targeted fish stocks as a central goal. Adoption of sustainable fishing practices and reduced exploitation to end overfishing is the only way Ghana can maintain the sustainability of its marine fisheries. Working closely with Ghana's government and stakeholders, this program aims to end overfishing of key stocks important to local food security. Behavior change is a key component of fisheries reform. Part of this approach requires capacity building in leadership. The overall goal is to create a cadre of innovative leaders who can begin the process of co-management leading to increased compliance and a change in ethics regarding common shared resources. We held a two-week Study Tour of New England for stakeholders from Ghana including representatives from Parliament, fishermen, and fisheries enforcement. They were introduced to best fishery practices, management and research in the US and in New England, leadership principles, conflict resolution and arbitration, and alternative livelihoods. These principles were introduced through direct engagement with US stakeholders, meetings, and various field trips around the region including tours of fishing ports. This Study Tour was a follow-up to previous visits and included additional stakeholders. It has resulted in a request to have a more formalized training program each year for at least five years. In Ghana, the results of the training are multi-faceted. The fishermen's organization, GITA (Ghana Industrial Trawlers Association) pledged in public at the National Conference to stop catching small sardinella and trans-shipping to smaller vessels to land (i.e. Saiko fishing). GITA has also continued to engage with the Parliament on a new version of the Fisheries Law, its relationship with the Parliament having been enhanced by the training received during the US Study Tour. The impact from this study tour will be a major shift in governance of fisheries for Ghana. They are committed to ending overfishing and stabilizing the fisheries, especially for sardinella. This is an important role that URI has played and will continue to play in their future.	