2017 University of New Hampshire Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

This report reviews the research, education and outreach activities from the New Hampshire Agricultural Experiment Station (NHAES) and the University of New Hampshire Cooperative Extension (UNHCE). Many of our activities are synergistic. NHAES covers the costs for the UNH farms, dairies, and greenhouses that are used in common with UNHCE. NHAES provides split salary funding for several UNHCE faculty and direct research support for a number of UNHCE activities.Therefore, a portion of UNHCE FY2017 achievements are the result of NHAES support and, likewise, some of the achievements and dissemination of NHAES research are facilitated by UNHCE.

A large proportion of NHAES research is focused on discovery; the outcomes of these activities may require a few to several years or even decades (plant breeding) before their findings lead to innovations in agriculture, nutrition, climate change, natural resources or supporting rural economies, which are important to producers and citizens. Disseminating best practice, without the discovery research component, is the primary responsibility of UNHCE.

UNHCE provides a direct link between UNH and people throughout the state. In partnership with local residents and volunteers, Cooperative Extension plans and conducts educational programs responsive to New Hampshire people and the issues they identify that are important to them. In 2017, UNHCE implemented the same regional model for program delivery established five years ago. Area of Expertise (AoE) teams were formed with two-four regional field specialists working closely with state specialists to deliver educational programs to focused audiences statewide. This model not only gives UNHCE flexibility in developing new teams when needs of our clientele change, it encourages non-Extension faculty involvement and has been well-accepted by stakeholders and allows field specialists to become true experts in a given field.

UNHCE state specialists and Extension educators serve as an outreach arm for UNH, providing applied research and practical education primarily, in agriculture and natural resources as a well as in family, youth, and community development. This programming not only helps participants but also results in many indirect benefits for non-participant taxpayers. As a university outreach program, we have a network of professional Extension educators (University of New Hampshire staff) located in all ten New Hampshire counties. Our staff work with local volunteers and specialists on the UNH campus to design and conduct educational programs that meet societal, environmental and economic needs.

Further, eXtension has become a more prominent source of information for many of our clientele, particularly in areas with limited resources. A prominent link to eXtension.org is on our website and all of our staff now have an eXtension ID. Further, many eXtension webinars are cross-posted on our staff development calendar. UNHCE joined the newly formed eXtension organization as a premium member and hopes to continue to promote resources found there.

During fiscal year 2017, UNHCE reached a significant portion of New Hampshire residents with information or assistance, and recruits, trains and supports 5,268 trained volunteers in ten counties, who spent over 212,865 hours with staff to conduct educational programs to reach a greater number of New Hampshire citizens (e.g., UNHCE Education Center Info Line staff, Lay Lake Monitors, Marine Docents, Wildlife Coverts, Natural Resource Stewards, Coastal Research Volunteers, 4-H Leaders). UNH Cooperative Extension's volunteers' work representing $5.3 million worth of value.

Highlights

UNHCE

- Community and Economic Development (CED)

CED collaborated with 23 communities on downtown revitalization, economic development, Main Street improvement and linking trails and downtowns. Twenty-seven economic development leaders, chamber of commerce directors and municipal planners participated in the Economic Development Academy, deepening their community development skills. CED staff helped towns address economic development opportunities by engaging local government, businesses, agencies and citizens in finding a way to collaborate on sustaining and growing jobs, and leveraging local assets.

- Food and Agriculture

UNHCE Food and Agriculture program cultivated farms business management skills through training in business planning, finance, marketing and agricultural law. In 2017, 171 commercial workers were certified in the safe and effective use of pesticides, resulting in reduced expenses in materials, labor and reduced exposure by workers to agricultural chemicals. Food safety specialists provided training to 385 restaurants, institutions and farms in sanitary food handling and preparation -- making local food industries safe and sustainable.

- Natural Resources

Across the state UNHCE provided science-based advice on land management and stewardship practices to landowner, communities and state agencies. The natural resources team trains and supports 3,000 volunteers who spent more than 44,000 hours of service to communities. They enhanced wildlife habitats, removed invasive species, protected against coastal erosion, and monitored lake water quality. Recommendations from county foresters resulted in $440,000 in additional revenue for landowners, $1.2 m additional total production value and nearly $44,000 in additional tax revenue for municipalities in 2017.

- UNH Professional Development & Training (PD& T)

A network of 200 instructors helped workers accelerate their careers through licensure renewal, job placement, and professional development. UNHCE's Professional Development team trained New Hampshire professionals in rapidly developing workforce areas including education, business, leadership, technology, natural resources, drone operation for first responders, craft brewing, social work and stormwater management. Our partnership with municipalities and state agencies helped invest in workforce development including advanced leadership training with first responders in Manchester.

- Youth and Family

Our staff and volunteers provided training for 1,215 educators, parents, and other caregivers to promote child, youth and family resiliency knowledge and skills. This included Youth Mental Health First Aid training for 155 adults which involves a five-step action plan offering initial help for young people showing signs of mental health challenge or crisis. Sixty-three (63) youth were elected to 10 county youth leadership teams. Teen leaders reported increased skills in decision-making, goal-setting, and communication, helping them grow into tomorrow's leaders. UNHCE trained 428 educators in STEM education best practices, content knowledge, and alignment with Next Generation Science Standards.

NHAES:

NHAES is housed in the College of Life Science and Agriculture (COLSA). In 2008, COLSA underwent a major reorganization, shrinking from seven departments of varying size, with four focused on Agriculture or Natural Resources: (Plant Science, Animal Science, Resource Economics, Natural Resources) to a college with three large departments (Biological Sciences, Natural Resources and the Environment, Molecular Cellular and Biomedical Sciences). None of these three departments had a primarily agricultural mission. In FY2017, a faculty working group examined the pros and cons of a new round of reorganization. In the spring, a majority of faculty voted to in favor of setting up a fourth department: Agriculture, Nutrition and Food Systems (ANFS). The new department, formed in July 2017, drew faculty from existing departments with disciplinary specialization in Animal Science Equine Sciences, Nutrition and Dietetics,

Horticulture, Plant Breeding, Plant Pathology and Agriculture Extension Specialists. ANFS will be the home department for undergraduate programs in Nutrition, Sustainable Agriculture and Foods Systems, Equine Studies, Animal Science, and graduate programs in Agriculture and Nutrition. This new department will strengthen education in food systems and related Cooperative Extension activities.
The farm, dairy and greenhouse facilities supported by the NHAES are also important resources for educational programs at the University. In the last academic year, forty classes visited or carried out experiential learning at MacFarland Greenhouses, Fairchild Dairy Research and Teaching Center, the Organic Dairy Research Farm, Kingman Farm and/or Woodman Farm. These venues are popular for visits by regional K-12 school groups, and host occasional workshops for NH Envirothon (http://nhenvirothon.org/) and soil judging. Trails at Kingman Farm and the Organic Dairy Research Farm are popular for public recreation, including cross-country skiing. Excess produce from research projects at Woodman and Kingman Farms, and lettuce and fish from aquaponics research at MacFarlane Greenhouses were donated to local food pantries (Cornucopia in Durham, St. Vincent De Paul in Exeter, and the NH Food Bank).
Each year, a portion of NHAES capacity funding (State and Federal) is used to maintain and/or upgrade research capacity at the farms, dairies, greenhouses and ancillary facilities. In FY17 major expenditures included: funds to build three greenhouses for aquaponics research at Kingman Farm ($173k), replacement of a Terrain cut forage harvester ($89,900) for Kingman Farm; replacment of gutter grates, a farm truck, calan doors, and a hot water heater at Fairchild Dairy; purchase a milk parlor upgrade, bale wrapper and tractor and provide paving at the Organic Dairy Research Farm, $149k); expansion of Arugus environmental control to Greenhouse Range 3 and renovation of a small room as research space for the new phytophathologist at Macfarlane Greenhouses ($92k). If general equipment purchases are made using federal funds, then appropriate prior approval from NIFA is sought, as was the case when a small boat was purchased to support oyster survey work on NH Great Bay.
NHAES research outcomes and impacts:
Conveying the significance of different types of NHAES research requires that progress and final reports, as well as this combined Annual Report, are accessible to a broad spectrum of stakeholders including producers, consumers, and legislators. This work helps USDA/NIFA make the case for the value of Federal investment in the Agricultural Experiment Station system,

NHAES research activities address questions ranging from basic to applied science, and stakeholder concerns on local, regional or national levels. The problems that NHAES researchers tackle are based on available expertise; multistate and interdisciplinary research enhances the NHAES's ability to deal with a wider range of concerns. Some examples of basic research leading to applied outcomes are listed below, grouped by associated planned program.

Childhood Obesity: Senior Lecturer Dr. Jesse Stabile-Morrell is part of NC1933: Using Behavioral and Environmental Tools to Identify Weight-Related Factors Associated with Health in Communities of Young Adults. This multistate research project has developed and tested audits and other tools to evaluate health attributes of campuses (Health Campus Audits) and the effectiveness of interventions and longevity on target audiences. Undergraduate Nutrition majors, supervised by Dr. Stabile-Morrell, (NIFA Accession # 1010738) carried out a Health Campus Audit of the University of New Hampshire Durham. Once the data were analyzed, results were shared with invited campus administrators and stakeholders via forum-style presentation.
Findings from the comprehensive environmental audits demonstrated to stakeholders adequacy of campus walking/biking paths, however, findings also showed a lack of healthy options available at vending machines, lack of healthy options at off-campus eateries, and lack of written campus policies related to nutrition or disease prevention. This knowledge will be used to elucidate the impact of environmental factors on young adult health and support changes that promote healthful behaviors.
Food Safety:
The rate of infections from Vibrio parahaemolyticus-contaminated shellfish harvested from the Northeast has steeply risen in just the last five years. Professor Cheryl Whistler"s research team (NH00620,

Accession #1004199) have developed tools to identify genetic characteristics associated with invasive pathogenic strains that link them to specific harvest areas, allowing more accurate trace-back of illnesses. The impact was realized in real time during the research project and has already informed management policy in CT, MA, and NH, aiding managers in these states to decrease illnesses (CT and MA), or maintain low incidence (NH).

Global Food Security and Hunger

NHAES celebrated 50 years of research of still-active Emeritus Professor James Brent Loy. with a research field day at Kingman Farm in September. This event drew members of the farm community, collaborators, colleagues, and a number of former students. Professor Loy's breeding program (NH00604-R, Accession 233554) remains very productive. He released disease-resistant, hybrid bush-type winter squash germplasm for further breeding and, in collaboration with commercial seed companies, three new cultivars:

- Ambassador Melon: an early, netted, green flesh Galia melon with good quality for local markets; this cultivar is resistant to two races of powdery mildew and fusarium wilt.
- Honey sak melon: midseason Crenshaw for local production; powdery mildew and fusarium resistant
- Smooth Operator summer squash: A highly productive, yellow straight neck squash with powdery mildew resistance and carrying the glabrous, gl-2 gene for reduced trichomes (spines) on stems and petioles, for improved market value.

Dr. Sandra Rehan's research group (NH00626-R, Accession 1004515) used Applied Next Generation Sequencing methods to evaluate the quantity and quality of wild bee pollen-masses. and compared this to previous studies of honey bees and bumble bees: Taken together, the resulting data reveal that generalist pollinator species are actually specialists, foraging on two to three plant species to comprise 80 to 90% of their diet.

A new faculty member, Dr. Shadi Atallah, working under the auspices of NHAES Director Wraith's umbrella Project NH00638, (NIFA Accession # 1007917), developed a theoretical economic pest control threshold model for the codling moth in apples. To evaluate this new strategy for IPM in apples Dr. Atallah and his student will work with regional apple growers over the next three years. The NHAES has not been able to provide support for state apple growers in two years since the plant pathologist Kirk Broders moved to Colorado. The new research will support this important state commodity group.

Dr. Cathy Neal and an undergraduate intern (NIFA Accession # 1010499) are working to improve plantings of pollinator meadows to support native pollinators. They have compared the relative attractiveness of cultivars of perennial species. Results show significant differences in bee foraging by cultivars, with form rather than color, most important in determining in bee attractiveness. Lists of pollinator-attractive plants need to reflect differences at the cultivar level in order to be useful in recommendations for establishing pollinator gardens.

Dr. Professor Iago Hale's lab group (NIFA Accession # 233561) used molecular markers and phenotyping to develop an initial genetic linkage map for common and Japanese barberry, to identify a single a-well-defined locus for wheat stem rust resistance in Japanese barberry.

Dr. Pete Erickson's research group (NIFA Accession #1001238) confirmed preliminary experiments, showing that niacin supplementation of prepartum dairy cows results in improved levels of immunoglobulin in the dam's colostrum. Newborn calves feed this colostrum appear to be more efficient in converting feed into growth.

Climate Change and Sustaining Natural Resources

Dr. A. Stuart Grandy's research group (NIFA Accession #1007001) is modeling the mobilization of different nitrogen pools in soils. "Nitrogen is rate limiting to crop growth, but more than half of added nitrogen fertilizer is lost before plants are able to assimilate it. " They have helped devel the "MIcrobial-MIneral Carbon Stabilization model (MIMICS)" and used the model with coupled N cycles and data synthesis to examine how climate-change driven alterations in precipitation patterns are likely to affect N cycling and

losses in agricultural landscapes and to highlight promising interventions to minimize environmental N losses. Modeling showed that conventional, fertilizer-use- efficiency-based approaches are insufficient to mitigate N losses now, and will likely be even less effective under climate change scenarios."
"The health of New Hampshire's Great Bay estuary is declining due to increasing land use change and human activity in the watersheds. One factor contributing to the decline of Great Bay is increasing nitrogen inputs from non-point pollution sources. These sources include residential, urban and agricultural areas. At the same time, streams and rivers can clean some of these pollution sources through natural ecosystem processes." Improved measurements of the sources and fate of pollution inputs that control the health of Great Bay are needed. Dr.Wil Wollheim's research group (NIFA Accession # 1003833) have shown that "reservoirs that are relatively wide given the amount of flow coming into them are extremely effective at removing nitrate before being exported to the estuary. Thus, dam removal should consider this loss of "ecosystem services" if reservoir reaches are restored to flowing channels."
"Nitrogen fixation by actinorhizal plants is an important part of the nitrogen budget of the planet." Dr. Lou Tisa's lab (NIFA Accession# 1006507) has developed an efficient and stable plasmid transfer protocol for the Frankia symbiont of actinorhizal plants. They used this tool for the first time to successfully express a gene of unknown function in Frankia, to verify the gene confers salt tolerance in an otherwise salt sensitive Frankia strain.

Supporting Rural Economies:

In urban/rural fringe areas there is a potential for increased "local" food production. This has been touted by advocates as reducing economic leakages via import substitution, promoting environmental quality, and facilitating the accumulation of social capital. This hypothesis of support for local food production was tested, to evaluate potential impacts on the sustainability of local farms. Dr John Halstead, working with NE 1049 (NIFA Accession # 233561) completed a series of focus groups of Maine, Vermont, and New Hampshire farmers to identify key issues and constraints in the region and to construct general consumer surveys. Survey respondents in Massachusetts and New Hampshire indicate the willingness to pay a substantial premium for locally grown produce over imported produce, and respondents place a higher value on supporting local farmers than the quality or freshness of local produce.
Dr. Ken Johnson, (NIFA Accession # 23122) working with multistate W3001, evaluated the impacts of the Great Recession on rural communities. Fertility rates have dropped and have not recovered; among the consequences are that in many parts of rural America, there are now too few births to offset deaths in a rapidly aging population. Another result is that growth of the Hispanic population has been particularly important to rural demographic change. Hispanics represented just 7.6% of the rural population in 2010, but they produced 63% of the total rural population gain between 2000 and 2010.
The high quality of work of Johnson has been recognized through his selection as one just 33 Andrew Carnegie Fellows; this is considered the most prestigious social science fellowship.

NHAES Communication Impacts

AES communications manager Lori Gula Wright has substantially improved the profile of NHAES in the state, and region with a comprehensive strategic communications effort that includes media relations, social media, and weekly direct email bulletins.
Traditional statewide news media (newspapers, radio, and TV) and trade agricultural media regularly cover NHAES research. Many of her news releases are picked up by local, regional/statewide, and national news outlets. These include national media (New York Times, ABC News, Washington Post, Fox News, U.S. News and World Report, The Atlantic), regional and statewide media (WBUR, WBZ Radio, Boston Globe, Union Leader, Foster's Daily Democrat, Concord Monitor, WMUR, NHPR, Portsmouth Herald), and trade agricultural media (Morning Ag Clips, Floral Daily, HortiDaily). In particular, the NH Associated Press picks up many of our research stories, resulting in a distribution of NHAES news to hundreds of media outlets and hundreds of thousands of readers.
Some of our key national placements include:

- Tunnelberries season extension research: New York Times and ABC News
- Bobcat research: ABC News
- New Truffle species research: New York Times

- Glossy buckthorn management research: US News and World Report
- Vibrio shellfish pathogen research: Fox News
- White Nose Syndrome in Bats: ABC News

(Several of these stories describe outcomes of research covered under the USDA's McIntire Stennis Program.)

NHAES research news is regularly publicized by USDA-NIFA, Ag is America, University of New Hampshire, UNH College of Life Sciences and Agriculture, UNH Sustainable Food and Agriculture Department, and UNH Cooperative Extension via social media (Facebook and Twitter). In addition, our research regularly appears in newsletters distributed by USDA-NIFA, the NH Department Agriculture, Markets & Food, and the NH Farm Bureau. We also distribute information about our research on YouTube and LinkedIn.

In the reporting period, content on the main NHAES Facebook page reached more than 2 million people; more than 175,000 directly engaged with it by clicking on a story. These stats are only for the NHAES Facebook page. We also have hundreds of thousands of people engage with us on our Facebok pages for the Fairchild Dairy Teaching and Research Farm, Organic Dairy Research Farm, Woodman Horticultural Research Farm, Kingman Research Farm, Macfarlane Research Greenhouses, and the NH Veterinary Diagnostic Lab. In total, we estimate our Facebook pages reaches 3 million people a year.

The NHAES Twitter feed logged more than 170,000 Twitter impressions from people who saw our tweets. We now have more than 700 Twitter followers, including USDA, USDA-NIFA, the NH College and University Council, Ag is America, NH Sea Grant, numerous state and regional reporters, Multistate Research Fund Impacts, Dairy One, Stonyfield Organic, Cabot Cheese, NH EPSCoR, Maine EPSCoR, Growing Produce Magazine, Greenhouse Management Magazine, Nursery Management Magazine, New Growth Management Magazine, U.S. Farm Report, New England Vegetable and Fruit Conference, NH Farm and Forest Expo, Woods Hole Research Center, Hubbard Brook, US Fish and Wildlife Service, USDA Climate Hubs, numerous state AESs and extension services, NOFA-NH, USDA communications staffers, Northeastern Regional Association of State Agricultural Experiment Station Directors, National Association of State Foresters, Johnny's Seeds, Stine Seed Co., Congresswoman Carol Shea-Porter, Congresswoman Annie Kuster, UNH President Mark Huddleston, and many researchers at UNH and elsewhere.

Direct emails about our research now reach almost 1,000 stakeholders. These go to key "agvocates," including the current and former NH commissioners of agriculture, governor, members of house and senate ag and environmental committees, federal delegation, USDA communicators, farmers/producers/growers, business and industry, external advisory committee members, NERA representatives, UNH faculty and staff, and the public. In addition, page views on the NHAES website totaled nearly 44,000 for the reporting period. The most-read story on our website during FFY 2017 was UNH Research: Microbial Traits, not Plants, Determine Abundance of Soil Organic Matter: https://colsa.unh.edu/nhaes/article/2016/12/soilorganicmatter.

Finally, NHAES research often is featured on high-traffic UNH websites such as the UNH Home Page and direct email releases, including UNH Today, which reaches 80,000 influencers weekly. NHAES contributes regularly to Ag is America, NIFA Impacts, and the Land-Grant Impacts database website.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	84.0	{No Data Entered}	22.0	{No Data Entered}
Actual	114.0	0.0	31.3	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- Other (Peer review of proposals, manuscripts and products)

2. Brief Explanation

The New Hampshire Agricultural Experiment Station (NHAES) carries out a formal, competitive, internal peer review process for proposed research projects. The competition for NHAES support is announced to eligible faculty via email at the beginning of the academic year. Faculty are encouraged to submit a one-page prospectus and discuss this prospectus with the Director or NHAES Faculty Fellow. If the prospectus is consistent with NHAES guidelines, the faculty member is asked to develop a full proposal for competitive review.
All proposals are evaluated by a review panel comprised of faculty members plus the Faculty Fellow. The review panel is selected from current, highly-productive NHAES project directors who have externally funded research programs. Each proposal is evaluated based on the following criteria:
• Scientific and technical merit.
• Soundness of approach, procedures, and methodology.
• Likelihood of significant outcomes and/or innovation.
• Demonstrates previous accomplishments or potential productivity.
• Probability to leverage NHAES resources.
• Likelihood of significantly enhancing NHAES research capability and competitiveness
Evaluations are discussed by the review panel, the members of which rank each proposal's funding priority. The director and faculty fellow use the panel evaluation, along with their own evaluations with respect to NHAES priorities and resources, to make recommendations on which projects to fund. Project directors, whose proposal have been recommended for funding by the NHAES, are guided in how to use REEport's Project Initiation module. Each project initiation is reviewed by the faculty fellow before submission to NIFA for final approval.
Merit review for NHAES research outputs (e.g., scientific publications) typically come through scholarly peer-review and researchers success in leveraging of NHAES support to earn highly competitive external funding. These external reviews provide consistent, strong feedback on the quality of our internal review process. In addition, evidence of the value of NHAES activities is seen in the adoption of novel crops in Northern New England, the release of disease-resistant squash, pumpkin, and melon cultivars with improved nutritional value, dissemination of new agricultural practices, breeding progress using marker-assisted breeding, and how regional planning bodies use NHAES research outcomes.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Survey of selected individuals from the general public

Brief explanation.

UNHCE
UNHCE strives to connect with the communities in New Hampshire. To do so, UNHCE advisory councils in all 10 counties engage with our stakeholders, assess their needs and we develop programs in response to those needs. To facilitate their engagement and facilitation, UNHCE specialists work with stakeholder where they are. In addition, Extension administration meets with each of the stakeholder groups regularly (face-to-face and via video conferencing) to ensure stakeholder input is considered when making broad organizational issues as well.
NHAES

The NHAES has an external advisory committee represents different segments of the agricultural and natural resources community in the state. The external advisory committee meets 1-2 times a year, usually in conjunction with a research field day event. In addition, the AES director, faculty fellow, or communications manager speak with members of the advisory committee throughout the year, for example at meetings of the Farm Bureau, and at the annual NH Farm and Forest Expo. In addition, members of the advisory board contact the AES director by email about issues of concern.
The NHAES Director is also in close contact the NH Commissioner of Agriculture and Program Leaders in the NH Department of Agriculture, Markets, and Food and leadership in the NH State Legislature Committee on Environment and Agriculture, officers of the NH Farm Bureau and NH Farm Union, and large commercial growers in the state.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use External Focus Groups
- Needs Assessments
- Use Surveys

Brief explanation.

UNHCE
UNHCE methods for identifying individuals and groups varies according to the situation and needs. Formally, our state field specialists locate individuals and groups whose needs align with our program goals. In addition, other individuals and groups come to us to request information or service required for improving their activities.
NHAES
The NHAES has an external advisory committee represents different segments of the agricultural and natural resources community in the state. Suggestions for potential members of the advisory committee come from NH Farm Bureau, NH Farm Union, the NH Department of Agriculture, Marketing and Food and as a result of other stakeholders meetings across the state. The external advisory committee meets 1-2 times a year, usually in conjunction with a research field day event. In addition, the AES director, faculty fellow, or communications manager speak with members of the advisory committee throughout the year, for example at meetings of the Farm Bureau, the Annual NH Farm and Forest Expo, etc. Members of the external advisory committee communicate with NHAES director by email, as concerns arise.
Focus groups are also used to collect information for specific research projects. How these groups are recruited vary with the objectives of the research project.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional individuals

Brief explanation.

UNHCE
UNHCE methods for identifying individuals and groups vary according to the situation and needs. Formally, our state field specialists locate individuals and groups whose needs align with our program goals. In addition, other individuals and groups come to us to request information or service required for improving their activities.

NHAES: Individual NHAES researchers engage directly with stakeholders.
Examples include:

• Professor Steve Jones (NH00647, Accession 1010499) was "invited to share our project findings at the Interstate Shellfish Sanitation Conference (ISSC) National Vibrio parahaemolyticus Workshop on September 6-7, 2017 - Baltimore, MD, and to help write up the workshop report. The purpose of this meeting was to identify what we know and don't know about pathogenic Vibrios in shellfish and harvest waters, and the applied focus of our project research was useful in many dimensions during the two days of discussion.

• Emeritus Professor Brent Loy (NIFA Accession# 233554) meets each fall with representatives of individual seed companies, to share his breeding advances, and get direct feedback about the seed companies breeding priorities.

• New faculty member Asst. Professor Annisa Poleatewich (under the auspices of NIFA Accession #1007917) met regional grower groups, such as apple farmers, to hear about major fungal pathogens.

• New Extension Specialist and NHAES Asst. Professor Ryan Dickson (NIFA Accession #1012018) meet "with growers at the New Hampshire Joint Winter Meeting, the New England Nursery Conference, the New Hampshire Plant Growers Annual Meeting, the Carrol County Farm Bureau annual meeting, the Tri-State Integrated Pest Management (IPM) workshops (Vermont, New Hampshire, Maine), the Northeast Greenhouse Conference, and separate greenhouse best management workshops hosted by the Universities of Maine, Massachusetts, and Connecticut. Attendance at these events ranged from 30-600 individuals. "

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- To Set Priorities

Brief explanation.

UNHCE

For UNHCE, specific input on staffing, budget and program priorities is solicited through discussion at meetings. Council members are identified based on input from other council members and staff continually look for individuals who might make good council members. Roles for council members include (but not limited to): advocacy on behalf of Extension, hiring/performance review of local staff, budget requests and program priorities.

NHAES

During Federal Fiscal year, COLSA initiated discussions about a discussion of departmental reorganization, the addition of a new department more focused on Agriculture and Food Systems. While University faculty are responsible for academic department organization, the faculty working group engaged major agricultural stakeholders across the state. Agricultural stakeholders were supportive of reconstituting a department in COLSA which is specifically focused on Agriculture. Individual research projects used stakeholder input in a variety of ways specific to each project.

Brief Explanation of what you learned from your Stakeholders

NHAES

A tri-state survey under the auspices Multistate project NE1049 (NH00612 -R, Accession 2333237) showed respondents in Massachusetts and New Hampshire indicate a willingness to pay a substantial premium for locally grown produce over imported produce; and respondents place a higher value on supporting local farmers than the quality or freshness of local produce.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1112225	0	2155543	0
Actual Matching	1112225	0	2444519	0
Actual All Other	7853288	0	2459020	0
Total Actual Expended	10077738	0	7059082	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	77367	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Childhood Obesity

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
703	Nutrition Education and Behavior	80%		100%	
704	Nutrition and Hunger in the Population	20%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	11.0	0.0	0.1	0.0
Actual Paid	12.0	0.0	0.2	0.0
Actual Volunteer	2.2	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	27776	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	817	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

UNHCE

Nutrition Connections--educational courses to income eligible NH residents--will be available through the

Expanded Food and Nutrition Education Program (EFNEP) and Supplemental Nutrition Education Program (SNAP-ed).

NHAES
Excessive weight gain is associated with increased risk of developing many serious diseases, including heart disease, diabetes, and high blood pressure. However, programs to address overweight/obesity among communities of young adults are lacking. The NC1193 multistate group is developing tools to assess the healthfulness of college campuses and effectively disseminate information that can be used by campus administrators and stakeholders to make changes that support and sustain healthier environments for their students. This multistate group is also adapting their survey instruments for low-income communities.

2. Brief description of the target audience

UNHCE

- Limited resource youth, ages 0-18
- Young adults (undergraduate students)
- Disabled and low-income students at Land Grant Universities and nearby community colleges.

NHAES

- College students (the majority of whom are between 17 and 22 years of age)
- Additional target audiences are low-income communities.

3. How was eXtension used?

Our staff promote resources available to UNHCE's clients

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1443	0	700	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	3	4

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of low-income adults participating in health and nutrition programming through Nutrition

Year	Actual
2017	113

Output #2

Output Measure

- Number of low-income youth participating in health and nutrition programming through Nutrition Connections

Year	Actual
2017	80

Output #3

Output Measure

- Number of undergraduate students participating in Healthy Campus Environment Audit and Behavior Environment Perceptions Survey for college campus

Year	Actual
2017	6

Output #4

Output Measure

- Number of UNH courses taught by the PI which used their research

Year	Actual
2017	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of participants who report an increase in their physical activity
2	Number of youth who learn how to choose foods according to the Pyramid and Dietary Guidelines
3	Number of participants who report eating nearer to the recommended number of cup equivalents from the Fruits and Vegetable Group
4	Apply new tools to assess healthfulness of college campuses and the effectiveness of interventions to improve student health.

Outcome #1

1. Outcome Measures

Number of participants who report an increase in their physical activity

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1378

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Overweight and obesity have greatly increased during recent decades. Contributing factors include physical inactivity, excessive food consumption, and unhealthy food choices. Many health related conditions exist in the NH SNAP eligible population including obesity, overweight, diabetes, pre-diabetes, and heart disease. The SNAP eligible population in NH also has higher rates of sugar sweetened beverages, time spent in sedentary activities, inadequate consumption of fruits and vegetables and physical inactivity. Health related conditions could be improved by following the US Dietary Guideline recommendations that are the guiding principles for this work at the individual, community and policy level. Modifiable risks for heart disease such as obesity, physical inactivity, and inadequate fruit and vegetable consumption are achievable through direct education. In addition, increasing fruit and vegetable consumption through efforts at farmers markets, food pantries and schools; working with community agencies, child care centers and schools to improve nutrition and physical activity supports; and working with community agencies and coalitions to make it easier for SNAP eligibles to eat healthier and be more physically active can reduce health related conditions over the long term.

What has been done
UNH Cooperative Extension Nutrition Connections staff implement nutrition and physical activity education for limited income adults and youth. Activities target physical activity, nutrition, community involvement and obesity awareness and prevention. Youth receive education in group settings; families and adults in groups and at home. Sustained behavior change through interventions that can reach individuals through multiple avenues is more effective. Longer lasting change can be achieved through collective impact strategies. With this in mind, we seek to leverage our relationships by finding common outcomes that we share with our partners, volunteers and coalition members. We then hope to facilitate the pursuit of these outcomes in order to more efficiently focus our collaborative efforts.

Our model places an emphasis on food and nutrition efforts that focus on the Dietary Guidelines and MyPlate, specifically, increasing fruits and vegetables and increasing physical activity. Our model also places an emphasis on opportunities to reach larger numbers of people through community and volunteer efforts.

Results
A total of 5,353 youth in 390 groups, participated in a series of lessons. Youth from pre-school through high school were reached in school, after-school settings and other youth related organizations. EFNEP programming reached 2,093 youth and SNAP-Ed programming reached 3,260 youth.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #2

1. Outcome Measures

Number of youth who learn how to choose foods according to the Pyramid and Dietary Guidelines

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	990

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Physical activity and nutrition play vital roles in overall health. Research has found that diet is associated with the leading causes of death, many of which are preventable; heart disease, obesity, diabetes, and several types of cancer. While rates of overweight and obesity continue to escalate, those with lower incomes have the highest rates of overweight and obesity. However, lifestyle choices (along with other environmental factors and genetics) have a power influence on one's health and quality of life. Following the USDA Dietary Guidelines can help.

What has been done
Nutrition Connections consists of two federal nutrition initiatives, EFNEP (Expanded Food and Nutrition Education Program) and SNAP-Ed (Supplemental Nutrition Assistance Program Education), whose key mission is to provide education to low-income audiences in the areas of

nutrition, physical activity, food budgeting/shopping, cooking, and food safety. Because we are able to work with people of all ages, the form and content of our programs vary greatly. We are also able to adapt our programs to accommodate the needs of specific populations using a variety of teaching materials, curricula, and publications. Nutrition Connections focuses on improving short and long-term outcomes. Individuals gain awareness and knowledge to apply skills and/or change behaviors.

Results
Five thousand, three hundred and fifty-three youth (5,353) participated in a series of lessons. Of those completing a pre/post survey related to nutrition and physical activity behaviors, significant impacts included:

31.4% (571 of 1817) of youth reported an increase in how often they eat fruit; grades 3-12
28% (507 of 1813) of youth reported an increase in how often they eat fruit; grades 3-12
26.6% (474 of 1784) of youth reported an increase in how often they are active, grades 3-12

Youth participating in 4H Healthy Living projects improved knowledge and behaviors:

82.6% (95 of 115) of youth increased their choices of healthier foods
96.4% (107 of 111) of youth increased their knowledge of healthier food choices
56.6% (64 of 113) of youth increased how often they were active

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #3

1. Outcome Measures

Number of participants who report eating nearer to the recommended number of cup equivalents from the Fruits and Vegetable Group

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1017

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
See previous outcome

What has been done
See previous outcome

Results
See previous outcome

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #4

1. Outcome Measures

Apply new tools to assess healthfulness of college campuses and the effectiveness of interventions to improve student health.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Excessive weight gain is associated with increased risk of developing many serious diseases, including heart disease, diabetes, and high blood pressure. However, programs to address overweight/obesity among communities of young adults are lacking. Including options for day to day activity built in the daily work and living environment, are important resources to help young adults maintain healthy weights.

Multistate NC1193 has developed and tested audits and other tools to evaluate health attributes

of campuses (Health Campus Audits) and the effectiveness of interventions and longevity on target audiences

What has been done
Undergraduates researchers carried out a Healthy Campus Audit at the University of New Hampshire under the supervision of Dr. Jesse Stabile Morrell (NIFA Accession # 1010738). These data were analyzed.

Results
New Hampshire's campus data, generated from the Healthy Campus Environmental Audit, were shared with invited campus administrators and stakeholders via forum-style presentation. Findings from the comprehensive environmental audits demonstrated to stakeholders adequacy of campus walking/biking paths. However, findings also showed a lack of healthy options available at vending machines, lack of healthy options at off-campus eateries, and lack of written campus policies related to nutrition or disease prevention. This knowledge will be used to elucidate the impact of the environmental factors on young adult health and support changes that promote healthful behaviors related to diet and exercise.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Appropriations changes
- Competing Public priorities

Brief Explanation

UNHCE observed a delay in the state's implementation of the SNAP-ED programming due to a hold of the state's funding.
NHAES: External factors did not impact outcomes during Federal Fiscal Year 17.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE
Four hundred and sixty-one adults (461) completed a series of lessons. Of those completing a pre/post food recalls and/or pre/post survey questions related to nutrition and physical activity behaviors, significant impacts included:

- 37.3% (172 of 461) of adults reported an increase in how often they eat fruit
- 36.7% (169 of 461) of adults reported an increase in how often they eat vegetables

- 26% (90 of 343) of adults reported an increase in physical activity

Five thousand, three hundred and fifty-three youth (5,353) participated in a series of lessons. Of those completing a pre/post survey related to nutrition and physical activity behaviors, significant impacts included:

- 31.4% (571 of 1817) of youth reported an increase in how often they eat fruit; grades 3-12
- 28% (507 of 1813) of youth reported an increase in how often they eat fruit; grades 3-12
- 26.6% (474 of 1784) of youth reported an increase in how often they are active, grades 3-12

Youth participating in 4H Healthy Living projects improved knowledge and behaviors:

- 82.6% (95 of 115) of youth increased their choices of healthier foods
- 96.4% (107 of 111) of youth increased their knowledge of healthier food choices
- 56.6% (64 of 113) of youth increased how often they were active

A number of groups assessed policies and documented changes including schools, food pantries, a summer meal site, and a group of farmers markets.

- In Coos County, six schools assessed their wellness policies and made changes affecting 967 youth. Three farmers markets (counted as one group) agreed to market and promote market activities jointly to increase visibility for all markets. One food pantry increased the variety of fresh fruits and vegetables, increased variety of canned vegetables, fruits and protein foods and increase the variety of low sodium canned foods and low-fat dairy products.
- In Merrimack County, two schools assessed their wellness policies and made changes affecting 738 youth. One food pantry made substantial changes; a major change was moving the pantry and making it a client choice pantry (instead of pre-boxed items). Changes were made to include fresh fruits and vegetables in front of canned items, increasing variety of fresh, frozen and canned fruits and vegetables, more low-fat dairy and low sodium and low sugar canned foods.
- In Rockingham County, one food pantry increased the quality of fresh and frozen fruits and vegetables, frozen protein foods and increased variety of grain products.
- In Grafton County, two schools assessed their wellness policies and made changes affecting 250 youth.
- In Carroll County, a group comprised of UNH Cooperative Extension, local school staff, and others to develop a plan to increase summer meal participation. More marketing was done at the end of the school year to identify the previous site and a new site for summer breakfast and lunch. The program served 2679 breakfast and 2092 lunches this past summer.

NHAES

Publication in peer-reviewed journals is a common means to assess the quality of research. The members of Hatch Multistate Project, NC1193, "Using Behavioral and Environmental Tools to Identify Weight-Related Factors Associated with Health in Communities of Young Adults" have collaborated to publish three peer-reviewed publications, and have four more manuscripts under review.

Key Items of Evaluation

See Evaluation Results

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Food Safety

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	0%		34%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	50%		33%	
723	Hazards to Human Health and Safety	50%		33%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	2.0	0.0
Actual Paid	4.0	0.0	3.2	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
47979	0	224007	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
47979	0	148368	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
212351	0	37782	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

UNHCE food safety programs:

- SAFE (Safety Awareness in the Food Environment) Programs
- ServSafe®
- Workshops for consumers

Several different NHAES research projects are conducted under this program. Activities include:

- Use genome sequencing to develop methods to distinguish for the detection and enumeration of pathogenic and benign strains Vibrio parahaemolyticus and Vibrio vulnificus in the water and in oysters.
- Develop models of the ecology of pathogenic and benign Vibrios in a fluctuating environment.
- Evaluating, through a variety of means, how toxic metabolites [beta methyl aminoL-alanine (BMAA) and microcystins] produced by cyanobacterial blooms in freshwater lakes, are spread across landscapes to animal and human food sources.
- Disseminating research outcomes via scientific, extension, formal and informal venues, and to stakeholder groups and natural resource managers.

2. Brief description of the target audience

UNHCE Food Safety education: Food handlers at restaurants, schools, health facilities, etc. and the general public.

The target audiences for NHAES research activities include both discrete and overlapping groups:

- For Vibrio pathogens in shellfish, the targeted audiences include the shellfish industry and shellfish regulatory agencies, graduate and undergraduate students, high school students, faculty collaborators, and other scientists.
- For microcystins from cyanobacterial bloom, the target audiences are students (college and pre-college), scientists, lakeshore residents, lake association members, local and regional decision makers, source water protection and watershed managers, suppliers of surface drinking water, and public health and environmental agencies.

3. How was eXtension used?

The Food Safety specialist used eXtension as a learning source. Our staff participated in workshops and training offered through eXtension. Food specialists use eXtension as the primary reference when the staff need to lead their clients to external resources.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1696	15000	233	1400

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	8	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of people who participate in ServSafe workshops

Year	Actual
2017	185

Output #2

Output Measure

- Number of adults participating in food safety programming through Nutrition Connections - educational courses to income-eligible New Hampshire residents

Year	Actual
2017	1158

Output #3

Output Measure

- Number of people who participate in SAFE (Safety Awareness in the Food Environment) programs

Year	Actual
2017	903

Output #4

Output Measure

- Number of undergraduate students directly involved in the research projects

Year	Actual
2017	46

Output #5

Output Measure

- Number of university courses in which project results have been incorporated

Year	Actual
2017	5

Output #6

Output Measure

- Number of presentations at regional, national, or international scientific meetings

Year	Actual
2017	7

Output #7

Output Measure

- Number of workshops, training sessions, and presentations to non-scientific and regulatory stakeholders

Year	Actual
2017	33

Output #8

Output Measure

- Number of graduate students directly involved in the research.

Year	Actual
2017	7

Output #9

Output Measure

- Number of reviewed, bulletin, popular and other publications

Year	Actual
2017	19

Output #10

Output Measure

- Number of websites in which project results have been incorporated

Year	Actual
2017	2

Output #11

Output Measure

- Number of surveys or other means of gathering information and data from participants
  Not reporting on this Output for this Annual Report

Output #12

Output Measure

- Postdoc and other scientists trained in cutting edge research method
  Not reporting on this Output for this Annual Report

Output #13

Output Measure

- Number of MS and PhD dissertations completed

Year	Actual
2017	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of program participants who score 75% or greater on knowledge tests of high risk practices including: * Personal hygiene * Holding/time and temperature * Cooking temperatures * Prevention of contamination
2	Number of food handlers who self-report an intent to adopt recommended hand washing practices,take steps to reduce cross-contamination and/or use proper time and temperature controls after attending a SAFE program.
3	Identify key planktonic and estuarine microbiome factors that affect V. parahaemolyticus population levels and diversity in oysters
4	Number of agencies and stakeholder groups involved in research outreach related to Vibrios in shellfish.
5	Knowledge about the changes in Vibrio genomes, which cause transitions to virulence;
6	Understanding of how microcystin toxins spread from lakes to the terrestrial food chain

Outcome #1

1. Outcome Measures

Number of program participants who score 75% or greater on knowledge tests of high risk practices including: * Personal hygiene * Holding/time and temperature * Cooking temperatures * Prevention of contamination

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1557

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
UNHCE

The U.S. Centers for Disease Control and Prevention estimates that each year approximately 1 in 6 Americans or 48 million people get sick from a foodborne illness. Of those people who get sick, 128,000 are hospitalized and 3,000 die from their illness. Demographic and lifestyle changes have increasingly shifted the responsibility for the safety of food from the consumer to other sectors of the food system.

What has been done
- The Safety Awareness in the Food Environment program (SAFE) is a two-hour, one-session program targeting food service workers. The program is implemented in all 10 New Hampshire counties.
- ServSafe® Manager is a national food safety and sanitation certification program. ServSafe® Manager programs are offered to food service managers/workers throughout the state.
- Preserving Your Harvest ? The Basics of Preserving Food Safely is a two-hour program for consumers.
- FSMA and food safety programs for food producers and processors including poultry and rabbit producers are designed to meet the needs of these audiences.

Results
UNHCE

- 55 SAFE programs reached 979 food service workers in NH. Results from 702 post-workshop

questionnaires indicated that 661 (94%) food service workers scored 75% or greater on the food safety knowledge questions. Of the 702 post-workshop questionnaires received, 456 (65%) food service workers indicated their intent to adopt a recommended food safety practice. The top three response categories were: 142 (31%) food workers intended implement recommended practices to prevent cross contamination, 109 (24%) food workers intended to make time and temperature changes in their food handling practices, and 104 (23%) food workers intended to improve personal hygiene practices.

- 185 food service managers/workers participated in a ServSafe® class and/or took the examination. 153 (83%) food managers/workers passed the certification examination with a score of 75% or greater.

- 5 ServSafe® participants completed an online follow-up survey approximately 2 months after completing the program. Participants reported more frequent use of 10 recommended food handling practices after completing the ServSafe® program as compared to before the program. One indicator (purchase food from approved, reputable sources) remained the same as all 5 participants indicated they implemented these practices "almost always" before and after the program. The mean for 5 food safety practices decreased from before to after program.

- 2 Food Safety for Poultry and Rabbit Producers programs were implemented reaching 39 producers.

- 2 Preventive Controls for Human Food classes were implemented reaching 35 processors and agency representatives. All 35 participants completed the class becoming a Preventive Controls for Human Food Qualified Individual.

- A Preventive Controls for Human Food information meeting was held for 17 people including 8 dairy processing businesses and 9 participants from state regulatory agencies, organizations and UNH Cooperative Extension. This meeting was a collaborative effort of UNH Cooperative Extension and the NH Department of Health and Human Services Food Protection.

- 1 Produce Safety Alliance Grower Training, co-sponsored with the University of Maine Cooperative Extension, was implemented in Portland Maine reaching 50 Maine and New Hampshire produce growers. Other Produce Safety efforts included 40 individual farm consults and 7 programs reaching 186 growers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #2

1. Outcome Measures

Number of food handlers who self-report an intent to adopt recommended hand washing practices,take steps to reduce cross-contamination and/or use proper time and temperature controls after attending a SAFE program.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	758

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
UNHCE

Each year foodborne diseases cause a significant number of illnesses, hospitalizations, and even deaths, resulting in severe economic losses due to medical treatment and lost productivity. In addition to health-care costs, foodborne illness outbreaks can result in economic and legal costs for food service businesses, school, health care, farmers, and affected individuals. Reducing the risk of foodborne illness and its associated costs benefits each sector of the food system in New Hampshire.

New Hampshire?s economy depends heavily on tourism of which restaurants are a significant part. A foodborne illness outbreak would be difficult on the industry in this region. Food establishment sales generate tremendous tax revenues. According to the National Restaurant Association, in 2016 NH restaurants are projected to record $2.5 billion in sales while employing 68,800 people. The number of people in the restaurant business represents over 10% of the employment in the state. A foodborne illness outbreak can cost a restaurant over $75,000 depending upon the number of cases, fines and legal fees. It?s imperative that food managers and workers receive food safety and sanitation education to prevent foodborne illness outbreaks.

According to the Centers for Disease Control (CDC) and Food & Drug Administration (FDA), the five biggest risks to the food supply are: poor personal hygiene of food workers; cross-contamination; time and temperature abuse; improper cleaning and sanitizing of equipment, dishes and surfaces; and, obtaining food from unsafe sources. Food workers who are more knowledgeable about safe food handling practices will follow recommended food handling practices resulting in fewer foodborne illnesses. CDC surveillance data for 1998-2008 indicated that 68% of foodborne disease outbreaks came from a restaurant or deli.

What has been done
The majority of work in the food safety program area is targeted toward food service workers with the following programs:

SAFE-Safety Awareness in the Food Environment is a two-hour basic food safety program covering good personal hygiene, preventing cross contamination, cleaning and sanitizing, and minimizing time and temperature abuse of food. This program is geared toward all food service workers including wait staff.

ServSafe® is an in-depth 8 hour certification class in food safety and sanitation developed by the National Restaurant Association. ServSafe® is for food service managers and workers.

Results
UNHCE

- 903 food handlers attended one of 50 SAFE workshops held throughout the state
- Conducted 12 food safety workshops for food pantries, soup kitchen and feeding programs through the NH Food Bank
- 12 ServSafe® programs reached 185 participants representing 66 businesses, schools, non-profits, nursing home and hospitals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #3

1. Outcome Measures

Identify key planktonic and estuarine microbiome factors that affect V. parahaemolyticus population levels and diversity in oysters

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Shellfish program managers, public health agencies, and the shellfish industry need to better understand and manage harvesting, based on how climatic and ecosystems conditions influence Vibrio-associated health risks in harvested oysters.

What has been done
Assoc. Prof. Steve Jones and his group (NIFA Accession #1010499) continue to monitor Vibrio parahaemolyticus populations in oysters, water, plankton, suspended solids and sediments at two sites in the Great Bay Estuary monthly through December in 2016, and monthly to bi-weekly in 2017 from April through September. These data are part of a database of water, ecosystems and climatic conditions at the time of, and in between, sampling.

Results
Preliminary analysis of sampling during summer of 2017 has been completed showing that the population dynamics of the Vibrio parahaemolyticus are similar to previous years, emerging in spring, peaking in July-August and declining thereafter. The water temperature in the estuary was lower than in previous years, and unlike the previous two years, the pathogen levels reached lower concentrations in the peak period of July-August. The complex data set will be used to model climate and ecosystem conditions correlated with increases in pathogenic strains of V. parahaemolyticus, prevent outbreaks of food-borne Vibrio diseases.

4. Associated Knowledge Areas

KA Code	Knowledge Area
723	Hazards to Human Health and Safety

Outcome #4

1. Outcome Measures

Number of agencies and stakeholder groups involved in research outreach related to Vibrios in shellfish.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
A growing oyster aquaculture industry in northern New England is threatened by an increased rate incidence of Vibrio parahaemolyticus-foodborne disease in this region. However, only rare strains of V.parahaemolyticus cause the illness.

What has been done
Newly developed molecular assays are being employed to discriminate between pathogenic and benign strains. The Jones research group (NIFA Accession #1010499 is using these data "to begin to model ecosystem and climate data, to identify significant factors that affect V. parahaemolyticus populations." NHAES researchers "were invited to share their project findings at the Interstate Shellfish Sanitation Conference (ISSC) National Vibrio parahaemolyticus Workshop in September 2017 and to help write up the workshop report."

Results
The purpose of the ISSC workshop was to identify what is known and what isn't know about pathogenic Vibrios in shellfish and harvest waters and to use this information to guide future research and regulatory functions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
723	Hazards to Human Health and Safety

Outcome #5

1. Outcome Measures

Knowledge about the changes in Vibrio genomes, which cause transitions to virulence;

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"The rate of infections from Vibrio parahaemolyticus contaminated shellfish from the Northeast has risen sharply over the last five years. Pathogenic strains have been collected by health agencies and made available to researchers, to better understand the different pathogenic

lineages present" in Long Island Sound and New England.

What has been done
The Whistler research group (NIFA Accession #1004199) conducted Genome sequencing and detailed comparisons were made between disease-causing Vibrio parahaemolyticus strains.

Results
1.Genetic markers have been identified for all major pathogenic lineages of Vibrio parahaemolyticus in the Northeast United States
2. Shared and unique diagnostic and virulence traits for these strains were identified, which make it possible to trace back individual strains to specific harvest areas, allowing for more accurate trace-back of shellfish-borne Vibrio illness.
3. These tools have been employed in NH and Massachusetts to track the presence and abundance of specific pathogenic strains.
4. These new diagnostic tools are being used to inform management and reduce disease in Connecticut and Massachusetts and maintain low- incidence in New Hampshire

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Measures

Understanding of how microcystin toxins spread from lakes to the terrestrial food chain

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Harmful cyanobacterial blooms (HCBs) occur when water supplies become eutrophic (high nitrogen and phosphorous). These HCBs are increasing worldwide threatening water and food supplies. the toxic metabolites produced by the bacteria, microcystins (MC) and methyl amino-L-alanine (BMAA) have been detected in the food chain in lakes, and more recently in agricultural

crops surrounding lakes experiencing blooms. Important questions remain about how the cyanobacteria toxins are transferred outside the aquatic system.

What has been done
The Haney Research group (NIFA Accession # 1007227) conducted the following studies:
1. Day and night aerosols were collected from highly eutrophic lakes with HCBs and clear, pristine lakes. Filters are being analyzed using epifluorescent microscopy;
2. New methods of aerosol analysis are being validated.
3. Controlled experiments were conducted evaluating uptake of aerosols and BMAA by lettuce and radishes in hydroponic chambers at lakeside.

Results
Data analysis for 1-3 are underway

4. Associated Knowledge Areas

KA Code	Knowledge Area
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities

Brief Explanation

UNHCE: No external factor was reported for this program
NHAES: No impact of external factors on these research projects.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE
Safety Awareness in the Food Environment (SAFE):

• 903 food handlers attended one of 50 SAFE workshops held throughout the state. Of the 629 people completing the evaluation, 590 (94%) scored 75% or higher on the food safety knowledge questions. Of those completing the evaluation, 302 (76%) indicated a desire to change a variety of food safety related behavior including preventing cross-contamination (31%), preventing time - temperature abuse of foods (26%), practicing good personal hygiene (20%), and using better cleaning and sanitizing techniques (18%). 95% of food workers indicated that it was somewhat to very likely they would make these practice changes to improve food safety.
• 197 different businesses, schools, child care and food pantries & feeding programs.

• City Health Departments in Bedford, Derry & Portsmouth sponsored programs for businesses located within their jurisdiction. Portsmouth has a special food handler certification quiz. Those who pass the quiz with 75% or higher receive Food Handler Cards from the Health Department

• Conducted 12 food safety workshops for food pantries, soup kitchen and feeding programs through the NH Food Bank. The majority of the programs were held at the NH Food Bank with a few others in Coos, Carroll & Strafford counties. NH Food Bank requires this training in food safety for facilities that receive food from them.

ServSafe®:

• 12 ServSafe® programs reached 185 participants representing 66 businesses, schools, non-profits, nursing home and hospitals. 153 (83%) examinees passed the exam thus receiving certification from the National Restaurant Association. Programs took place across the state.

ServSafe® Food Handler

• One program reached 20 UNH students taking part in the UNH Recreation Center test/demonstration kitchen. 100% of students passed with a score of 75% or higher on the end of the program quiz.

NHAES

A common measure for the evaluation of basic research is the preparation and submission of manuscripts that are peer-reviewed. Two of the three NHAES projects in the area of food safety have published eight peer-reviewed papers. The third project maintains several popular websites (www/cfb.unh.edu, 441821 views; cfb.unh.edu/phycokey/phycokey.htm, 277044, cfb.unh.edu/CyanoKey/indexCyanoQuickGuide.html, 4289 views) that provide important tools for identifying phytoplankton associated with harmful cyanobacterial blooms

Key Items of Evaluation

NHAES: Genetic markers that distinguish benign and pathogenic Vibrio parahaemolyticus strains, developed as part of this research, are being used by state labs in New England to monitor shellfish safety.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Global Food Security and Hunger

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	5%		0%	
133	Pollution Prevention and Mitigation	0%		5%	
135	Aquatic and Terrestrial Wildlife	0%		5%	
136	Conservation of Biological Diversity	0%		2%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		7%	
202	Plant Genetic Resources	0%		3%	
204	Plant Product Quality and Utility (Preharvest)	0%		6%	
205	Plant Management Systems	10%		8%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		2%	
212	Pathogens and Nematodes Affecting Plants	10%		15%	
213	Weeds Affecting Plants	5%		2%	
216	Integrated Pest Management Systems	10%		4%	
301	Reproductive Performance of Animals	10%		7%	
302	Nutrient Utilization in Animals	10%		11%	
307	Animal Management Systems	5%		15%	
402	Engineering Systems and Equipment	0%		2%	
403	Waste Disposal, Recycling, and Reuse	0%		3%	
502	New and Improved Food Products	0%		3%	
601	Economics of Agricultural Production and Farm Management	15%		0%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	0.0	14.0	0.0
Actual Paid	22.0	0.0	19.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
361434	0	1485232	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
361434	0	1474005	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1284388	0	1207659	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

UNHCE

- Workshops/conferences - including single- and multiday conferences, NH Farm and Forest events, and various producer association meetings
- Pasture walks & twilight meetings
- Farm/site visits, including kitchen table meetings and private consultations
- On-farm and university-based applied research projects
- Phone consultations
- Soil and plant tissue diagnostic services
- Publications - newsletters, news releases, fact sheets, publications, web page
- Radio and TV spots

NHAES

- Conduct applied and discovery research in multiple aspects of plant and animal agriculture, aquaponics, integrated pest management related genetics and genomics, and various types of aquaculture
- Engagement with stakeholders at a varieties/modalities: research field days (Woodman Farm June 2017, Durham Farm Day August 19, 2017), at UNHCE twilight meetings, seminars and education sessions at the NH Farm and Forest Expo, the Northeast Organic Farming Association NH meeting, and the NE National Farmers Union Meeting. The Farm and Forest Expo presentations were made available via YouTube videos.

2. Brief description of the target audience

UNHCE and NHAES audiences include:
Farmers/producers, scientists, veterinarians, agricultural researchers, agricultural teachers, graduate and undergraduate students, and the faculty and staff of the region's land-grant universities and others who work in agriculture-related fields, and taxpayers in the state, region and nation.

3. How was eXtension used?

UNHCE's Pesticide Safety Education Program (PSEP) within the Food Safety program used eXtension for two main purposes: (1) to promote workshops and training, (2) as a reference for New Hampshire clients. In 2016 - 2017, PSEP used eXtension to promote seven workshops including Using Backpack Sprayers, Personal Protective Equipment, Using Backpack Sprayers, The Label and Labeling, Storage and Disposal, and Pesticide Hazards and First Aid.

In addition to the workshops and training, PSEP use eXtension as the primary reference when the staff need to lead their clients to external resources.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	11401	83631	2303	5375

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017
Actual: 1

Patents listed
62/497/257 Method and apparatus for using nuclear magnetic resonance spectroscopy to determine body compositions of dairy calves

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	97	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of farm or agricultural business site visits or private consultations

Year	Actual
2017	691

Output #2

Output Measure

- Number of Pesticide Applicators attending recertification training

Year	Actual
2017	698

Output #3

Output Measure

- Number of soil and plant analyses conducted by diagnostic labs

Year	Actual
2017	2987

Output #4

Output Measure

- Number of people reached through educational workshops

Year	Actual
2017	10456

Output #5

Output Measure

- Number of undergraduate students directly involved in the research projects

Year	Actual
2017	119

Output #6

Output Measure

- Number of graduate students directly involved in research projects.

Year	Actual
2017	53

Output #7

Output Measure

- Number of university courses in which research project results have been incorporated

Year	Actual
2017	35

Output #8

Output Measure

- Number of research presentations at regional, national, or international scientific meetings

Year	Actual
2017	85

Output #9

Output Measure

- Number of workshops, training sessions and presentations to non-scientific stakeholders
  Not reporting on this Output for this Annual Report

Output #10

Output Measure

- Number of reviewed, bulletin, popular and other publications resulting from research projects

Year	Actual
2017	41

Output #11

Output Measure

- Number of websites in which research project results have been incorporated

Year	Actual
2017	11

Output #12

Output Measure

- Number of surveys or other methods used to collect data from participants conducted for research projects

Year	Actual

2017	2

Output #13

Output Measure

- Number of postdocs and other scientists trained in cutting edge research methods

Year	Actual
2017	7

Output #14

Output Measure

- Website views to 9 various, research-related websites and blogs

Year	Actual
2017	21217

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of NH growers who adopt practices to improve farm productivity and/or profitability.
2	Number of NH farmers and gardeners who use soil testing recommendations to guide nutrient application.
3	Number of NH growers who monitor for pests, use cultural practices to manage pests and/or select reduced-risk (lower EIQ) materials to manage pests.
4	Number of NH growers who increase their knowledge and/or skills in crop production practices suited to the region.
5	Number of NH growers who increase their knowledge and/or skills in dairy, livestock or equine management practices.
6	Increase knowledge about plant varieties and production practices suited to the state and region.
7	New knowledge about dairy production, nutrition, animal health and dairy products important to regional producers.
8	New genomic knowledge translated into tools and strategies to facilitate varietal selection through marker-assisted breeding.
9	Knowledge related to how the neuroendocrine system influences reproduction in fin fish aquaculture and other vertebrate animals and in the control of pest species such as lamprey eels.
10	New commercialized varieties of cucurbit vegetables suited to state and region growing conditions, with improved yields, and disease and pest resistance.
11	Increased information on non-Apis bees, their conservation, pathology, susceptibility to pesticides and contribution to crop pollination including economic value.
12	Use genomic resources developed for barberries, to identify the genetic mechanisms(s) of resistance to wheat stem and stripe rusts.
13	Improve equipment and deployment methods developed for oyster aquaculture in Northern New England and disseminate to the growing number of NH oyster farmers.
14	Establish a breeding program for hardy kiwifruit (Actinidia spp.) cultivars for New England, by characterizing with genetic and molecule tools, and phenotyping hardy Actinidia germplasm obtained the USDA's National Genetic Resources Program.
15	Number of acres on an Integrated Pest Management Plan
16	Number of farmers who report adopting practices resulting in better forage crop quality and yield.
17	Establish dietary guidelines in recirculating aquaculture systems for brown bullhead (catfish) and striped bass.

18	Understanding of how small vertebrate carcasses contribute to overall soil health and the role of necrophilous insects in this process.
19	Characterize the nutrient production in the culture system and effluent streams from a recirculating aquaculture system in terms the macro- and micro-nutrients required for hydroponic plant production.
20	Evaluate the feasibility of using low tunnels to improve different aspects of production for day-neutral (fall-bearing) strawberries.
21	Determine the relative stress-responsiveness of pure-bred striped base.
22	Evaluate whether dairy calves take up enterolactone(EL) and enterodiol from EL-enriched milk
23	Evaluate the relative attractiveness of native perennial species and their cultivars to key pollinators.

Outcome #1

1. Outcome Measures

Number of NH growers who adopt practices to improve farm productivity and/or profitability.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2512

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Numbers of farms that produce vegetables and fruits are increasing in New Hampshire, and consumer interest in locally grown food has also grown in recent years throughout New England. Between 2002 and 2007 the number of vegetable farms increased 36%, and the number of orchards increased 28%. Many of these are operated by new farmers that lack experience and knowledge of effective crop production practices in our region. Successful crop production depends on making decisions on a wide range of topics, from irrigation, variety selection, site selection and soil preparation, planting schedules, training/pruning crops, and various methods to extend the short growing season. These practices have the potential to greatly increase farm profitability by increasing crop yields and crop quality, and reducing labor and inputs. For example, over-application of fertilizers is expensive and can negatively impact water quality as

well as plant growth. Under-application of fertilizers results in poor plant growth and loss of potential yields and profits. Soil tests and plant tissue tests are tools that growers can use to determine nutrient availability and crop needs, so that they can meet nutrient needs accurately.

What has been done
To address food production issues among New Hampshire farmers, UNHCE provided the following activities:
- Workshops/conferences - including single- and multiday conferences, NH Farm and Forest events, and various producer association meetings
- Farm/site visits, including kitchen table meetings and private consultations
- On-farm and university-based applied research projects
- Soil and plant tissue diagnostic services

Results
Participants were also asked whether they intended to make any changes on their farm based on what they learned. A free-form box was provided, where participants could write in intended changes. These changes were summarized and grouped into similar themes. The most frequently mentioned changes included considering grafting melons (35% of respondents!), adopting one or more pest management practices (37% in total; these are broken out more specifically below), changing varieties (17%), and monitoring days from pollination or fruit pruning to improve quality (17%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems

Outcome #2

1. Outcome Measures

Number of NH farmers and gardeners who use soil testing recommendations to guide nutrient application.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of NH growers who monitor for pests, use cultural practices to manage pests and/or select reduced-risk (lower EIQ) materials to manage pests.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	167

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Landscape and greenhouse horticulture is the largest sector of New Hampshire's agricultural economy with sales and services valued at $276 million1. Over 1,100 businesses (which employ over 12,000 people) are involved in plant production, retail sales and landscape services including lawn maintenance and tree care. In addition, horticulture is an essential component of the human environment, affecting health and well-being, social behavior, and environmental health. Our landscape helps to define the sense of place that we call New Hampshire.

Garden center and/or landscape professionals are often the primary source of information for the gardening public. These professionals utilize many resources to guide the public in proper planting and maintenance practices, but look to UNH Cooperative Extension as the local source of science-based recommendations for plant selection, culture and nutrient management, pest diagnosis and recommendations and sustainable production and landscape practices. In addition, field/state specialists, the Education Center, Master Gardeners and other volunteers educate many thousands of consumers each year on horticultural topics.

The priorities of producers (greenhouse and nursery crops) and other green industry businesses are somewhat different than those of the consumer. Producers are focused on crop production and the economic viability of their businesses. However many nurseries and greenhouses are producing crops at less than optimal efficiencies. Labor, raw materials, and energy are becoming increasingly more expensive and/or are hard to source. Owners, operators and employees often lack sufficient knowledge and skills to maximize productivity while maintaining level or decreased inputs.

What has been done

The mission of the University of New Hampshire Cooperative Extension?s Landscape and Greenhouse Horticulture Area of Expertise Team is to develop and provide research-based educational resources that meet the needs of businesses, property owners, and home gardeners. The adoption of recommended best practices to support sustainable businesses, enhance the environment and provide essential eco-system servicesi that ultimately benefit all the citizens of the State.

Results

In 2017, as an outcome of UNHCE's educational program, 167 NH growers monitor for pests, use cultural practices to manage pests and/or select reduced-risk (lower EIQ) materials to manage pests.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #4

1. Outcome Measures

Number of NH growers who increase their knowledge and/or skills in crop production practices suited to the region.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1005

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
(See previous outcome)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #5

1. Outcome Measures

Number of NH growers who increase their knowledge and/or skills in dairy, livestock or equine management practices.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1005

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products

Outcome #6

1. Outcome Measures

Increase knowledge about plant varieties and production practices suited to the state and region.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many of the high-value crops grown in New England are grown using production systems that are different from the growing methods used in major producing areas and warmer climates. Use of the most effective growing practices for our region (including new varieties, new crops, and season extension strategies) can increase farm profitability through diversification, improved yields, and improved crop quality. Therefore, the focus of this integrated research and extension effort is in the area of high-value specialty crop production systems and methods of extending the growing season (e.g. season extension).

What has been done
Sideman's research group (#1006928) worked on several ongoing experiments.
1. Evaluate eight hardy table grape cultivars with three distinct training systems.
2. Evaluate onion germplasm in an overwintering production system for survival, timing of bulb formation, and potential bulb yield.
3. Biological control of cabbage aphid was investigated.
4. Two production systems were evaluated for baby ginger propagation.
5. The third year of bell pepper production in high tunnels was completed.

Results
1. Vines were replaced that died in their first two years of growth, disease susceptibility data were collected, and a preliminary research report was disseminated to growers (https://extension.unh.edu/resources/files/Resource006259_Rep8964.pdf)
2. A preliminary pilot study that investigated overwinter survival of scallions with low-cost row cover protection was completed. This work resulted in a research report for growers (https://extension.unh.edu/resources/files/Resource006811_Rep9838.pdf)
3. Data were analyzed on pest and beneficial insect presence in Brussel sprout plots with two different types of treatment: organic insecticides, and insectary plantings designed to promote biological control of cabbage aphid. Organic insecticides provided good control of this pest, but insectary plantings did not. Preliminary data were used to design a more comprehensive study.
4. After a pilot experiment in 2016, a small replicated study was conducted in two production environments (low tunnel and high tunnel) to measure yield penalties for early harvest of baby ginger, a high-value specialty crop now being grown in high tunnels throughout Northern New England region. Early harvesting did result in significant yield penalties, and we observed generally poor growth and yields in low tunnels as compared with high tunnels.
5. Data and analysis of three years of bell pepper production are underway.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #7

1. Outcome Measures

New knowledge about dairy production, nutrition, animal health and dairy products important to regional producers.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
1.Calves are born with a naive immune system and must obtain their initial immune functioning system from the first secretion of the udder-colostrum. The immune system has a direct impact on calves future performance in milk production.
2. Purchased feed and grains account for 36% of total cash expenses of organic dairy farms in Northern New England. However, conserved forage has lower nutritional values than good quality pasture. Research is crucial to help reduce winter feeding costs in organic dairy herds. Ongoing studies are focused on how flaxseed meal and sucrose impact the product of enterolactone (EL) in the rumen. Enterolactone has been linked to human health benefits.

What has been done
1.Professor Erickson's research group(NIFA Accession 1001283) has conducted preliminary experiments suggesting that the poor quality of dairy cow colostrum may be improved by supplements to the prepartum cow's diet. In a second, more definitive study, they evaluated the effects of supplemental feeding of different levels of nicotinic acid or beta-carotene to 45 multiparous Holstein cows for four weeks prepartum.
2. Assoc. Prof. Brito's research group (NIFA Accession 1001855) has been conducting feeding experiments with sucrose and/or flax oil or flax meal to determine how these impact milk productions EL concentrations.

Results
1. A linear increase in colostrum IgG concentration was observed as nicotinic acid supplementation increased. Similarly, cows fed beta-carotene also had greater colostrum quality

than control cows. The calves fed higher quality colostrum, from the nicotinic acid supplement, consumed less started grain but were more efficient in converting feed into growth.
2.Results for Assoc. Prof. Brito's studies showed that sucrose or flax oil alone or in combination did not change milk EL in diets containing 15% of flaxseed meal fed to lactating dairy cows. However, the concentration of milk EL was significantly greater in cows fed flaxseed meal compared with those cows fed soybean meal. The overarching impact of this flaxseed meal research is producing knowledge about how to increase the concentration of EL in milk, so that farmers can adopt best feeding strategies to increase the output of EL in milk, while dieticians can develop dietary guidelines and milk processors value-added marketing opportunities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems

Outcome #8

1. Outcome Measures

New genomic knowledge translated into tools and strategies to facilitate varietal selection through marker-assisted breeding.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Strawberry is a very important fruit crop, but most breeding programs focus on cultivars for production in California and Florida. Professor Davis's research group aims to use a combination of traditional and marker-aided breeding (MAB) methods to develop locally adapted strawberry varieties for New Hampshire and the Northern New England region. Implementation of MAB will enable a more rapid breeding response to local needs and opportunities, among which is the shortfall of strawberry production in New Hampshire in relation to unmet demand for locally produced, high-quality fruit. In addition, Davis and his colleague Dr.Lise Mahoney seek to release attractive ornamental varieties for the home garden and landscaping.

What has been done

The Davis lab strawberry breeding program continued work to identify hereditary associations between molecular markers and traits of economic interest, by collecting phenotypic data from breeding and genetic study populations of strawberry with reference to the traits of disease resistance, fruit quality, flowering habit, and flower color.
Population development in the breeding program included the performance of crosses or enforced self-pollinations, followed by the collection and planting of the seed to establish the subsequent generation plant populations.

Results
1.Plant tissue samples from a multigenerational pedigreed population were submitted to a genotyping services lab for the purpose of generating molecular marker data, and the resulting data are now being analyzed with the objective of identifying marker-trait associations as well as to assess the progress of inbreeding.
2.Plant tissue samples from a different progeny population segregating for resistance/susceptibility to the fungal disease verticillium wilt were submitted to a genotyping service lab.
3. New strawberry hybrids and inbred lines were generated from crosses and self-pollination, involving a diverse array of germplasm. This work generated new, advanced generation progeny populations for breeding purposes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources

Outcome #9

1. Outcome Measures

Knowledge related to how the neuroendocrine system influences reproduction in fin fish aquaculture and other vertebrate animals and in the control of pest species such as lamprey eels.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Understand the underlying mechanisms of neuroendocrine control are essential to regulating vertebrate reproduction. Gonadotropin-releasing hormone (GnRH) is the "master or central control" of reproduction and has provided the focus of decades of concerted and intensive research and along with pituitary hormones has led to the development of current treatments for infertility, cancers of the reproductive system and for use in agriculture/aquaculture. Lamprey eel represents one of the oldest existing vertebrate lineages, and has been very useful for comparative endocrinology research.

What has been done
Professor Sower's lab (NIFA accession 1003341) performed several studies to better understand the structure and function of glycoprotein hormones and respective receptors in lampreys.
1. Examined RNA expression of three lamprey GnRH in the brains of larval, parasitic phase and adult sea lampreys, Petromyzon marinus, using triple-label in situ hybridization technique.
2. Determined the RNA expression of lGpH-R I and II in the gonads and thyroids of larval, parasitic phase, and adult lampreys.
3. Cloned and expressed of the lamprey glycoprotein hormone subunit B5 (lGpB5) as part of functional analysis of this gene product.

Results
1. Results show that lGnRH-I, -II, and -III have different localization and co-expression in the development and sexual maturation of lampreys, which may suggest unique physiological roles at each life stage and sex in the developing and mature lamprey brain.
2. Professor Sower's lab results provide supporting evidence that the lamprey pituitary hormones may differentially activate the lamprey GpH-Rs in regulating both thyroid and gonadal activities during each of the three life stages of the sea lamprey.
3. Cloned and expressed lGpB5 was able to form a heterodimer with lamprey glycoprotein hormone subunit A2 (GpA2) to form a functional thyrostimulin for the sea lamprey. It is hypothesized that lGpH and l-thyrostimulin differentially regulate reproductive and thyroid activities in some unknown way(s). These data support the functional role of thyrostimulinin a basal vertebrate prior to the diversification of luteinizing hormone (LH), follicle-stimulating hormone (FSH), and thyroid-stimulating hormone (TSH) in jawed vertebrates.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
307	Animal Management Systems

Outcome #10

1. Outcome Measures

New commercialized varieties of cucurbit vegetables suited to state and region growing conditions, with improved yields, and disease and pest resistance.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"Improved cucurbit variety performance in terms of yield, quality and ease of culture as well as better appearance and improved nutrition and eating quality increase consumer acceptance and demand for locally produced vegetables." .."This will provide more income to growers and for regional seed companies marketing locally adapted varieties helps maintain their profitability."

What has been done
1. Winter squash is an important crop in the Northeast. Emeritus Professor J. Brent Loy's recent breeding efforts (NIFA Accessions # 233554 & 1010296) have focused on developing interspecific hybrids; these hybrids are more productive than traditional varieties, and also have better resistance to common diseases and insects plaguing squash. Because interspecific hybrids are resistant to most soil-borne diseases affecting cucurbit crops, an important use of these hybrids worldwide is to serve as rootstocks for grafting to melons, a high-value crop in the Northeast.

Results
1."As a result of selection in several segregating generations over the past five years, four new bush breeding lines of C. maxima have been developed. In 2017, mean seed yields per fruit of two new bush C. maxima lines, NH.Max2342 (311 seed) and NH.Max5101-3, (232 seed) were at least double that of NH65 (117 seed), to improve C. moschata germplasm, a breeding population was made in 2010, involving the variety Large Cheese, a NH breeding line (NH421) with powdery mildew resistance (PMR) and high carotenoid content, and a Dickinson Field processing strain from Rupp Seeds (SC936). After several generations of selection, five new processing strains were developed. These new breeding lines have high carotenoid contents, and the major carotenoid is beta-carotene, a relatively stable carotenoid for steam-processing. New varities with UNH germplasm have been adopted by several seed companies for commercial distribution. Professor Loy and his MS student Janel Martin have shown that melon grafted to squash rootstocks can considerably increase yields and extend the growing season. Additional field studies are underway to characterize the effects of different hybrid rootstocks on production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)

212 Pathogens and Nematodes Affecting Plants

Outcome #11

1. Outcome Measures

Increased information on non-Apis bees, their conservation, pathology, susceptibility to pesticides and contribution to crop pollination including economic value.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

1.Bees are important pollinators of food crops and natural ecosystems. The abundance of and diversity of pollinators are declining in many agricultural landscapes across the United States. Assistant Professor Rehan (NIFA Accession # 1004515) has initiated long-term monitoring of bee biodiversity in New Hampshire and identify species to identify species at risk and changes in pollinator communities and restore and rejuvenate healthy plant-pollinator habitats.
2.Establishing and maintaining bee forage (on farms) or wildflower meadows (in the landscape) is difficult, costly and time-consuming for land managers, however, and often results in failure. Research is needed to determine site preparation, species mixes and planting methods that can be used to conserve, enhance/and create pollinator habitat on farms, and in landscapes on public and private lands.

What has been done

1.a.Through ongoing land use surveys the Rehan bee lab has been able to determine optimal land use practices for bee abundance and biodiversity and long-term studies are underway to assess the sustainability of our pollinator populations. Through historic studies of wild bee populations, Rehan and her students have been able to identify species in decline as well as critical host plants, many of which are also threatened.
1b. Next-generation DNA sequencing of pollen-masses from wild bee nests was used determine diet breadth as well as pathogen loads in the nest.
1c Initiated experimental manipulation of pollen provisions in wild bee nests to determine the quality and quantity of food required for healthy pollinator populations.

Results
1. Rehan and her students observed that conventional pesticide farms harbor low bee diversity and abundance while organic farms promote wild bee diversity and abundance.
2. DNA-analyses of pollen masses reveal that generalist pollinator species are actually specialists foraging on 2-3 plant species to comprise 80-90% of their diet.
3. "By reducing and adding nutrients we were able to show marked variation in offspring body size and fat stores (Lawson et al. 2017). These data show that it is not only the quantity of pollen provided but also quality of nutrients that are essential to bee overwintering survival and reproductive success.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #12

1. Outcome Measures

Use genomic resources developed for barberries, to identify the genetic mechanisms(s) of resistance to wheat stem and stripe rusts.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"The common barberry (Berberis vulgaris) was introduced to the Americas as an important hedgerow and medicinal plant. It quickly naturalized and spread as wild stands throughout New England and other parts of the country. Unfortunately, barberries have been shown to function as the alternate host to stem rust and stripe rust, driving the evolution of two of the most devastating fungal diseases of wheat and barley." While barberry was eradicated in the grain belt in the last century, as local grain production returns to New England after more than 150 years, common barbary represent serious risks for the generation of new virulent races of wheat stem rust.

What has been done
1. The Hale lab group (NIFA Accession #233561) has developed genomic resources for barberry including tools for molecular tools to distinguish barberry species.
2. Application of these resources to examine gene flow between common barberry and the invasive ornamental Japanese barberry (B. thunbergii). Unlike common barberry, Japanese barberry exhibits 'non-host resistance' to the stem rust pathogen.
3. Generation of interspecific F1 hybrid populations for B.vularis X B.thunbergii for gene-mapping.

Results
1. "Using the de novo (i.e. reference-independent) genotyping-by-sequencing (GBS) pipeline previously developed in the Hale lab (GBS-SNP-CROP), the genotyped B. vulgaris accession 'WH01' (seed parent), B. thunbergii accession 'UCONN' (pollen parent), and the population of 200 F1 interspecific hybrids generated from their cross were genotyped. These were used to generate initial genetic linkage maps for both parents, the first such maps constructed for any barberry species.
2.The genetic maps described above were combined with the results of two years of controlled inoculations, to generate the first quantitative trait loci (QTL) analysis of wheat stem rust Puccina gramis (Pg) non-host resistance in barberry, revealing a single, well-defined resistance locus in B.thunbergii (Japanese barberry).

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources

Outcome #13

1. Outcome Measures

Improve equipment and deployment methods developed for oyster aquaculture in Northern New England and disseminate to the growing number of NH oyster farmers.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a need to make information on oyster farming in the Northern New England more accessible to existing and potential oyster farmers. The major outcomes of Research Professor Ray Grizzle's (NIFA Accession #1003387) will be continued growth and stability of the rapidly emerging NH oyster farming industry.

What has been done
1. Quantify the effects of variations in major gear types and deployment methods on oyster growth.
a. Two experiments were completed on the effects of distance above the bottom on growth and mortality rates of oysters held in mesh bags in racks, the most common gear type in NH.
b. Two experiments were conducted on how 'wet storage' methods might be developed to produce quality oysters during the winter.
c. One experiment was completed on how predation by crabs is related to oyster size in order to better design 'bottom seeding' practices
2. Use interviews and oyster farm visits to assess gear types and methods that oyster farmers in the region currently use from the perspective of possible standardization on NH farms.

Results
1a. Of two experiments conducted on the effect of distance of oyster bags above the bottom, on indicated no significant differences in either oyster metric related to bag height, while the second indicated a marginal but complicated effect possibly related to environmental conditions.
1b. Neither experiment on wet storage methods yielded data indicating the existing methods could be readily improved upon.
1 c. The major result of the predation experiment was that oysters >1.5 inches in shell height would likely have high survival rates.
2. A wide range of harvest methods are being used, in part due to the wide range of water depths and bottom types (from mud to cobble) on the farm sites. Most farmers use some type of "rack and bag" deployment, but other methods are being assessed. There appeared to be a major move towards "bottom seeding" (distributing oysters onto the bottom for final grow-out) by many farmers because it is thought that the result is improved quality over other methods.
This project contributed to the ongoing growth of the oyster farming industry in New Hampshire by providing new knowledge on how different farming methods compare with respect to oyster growth and mortality. This information has been transmitted in part to regional oyster farmers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #14

1. Outcome Measures

Establish a breeding program for hardy kiwifruit (Actinidia spp.) cultivars for New England, by characterizing with genetic and molecule tools, and phenotyping hardy Actinidia germplasm obtained the USDA's National Genetic Resources Program.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New England fruit and vegetable agriculture is distinct in both the diversity of its production and its high proportion of direct sales to consumers. The large and growing demand for diverse, local produce in the region creates an opportunity for the development of cultivars and entirely new horticultural products. Extremely high in vitamin C, beta-carotene, anthocyanins, and lutein, the remarkably sweet and flavorful fruits(of kiwiberry) have largely remained the domain of hobbyist growers, due to their relatively small size and postharvest performance. Utilizing the kiwiberry germplasm currently present in North America, the NHAES has invested in a breeding program for kiwiberries for New England.

What has been done
1. The Hale research group (NIFA Accession # 233561) conducted Genome by Sequencing (GBS) of the North American collection of Kiwiberry
2. Three years of phenotyping of harvest timing and postharvest storage physiology was carried out for replicated vines of cultivar Michigan has been completed to identify baseline production parameters.

Results
1. Genome by Sequencing "(GBS)-based deconvolution of the North American collection of kiwiberry germplasm, enabled the successful characterization of population sub-structure, accession redundancy, and genetic diversity in this large and historic collection. The results of this analysis were applied to guide parent selection for controlled crosses.
2. GBS was completed to identify sex-linked molecular markers for Actinidia arguta and A.kolomikta, and these markers are being applied to screen breeding populations before

to the research vineyard.
3. A second collection trip was carried out in the mid-Atlantic and northeast regions of the US, resulting in the identification and propagation of 35 additional historic (i.e. pre-1930's) vines.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources

Outcome #15

1. Outcome Measures

Number of acres on an Integrated Pest Management Plan

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #16

1. Outcome Measures

Number of farmers who report adopting practices resulting in better forage crop quality and yield.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	54

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
307	Animal Management Systems

Outcome #17

1. Outcome Measures

Establish dietary guidelines in recirculating aquaculture systems for brown bullhead (catfish) and striped bass.

Not Reporting on this Outcome Measure

Outcome #18

1. Outcome Measures

Understanding of how small vertebrate carcasses contribute to overall soil health and the role of necrophilous insects in this process.

Not Reporting on this Outcome Measure

Outcome #19

1. Outcome Measures

Characterize the nutrient production in the culture system and effluent streams from a recirculating aquaculture system in terms the macro- and micro-nutrients required for hydroponic plant production.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The overall goal of Assist. Professor Todd Guerdat's research (NIFA Accession # 1010110) is "to establish design parameters, from an engineering perspective, for the development of an integrated, recirculating aquaponics system. The proposed project will characterize the processes critical to the integration of two traditionally separate production systems - a recirculating aquaculture system (RAS) and a hydroponic plant production system. The proposed study will focus on optimizing the production of food fish (e.g. tilapia, striped bass) and one or more types of food plants (e.g. lettuce, herbs, and other leafy greens) in a controlled environment agricultural production setting. These goals form the foundation for the development of an economically sustainable, small and mid-size agricultural-based production model that can improve small, rural farming practices and form the basis for sustainable urban agriculture as well."

What has been done
1. "Water quality analyses have been conducted to profile the nutrients (e.g. N, P, K, etc.) dissolved in the water in recirculating aquaculture systems. Data were collected and analyzed to first characterize the differences in dissolved nutrients for fish fed one of three different protein content feeds."

2. "Waste sludge from recirculating aquaculture systems (RAS) was collected and nutrient analyses were conducted."
3. "Quantify plant-nutrient uptake rate. For the reporting period, research systems were constructed and brought online slowly. The first priority was to identify a good variety of lettuce for hydroponic production."

Results
1."This study showed no significant difference in the nutrient content between the three different feeds. This result will prevent producers from mistakenly selecting a 'premium' feed for the sake of improving nutrient profiles in the water."
2. "Preliminary ranging studies have been conducted to determine operating condition requirements for aerobic and anaerobic treatment to extract nutrients from the solid waste."
3. "The initial lettuce variety selected for aquaponics was subsequently determined to be an inappropriate candidate as the variability was too great in germination rate, size, and growth rate between plants. As such, a new variety was selected following suggestions from hydroponic producers, and research protocols finalized."

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse

Outcome #20

1. Outcome Measures

Evaluate the feasibility of using low tunnels to improve different aspects of production for day-neutral (fall-bearing) strawberries.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Strawberry production in NH has traditionally been limited to June bearing varieties. Season extension methods and improved varieties of fall bearing-strawberry varieties provide an

opportunity to expand the NH strawberry season, with late-season local berries having high market value.

What has been done
Prof. Sideman's research (NIFA Accession # 1006928) is part of the www.tunnelberries.org collaboration, sponsored a USDA small crops research initiative.
1.This was the 2nd year experiments on "fall-bearing" strawberries. The effects of three different mulch treatments and four different covering treatments were compared for effects on yield and quality (soluble sugars or brix, color, firmness, and postharvest storage quality) of fruit for the day-neutral strawberry cultivar 'Albion'.
2.Another smaller experiment was established to compare several cultivars' performance in a single standard low tunnel treatment.

Results
1.Preliminary results were confirmed, suggesting that low row-covers had a significant impact on fruit quality, and that mulch treatment had a significant effect on plant growth and yield. In the last two years, strawberry production on 'fall-bearing' Albion began in late June and continued through October.
2. Significant differences in yield, quality, and production period for several cultivars that were tested.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #21

1. Outcome Measures

Determine the relative stress-responsiveness of pure-bred striped base.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The US is a major consumer of aquaculture products, yet we grow only a small fraction of what we consume. The overall goal of research in the Berlinsky lab is to improve profitability of finfish culture in Recirculating Aquaculture Systems (RAS) and aquaponic systems.

What has been done
A number of hatchery-related stress experiments were conducted. In one completed experiment, the effect of transport on stress responsiveness of 2 strains of striped bass (a domesticated strain and Florida strain) and the ability of anesthetics and salt to mitigate the cortisol stress response were determined. Treatments included reduction of salt (from brackish to freshwater conditions), and transport with or without anesthetic. These treatments mimic disruptions expected in aquaculture RAS.

Cortisol levels, a marker of stress, were measured after different combinations of treatment, and then the fish were observed for health, feeding behavior and survival over a period of a week.

Results
Each treatment was replicated three times, totaling 108 fish from each strain (216 fish total). Results of this experiment are currently being analyzed and a publication is in preparation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #22

1. Outcome Measures

Evaluate whether dairy calves take up enterolactone(EL) and enterodiol from EL-enriched milk

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"Flaxseed is the richest source of the plant lignan secoisolariciresinol diglucoside, which is converted to the mammalian lignans enterolactone (EL) and enterodiol by the gut microbiota of ruminants and humans. Enterolactone has been associated with improved animal and human

health due to its antioxidant and anticarcinogenic properties." "The objective of this study [by Assoc. Prof. Andre Brito's research group (NIFA Accession 1001855)] was to determine the pharmacokinetics of EL in newborn dairy calves fed milk replacer or EL-enriched milk."

What has been done
On day 5 of life, calves were administered 2 Liters of milk replacer (low EL-treatment) or 2 Liters of EL-enriched milk during morning feeding. Blood samples were taken multiple times over a 2 day period.

Results
Uptake of EL was substantially (~3 fold) higher in calves fed EL-enriched milk versus milk replacer. Calves were able to absorb EL, indicating that EL-enriched milk can potentially be used as source of EL to pre-weaned ruminants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

Outcome #23

1. Outcome Measures

Evaluate the relative attractiveness of native perennial species and their cultivars to key pollinators.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"Lack of good quality habitat is a major factor contributing to widespread pollinator declines in recent years. Pollinators need a diversity of wildflowers and other plants that provide a continuous sequence of bloom on which they can feed throughout the season. "NHAES Research Professor and Extension Specialist (NIFA Accession # 1010499) studies "will result in recommendations for species mixes and planting methods, as well as site preparation alternatives for both organic and conventional systems in the northeast, that can be used to conserve, enhance and/or create pollinator habitat on farms, in landscapes and on public and private lands."

What has been done
"Seven cultivars of purple coneflower (Echinacea purpurea) were obtained as liners and grown on to mature flowering plants in containers, representing traditional and modified flower forms and colors of this popular garden plant. In mid-summer, they were arranged in a replicated block trial and pollinator visitation rates were monitored by doing timed pollinator counts repeatedly on several days during peak bloom. "

Results
Results showed significant differences in bee visitation for cultivars. "Color was less important than form in determining relative bee attractiveness, and highly modified petal forms were altogether ignored by all types of bees. Lists of pollinator-attractive plants need to reflect differences at the cultivar level in order to be useful to people choosing plants for their pollinator gardens."

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Appropriations changes

Brief Explanation

UNHCE: There was no reported external factor
NHAES: External factors did not impact outcomes in this Planned Program

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE
Impacts
Apples: The average incidence of pest injury at harvest in 2017 was 4.38%, well below the pre-IPM average of 10 to 12% injury. Growers saved (an estimated) $60,000 in spray costs (compared to pre-IPM spray patterns) and $100,000 in reduced fruit injury [estimate; NASS data not available until after January 2018] for a total savings of $160,000 statewide.
Veggies, Sweet Corn: In the audience evaluations for the January 2017 Cucurbit school, 22% of attendees at reported the intended to adopt some of the pest management activities mentioned (improved scouting, pollinator protection, row covers...) Analysis of the 2017 vegetable grower reports is not complete at this time, but we have just completed the analysis of the 2016 data:
In 2016, thirty-four growers participated in the sweet corn IPM program. Participating growers made 2.77 fewer sprays than they did prior to the current IPM program. This was a $25,842 saving in pesticides and $35,892 saving for labor and equipment costs. In addition to reducing spraying, growers reduced their cull rate (throwing away insect-damaged ears), resulting in an income increase of $174,361. The cull rate before IPM was 14.62%, while this year participating growers culled only 3.63% of the ears. Total sweet corn impact

(spraying and culling): $236,096.
In the 2016 Cucurbit IPM program, we monitored squash vine borers with traps at 18 sites. Squash vine borer numbers were high, and they started flying earlier that we normally expect. Participating growers reported they applied 2.02 fewer sprays than they usually did, on 275.13 acres of summer squash, winter squash and pumpkins. Growers noted no plant loss due to squash vine borer. Savings were 68.78 gallons of pesticide, worth $9,998 and $23,885 for labor and equipment costs.
Greenhouse: Audience evaluations from the January 2017 tri-state greenhouse workshops continue to show increases in the number of growers who try biological controls, now about 85%. When we began our workshops over 20 years ago, the number was below 5%.
NHAES
Publication of peer-reviewed papers and success in obtaining external grants are typical measures of evaluating the quality of basic and applied research. The projects in this associated planned program have been highly productive, with the combined publication of 97 peer-reviewed journal articles during FY 17. The 22 projects associated with this Planned Program have leveraged Hatch and State funds by competing for more than $1.2M in additional funding.

Key Items of Evaluation

UNHCE Food and Agriculture program cultivated farms business management skills through training in business planning, finance, marketing and agricultural law. In 2017, 171 commercial workers were certified in safe and effective use of pesticides, resulting in reduced expenses in materials, labor and reduced exposure by workers to agricultural chemicals. Food safety specialists provided training to 385 restaurants, institutions and farms in sanitary food handling and preparation -- making local food industries safe and sustainable.
NHAES Significant outcomes of this Planned Program include:

- Loy research group: The second year of trials confirmed it possible to improve melon production for Northern New England growing conditions by grafting of cantaloupe melon scion to disease resistant, cold-hardy hybrid squash rootstock (UNH germplasm). The hybrid squash rootstock supports faster growth in cool early season soil conditions, as well as resistance to sudden wilt.
- Adding to his exemplary 50-year career in cucurbit breeding, Emeritus Professor J. Brent Loy released three new cultivars:
    - Ambassador Melon: an early, netted, green flesh Galia melon with good quality for local markets; this cultivar is resistant to two races of powdery mildew and fusarium wilt.
    - Honey sak melon: midseason Crenshaw for local production; powdery mildew and fusarium resistant
    - Smooth Operator summer squash: A highly productive, yellow straight neck squash with powdery mildew resistance and carrying the glabrous, gl-2 gene for reduced trichomes (spines) on stems and petioles, for improved market value.
- Rehan research group applied Next Generation DNA-Sequencing methods to evaluate the quantity and quality of wild bee pollen-masses. and compared this to previous studies of honey bees and bumble bees: Taken together, the resulting data reveal that generalist pollinator species are actually specialists, foraging on 2-3 plant species to compromise 80-90% of their diet.
- Neal and her student compared the relative attractiveness of cultivars of perennial species. Results show significant differences in bee foraging by cultivars, with form rather than color, most important in determining in bee attractiveness. Lists of pollinator-attractive plants need to reflect differences at the cultivar level in order to be useful in

recommendations for establishing pollinator gardens.

- Hale's research group used molecular tools to deconvolute the North American collection kiwiberry germplasm, enabling characterization of population substructure, accession redundancy and genetic diversity in in the large and historic collection.
- The Hale lab group used molecular markers and phenotyping to develop an initial genetic linkage map for common and Japanese barbary, to identify a single a-well-defined locus for wheat stem rust resistance in Japanese barberry.
- Erickson's research group confirmed preliminary data, showing that niacin supplementation of prepartum dairy cows results in improved levels of immunoglobulin in the dam's colostrum and the resulting calves appear to be more efficient in converting feed into growth.
- The Brito lab group demonstrated that lactating dairy cows feed flaxseed meal rather than soybean meal have significantly greater amounts of enterolactone (EL). EL is an important antioxidant and anticarcinogen.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Climate change and sustaining natural resources

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	0%		10%	
102	Soil, Plant, Water, Nutrient Relationships	0%		22%	
112	Watershed Protection and Management	20%		20%	
123	Management and Sustainability of Forest Resources	40%		0%	
124	Urban Forestry	10%		0%	
131	Alternative Uses of Land	10%		0%	
132	Weather and Climate	0%		8%	
136	Conservation of Biological Diversity	0%		10%	
206	Basic Plant Biology	0%		10%	
216	Integrated Pest Management Systems	10%		0%	
401	Structures, Facilities, and General Purpose Farm Supplies	0%		3%	
403	Waste Disposal, Recycling, and Reuse	0%		5%	
605	Natural Resource and Environmental Economics	10%		2%	
610	Domestic Policy Analysis	0%		8%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%		2%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	14.0	0.0	5.0	0.0
Actual Paid	28.0	0.0	7.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
222025	0	313494	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
222025	0	793662	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2369635	0	1213579	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

NHAES researchers will:

• Compare new methods for assessing microbial efficiency as they impact soil C storage and greenhouse gas emissions.
• Investigate the plant and microbial contributions on Soil Organic Matter (SOM) and soil nitrogen cycling.
• Examine the processes of N mineralization in soil.
• Investigate climate impact on soil C cycling to improve the Community Land Model, a component of climate change assessments.
• Evaluate how energy fluxes from different surfaces in a mixed-use landscape impact radiative forcing budgets to improve the Community Land Model for climate change.
• Monitor the flux of N from agricultural, suburban and forested lands, and atmospheric N deposition as these impact the nutrient status of the Great Bay Estuary.
• Refine economic models of on-farm production of animal bedding, static-pile aerobic composting with heat extraction, and uses of the finished compost as soil amendments.
• Analyze existing institutional framework for flood risk management in NH along with trends in flood risk management and stakeholders awareness and interest in these.
• Examine whether Integrated Multitrophic Aquaculture changes the species diversity of native seaweeds in the Great Bay Estuary.
• Quantify nutrient pulses in agricultural and forest soils from the decomposition of small vertebrates facilitated by burying beetles.
• Evaluate whether and how wind turbine vibration may impact communication burying beetles, which initiate decomposition of vertebrate carcasses and thus are important to the health of soil ecosystem.
UNHCE will carry out the following:

• Development of educational Information: newsletters (including e-newsletters), fact sheets, trade magazines, journals, posters, and displays.
• Efforts to promote local seafood awareness, marketing and consumption.
• On-line/web-based information: web page updates; blogs, social media (Facebook and Twitter); electronic pest alerts; developing educational visuals/videos; podcasts.
• One-on-one education: Site visits to landowners, fishermen and natural resource professionals; phone, email, video chats and walk-in clients; one-on-one assistance to develop management or business plans.

- Public Relations/marketing/communications.
- Technical Assistance to state agencies/organizations.
- Workshops, conferences, statewide Speaker's Bureau State-wide and multistate (regional) public forums, demonstrations Invited presentations.
- Write and respond to news media.

2. Brief description of the target audience

Audiences for **NHAES researchers** include agricultural producers, natural resource managers and consumers, land managers, scientists, wind energy developers, undergraduate and K-12 students, public policy makers, regional planners, local communities, and decision-makers concerned with the magnitude of different pollution sources that impact local water quality. Additional target audiences include stakeholders, town, county and state agencies dealing with flood risk management.

Additional target audiences for **UNHCE** include nonindustrial private forest owners (NIPF), municipal and other forest landowners, natural resource professionals, communities, volunteers, NH forest-based industries, and the public, landowners and recreational users of New Hampshire's lakes, estuaries, rivers, and ocean beaches.

3. How was eXtension used?

Shane Bradt is the leader of our eXtension Map@Syst Community of Practice. He coordinated all social media and webinar activities for the group.
As the PI of an eXtension Innovation grant (https://www.extension.org/spatial-reasoning-in-communication-and-decision-making/), he was responsible for group coordination, financial and contractual issues, and outreach related to the increased use of mapping in Cooperative Extension nationally. Brandt also applied for and was awarded a second eXtension Innovation grant to support further outreach related to the National Extension Web-mapping Tool (https://www.extension.org/national-extension-web-mapping-tool/).
Brandt served as a concept map facilitator and a key informant on Story Maps at three Designathon events:
- Dec 7 to Dec 9, 2067 - eXtension Community Issue Designathon, Detroit, MI
- Feb 13 to 15, 2017 - eXtension Designathon: Diversity and Inclusion, Hebron, KY
- May 31 to Jun 1, 2017 - North Central Region Water Network Designathon, Madison, WI
Shane Bradt was one of eight Cooperative Extension professionals in concept framework development for eXtension Impact Collaborative, which focused on best practices for Designathons. The final framework can be viewed at http://bit.ly/ImpactFramework2017
Shane Bradt presented two webinars in conjunction with eXtension Impact Collaborative
- May 2, 2017 - Using Story Maps to engage your audience - https://learn.extension.org/events/3079
- May 23, 2017 - The Power of Online Maps for Outreach - https://learn.extension.org/events/3080

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	28531	130698	9388	52

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	67	77	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of undergraduate students directly involved in the projects.

Year	Actual
2017	54

Output #2

Output Measure

- Number of graduate students directly involved in the projects.

Year	Actual
2017	18

Output #3

Output Measure

- Number of university courses in which the project results have been incorporated.

Year	Actual
2017	20

Output #4

Output Measure

- Number of presentations at regional, national, or international scientific meetings

Year	Actual

2017	77

Output #5

Output Measure

- Number of workshops, training sessions and presentations to non-scientific stakeholders

Year	Actual
2017	395

Output #6

Output Measure

- Number of websites in which research project results have been incorporated.

Year	Actual
2017	8

Output #7

Output Measure

- Number of one-on-one consultations (woodlot exams, phone calls, emails, office visits, cost share programs, forester referrals, etc.)

Year	Actual
2017	1764

Output #8

Output Measure

- Number of volunteers trained and supported: Coverts, Natural Resource Stewards, Stewardship Network, Lakes Lay Monitoring and Coastal Research volunteers/citizen scientists

Year	Actual
2017	2674

Output #9

Output Measure

- Number of annual lake reports and coastal reports published on water quality assessments from volunteer monitoring/citizen science efforts

Year	Actual
2017	46

Output #10

Output Measure

- Number of towns and conservation groups provided with direct assistance regarding land and water conservation

Year	Actual
2017	76

Output #11

Output Measure

- People reached through media: press releases, newsletters, radio, TV, web, direct mailing

Year	Actual
2017	1334195

Output #12

Output Measure

- Number of postdocs trained in cutting edge research.

Year	Actual
2017	7

Output #13

Output Measure

- Number of Master of Science and Ph.D degrees completed

Year	Actual
2017	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of acres of forest management plans meet or exceed NH forest stewardship standards
2	Number of volunteers in conservation work in NH communities as a result of training and continued work by UNHCE primarily in the Coverts, Stewardship Network and Natural Resource Stewards programs
3	Number of volunteers that provided conservation work in NH communities as a result of training and continued work by UNHCE primarily in the Coverts, Stewardship Network and Natural Resource Stewards, Lakes Lay Monitoring and Coastal Research volunteer programs
4	Number of communities making progress in community-based natural resource protection and climate resiliency programs and projects
5	Design and validate new methods for analyzing plant and microbial contributions to soil organic matter (SOM).
6	Further understanding of how global change factors impact microbial efficiency, a key determinate of soil C storage and greenhouse gas emissions.
7	Increase understanding of landscape configuration in determining the effectiveness of natural ecosystem services to attenuate N loading from agricultural versus suburban landscapes
8	Refine an integrated system for providing animal bedding using on-farm forest resources; evaluate an experimental static pile aerobic composting system for energy extraction from animal bedding and manure. Estimate costs and payback timeline for the various components of the composting system.
9	Number of Extension participants who engage with a licensed forester and/or a certified logger.
10	Number of people who report using a forest stewardship best management practice.
11	Validate the Community Land Model (CLM) for CO2 and water flux, radiation, and albedo, across agricultural, forested and suburban landscapes comparing eddy flux data to remote sensing data and modeling.
12	Understand of the mechanisms that that Frankia-actinorhizal plant symbioses aids the plants to overcome harsh environmental conditions, and clarify the role of natural products in the life style of Frankia in the soil environment and as a plant symbiont.
13	Investigate how mineral associated organic matter (MAOM) in the soil provisions nitrogen to the roots of plants.
14	Integrate Microbial-Mineral Carbon stabilization model to improve predication of soil N cycling under climate change.
15	Determine whether wind turbine vibrations disrupt reproductive behavior of soil-dwelling invertebrates such as burying beetles.
16	Improve understanding of land-use and management on climate

17	Evaluate how oyster farming and integrated multitrophic aquaculture impact seaweed communities in the New Hampshire's Great Bay Estuary.

Outcome #1

1. Outcome Measures

Number of acres of forest management plans meet or exceed NH forest stewardship standards

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	19352

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The health of New Hampshire's wildlife habitat and forestlands depends on sound land use, strong conservation organizations and citizens engaged in natural resource management and conservation.

Approximately 83,700 private landowners control 80% of New Hampshire's forestland and wildlife habitat. The collective decisions of these landowners have a tremendous impact on New Hampshire's landscape and natural resources. Education about forests, wildlife habitat, and land stewardship is key to helping landowners and natural resource professionals make informed decisions influencing the health and productivity of their land. The majority of private landowners do not have management plans to guide their activities on their property, so there is great opportunity for outreach and research efforts to inform sound stewardship of wildlife habitats in New Hampshire.

New Hampshire has the fastest-growing population in the Northeast, and the loss of habitat from human development is one of the biggest threats to wildlife species and their habitats. In addition, issues such as climate change, invasive species, and declining rates of community and citizen engagement are also affecting the state's natural resources. These challenges require an interdisciplinary approach at multiple scales to improve the ecological health of New Hampshire, reflecting a need to build the capacity of landowners, community leaders, professionals, and volunteers to protect and manage natural resources.

What has been done
In addition to educating private landowners about their own property, actively engaging citizens on public and conservation land through volunteer workdays, citizen science projects, or field

walks, for example, can provide an important link between conservation groups and the communities they serve. This helps to create a sense of community that can foster support for future stewardship and conservation efforts in New Hampshire.

Results
In 2017, Coverts Cooperators:
a. Contributed 21,915 volunteer hours (valued at over $545,000) on behalf of forest stewardship or wildlife habitat issues in their communities;
b. Worked to conserve over 4,794 acres of land in their communities;
c. Reached out to over 12,300 people with a message of sound forest stewardship and wildlife conservation;
d. Managed 9,240 acres for wildlife habitat, including timber stand improvement, hardwood management, wetland enhancement, grassland and old field management, and the creation of early successional habitat.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Number of volunteers in conservation work in NH communities as a result of training and continued work by UNHCE primarily in the Coverts, Stewardship Network and Natural Resource Stewards programs

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2674

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Monitoring stewardship and educating people on the condition and practices for standing our important Natural Resources is a challenging task and Extension Natural Resource volunteers increase our capacity to deliver impacts across the state.

What has been done
Lakes Lay monitoring, Natural resource steward, coverts, coastal research, volunteers and specialists for wildlife volunteers are trained by Extension to build natural resources stewardship capacity of New Hampshire communities.

Results
2674 volunteers in conservation work in NH communities as a result of training and continued work by UNHCE primarily in the Coverts, Stewardship Network and Natural Resource Stewards programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
124	Urban Forestry
131	Alternative Uses of Land

Outcome #3

1. Outcome Measures

Number of volunteers that provided conservation work in NH communities as a result of training and continued work by UNHCE primarily in the Coverts, Stewardship Network and Natural Resource Stewards, Lakes Lay Monitoring and Coastal Research volunteer programs

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of communities making progress in community-based natural resource protection and climate resiliency programs and projects

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
131	Alternative Uses of Land
605	Natural Resource and Environmental Economics

Outcome #5

1. Outcome Measures

Design and validate new methods for analyzing plant and microbial contributions to soil organic matter (SOM).

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Further understanding of how global change factors impact microbial efficiency, a key determinate of soil C storage and greenhouse gas emissions.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

"Agricultural productivity is dependent on nutrient cycling processes which are mediated by soil microorganisms. Microbial activity, in turn, is controlled to a large degree by temperature,

moisture, substrate quality, and nutrient availability. Human-induced environmental change (e.g., climate warming, land-use change) may alter the microbial community and the nutrient cycling processes it mediates. Research is needed to increase the accuracy of measures of microbial nutrient cycling and then use these to improve models for ecosystem carbon dynamics. "

What has been done
1. The Frey lab conducted experiments "to compare methods for assessing microbial carbon use efficiency. Five methods were compared: 13C and 18O isotope tracing approaches which directly estimate microbial growth and carbon use efficiency; calorespirometry which infers growth and carbon use efficiency from heat flux and respiration; metabolic flux analysis which determines carbon use efficiency from the balance between biosynthesis and respiration using position-specific carbon dioxide production of added substrates; and stoichiometric modeling which derives carbon use efficiency from elemental ratios of biomass and substrate."

Results
The carbon use efficiency estimates obtained were method-dependent, ranging from ~0.35 (substrate-independent methods of 18O and stoichiometric modeling) to ~0.70 (13C method, metabolic flux analysis). Each method addresses different aspects of microbial metabolism, growth and death, and carbon use efficiency. This makes the parallel use of multiple methods attractive for a more holistic perspective on microbial functioning than any single method can provide alone.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #7

1. Outcome Measures

Increase understanding of landscape configuration in determining the effectiveness of natural ecosystem services to attenuate N loading from agricultural versus suburban landscapes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

"The health of New Hampshire's Great Bay estuary is declining due to increasing land use change and human activity in the watersheds. One of the factors contributing to the decline of Great Bay is increasing nitrogen inputs from non-point pollution sources. These sources include residential, urban and agricultural areas. At the same time, streams and rivers can clean some of these pollution sources through natural ecosystem processes." Improved measurements of the sources and fate of pollution inputs that control the health of Great Bay are needed.

What has been done
The Wollheim research group "deployed a new generation of high technology sensors that could be placed directly into streams and rivers to measure nitrate concentrations continuously across all flow conditions." These and other tools were used to collect data on N flux levels streams and rivers that are part of the Great Bay Estuary.

Results
1. Wollheim's research group data analysis showed "the best way to improve estimates of annual nutrient loads in headwater catchments is not through the deployment of high-frequency in-situ sensors but through improved estimates of headwater discharge. However, high-frequency sensors are still invaluable for understanding differences in storm patterns and storm-scale fluxes among different catchment types.
2.In urban and agricultural headwater streams, nitrate concentrations are always elevated compared to forests. cross a broader range of headwater streams, agricultural streams show considerably more scatter, suggesting that specific agricultural practices or spatial location of agricultural activity can result in better water quality."
"E. coli concentration was highest in the most land use impacted stream, College Brook. E. coli flux is highly correlated with storm runoff. The loading function with land use, precipitation, and air temperature explain much of the variability in terrestrial E. coli loading."
3."Reservoirs that are relatively wide given the amount of flow coming into them are extremely effective at removing nitrate before being exported to the estuary. Thus, dam removal should consider this loss of "ecosystem services" if reservoir reaches are restored to flowing channels. Overall, larger watersheds with a greater abundance of lakes, reservoirs or beaver ponds and under lower flows have a greater capacity to regulate material fluxes to coastal areas than smaller watersheds with fewer lakes/reservoirs/ponds and under higher flows."

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

Outcome #8

1. Outcome Measures

Refine an integrated system for providing animal bedding using on-farm forest resources; evaluate an experimental static pile aerobic composting system for energy extraction from animal bedding and manure. Estimate costs and payback timeline for the various components of the composting system.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Among the highest costs to organic dairies in New England are the cost grain, bedding, and energy. Environmental footprints are also of concern to these producers. An aerobic composting and heat capture system was built at the Organic Dairy Research Farm (ORDF), with additional help from the USDA's SARE program. This facility and the farm woodlot and a wood shaver were used "develop and test ways to reduce both energy and bedding costs, while also reducing nutrient loading and water requirements for the operation of the ODRF."

What has been done
1.The Aber research group "completed a series of experiments related to the short- and long-term generation of heat energy through the aerated static pile composting process and expressed these results in terms useful to practitioners at the farm and commercial scales."
3. "An analysis of the economics of using low-quality softwood stems as bedding material using a commercial wood shaving machine was completed."

Results
1. It was determined "that the two primary factors controlling total heat capture were the temperature in the composting material and the temperature in the heat sink used to retain that heat. Model projections of changes in the mechanical and physical characteristics of the processing plant demonstrated that the ODRF system is optimally constructed such that changes in air handling rate or configuration of the piping system had little effect. This emphasizes that it is important to link this system to one that draws heat from the heat sink continuously. Another major finding was that optimizing this system for total heat capture suggests longer retention time in the composting facility than is generally used by processors who choose to maximize throughput of material."
2. "A business built around processing" locally harvested softwoods to produce animal bedding "could be financially viable in a region in which bedding costs were high. However, the operation of a small wood-shaving machine on an individual farm was not a viable option for operations of a size typical for New England."

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies

403	Waste Disposal, Recycling, and Reuse
605	Natural Resource and Environmental Economics

Outcome #9

1. Outcome Measures

Number of Extension participants who engage with a licensed forester and/or a certified logger.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	223

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
131	Alternative Uses of Land

Outcome #10

1. Outcome Measures

Number of people who report using a forest stewardship best management practice.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	692

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
216	Integrated Pest Management Systems
605	Natural Resource and Environmental Economics

Outcome #11

1. Outcome Measures

Validate the Community Land Model (CLM) for CO2 and water flux, radiation, and albedo, across agricultural, forested and suburban landscapes comparing eddy flux data to remote sensing data and modeling.

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Understand of the mechanisms that that Frankia-actinorhizal plant symbioses aids the plants to overcome harsh environmental conditions, and clarify the role of natural products in the life style of Frankia in the soil environment and as a plant symbiont.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"Nitrogen fixation by actinorhizal plants is an important part of the nitrogen budget of the planet."..."Actinorhizal plants also provide an excellent mechanism to restore disrupted environmental sites, including saline soils. The mechanisms by which the symbiotic bacteria (Frankia sp.) and their host plants withstand harsh environments are poorly understood.

What has been done
1.The Tisa lab (NIFA Accession # 1006507) "combined genomic, transcriptomic and proteomic approaches to understand the molecular mechanisms of salt tolerance in Frankia strains isolated from Casuarina trees."
2. The Tisa research group have developed an efficient and stable plasmid transfer protocol in Frankia "using the pHTK1 plasmid and have successfully introduced derivatives of the cloning vector pBBR1MCS carrying different antibiotic resistance into several Frankia strains."

Results
1." Several unique genes were identified being upregulated under elevated salt conditions. Many of these genes code for proteins of unknown function, termed hypothetical proteins."
2. "The salt-tolerance candidate gene from the high salt-tolerance strain CcI6 identified in (1) was cloned in pBBR1MCS-3 (tetracycline resistance) and introduced to the salt-sensitive Frankia strain CcI3. The presence of the plasmid was confirmed by molecular approaches and the resulting transconjugant showed increased salt tolerance. This represents the first successfully expression of a cloned gene in Frankia." This approach for the first time allows for functional analysis of hypothetical proteins encoded in the Frankia genome.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology

Outcome #13

1. Outcome Measures

Investigate how mineral associated organic matter (MAOM) in the soil provisions nitrogen to the roots of plants.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"Added nitrogen (N) drives modern intensive agricultural systems but is N inefficient, resulting in environmental N losses that degrade water quality and increase atmospheric nitrous oxide (N2O)". Common practices largely ignore the provisioning of N by internal, microbial-driven processes. Despite this, agricultural plants typically get more than half of their N from internal sources and microbial processes rather than fertilizers." "New conceptual models and experiments are needed to explore the simple but challenging question: from where and how do plants get their nitrogen?"... "Is it possible manage soils to foster N transfer from this mineral associated organic matter?"

What has been done
1.The Grandy lab (NIFA Accession # 1007001" has "developed a robust series of conceptual models arguing that a previously 'hidden' pool of nitrogen mineral-associated organic matter (MAOM) is a major supplier of plant N."
2. Determined "how microbial community composition and activity interact with clay content and type to control priming effects to recycle N from clay to microbes to roots."

Results
1. "Mineral-associated organic matter (MAOM) is a rich soil reservoir for N and can hold up to 20x more N than particulate fractions. MAOM fractions also preferentially accumulate N compounds such as proteins, amino acids, and nucleic acids. While some MAOM is protected from degradation, other MAOM can be mobilized by plants, microbes, and their interactions, leading to substantial amounts of MAOM-derived N in the soil solution."
2. Laboratory experiments and model of experimental data showed "The C and N use efficiency (CUE, NUE) of the microbial community coupled with its cellular stoichiometry will determine nutrient demand. As microbial CUE increases, N demand and NUE also increase to maintain cellular C/N ratios. With increasing N demand as microbial CUE and NUE increase, the microbial

N-mining response to root exudation should also increase. That is, as root exudates provide a labile C source and microbial C needs are satisfied, microbes will invest more in enzymes to acquire N from MAOM. In contrast, microbes that use C inefficiently will require less N and will show a depressed N mining response to root exudation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #14

1. Outcome Measures

Integrate Microbial-Mineral Carbon stabilization model to improve predication of soil N cycling under climate change.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Mineral-associated organic matter (MAOM) in soil, which is a large component of the soil nitrogen, "has been assumed to be unavailable to plants due to physicochemical forces on mineral surfaces. Recent experiments show that some microbial communities control N mineralization and thus N availability to plants." This new information needs to be incorporated into soil climate models.

What has been done
The Grandy Lab (NIFA Accession number 1007001 has used their newly developed "MIcrobial-MIneral Carbon Stabilization model (MIMICS) with coupled N cycles and data synthesis to examine how climate-change driven alterations in precipitation patterns are likely to affect N cycling and losses in agricultural landscapes and to highlight promising interventions to minimize environmental N losses while maintaining or increasing productivity."

Results
The MIMICS "model was applied to climate projections for the Midwest United States and then used to highlight key water-N linkages and the vulnerability of N to environmental loss. Modeling showed that conventional, fertilizer-use- efficiency-based approaches are insufficient to mitigate N

losses now, and will likely be even less effective under climate change scenarios."

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #15

1. Outcome Measures

Determine whether wind turbine vibrations disrupt reproductive behavior of soil-dwelling invertebrates such as burying beetles.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"Wind energy is increasingly promoted and viewed as a sustainable complement to traditional land uses such as agriculture and grazing, although we lack a clear understanding of the ecological effects of wind turbine vibration on soil-living organisms. Understanding how seismic vibration influences soil-dwelling invertebrates will allow us to predict how seismic disturbance is likely to affect biological communities important to soil health, and also provide basic scientific insights into the mechanisms of sensory pollution from a soils health context.".." This knowledge is critically important in agricultural decision-making, especially as soil resources come under increasingly intense and diverse productivity demands."

What has been done
Burying beetles contribute directly related to soil nutrient cycling. The Howard lab (NIFA Accession # 1010114) has completed "three sets of replicate experiments testing vibrational noise effects (with intensities from low (5 mm/s) to high (~40 mm/s)) on burying beetle reproductive behavior.

Results
"Thus far these results indicate that these beneficial soil arthropods are resilient to noisy soil conditions, exhibiting little response to the noise in terms of basic parental care and reproductive behavior. These data support the model that beneficial soil invertebrates have high behavioral

tolerances to soil seismic disturbance. "

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

Outcome #16

1. Outcome Measures

Improve understanding of land-use and management on climate

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
"Forest, agricultural, and residential ecosystems play an important role in regulating climate by exchange of carbon dioxide and other greenhouse gases), exchange of heat through evapotranspiration of water), and "reflectivity" of incoming sunlight that is absorbed as heat or reflected back towards space."..." Understanding the climate impact of different land-use and land management activities requires knowledge of all three of these processes across a variety of land cover types."

What has been done
The Ollinger research group (NIFA Accession # 1006997) has made continuous measurements of CO2 and water fluxes, solar radiation, albedo, and heat fluxes at four flux tower sites: forest (Thompson Farm, Durham), field/pasture (Kingman Farm, Madbury) corn/agriculture (Moore Fields, Durham), and residential/paved (West Edge Parking Lot, Durham). "The initial hypothesis was that the higher albedo (reflection) of agricultural systems relative to forests would facilitate local cooling, but that this would be partially or wholly offset by differences in evapotranspiration between trees, grasses, and crops."

Results
Although this hypothesis was partially validated, "the Ollinger group found that differences in

surface roughness--caused by the height and physical structure of vegetation--had an equal or greater role on local temperatures. In open land, the surface temperature is typically cooler (-4.8°C to -0.05°C) than the forest at night and warmer (+0.16°C to +8.2°C) during the day, a difference that is consistent throughout the year."..."This finding has interesting implications for the potential to manage local temperatures by varying the planting densities." This and related findings are being integrated to improve the Point-based Community Land Model, which "formalizes and quantifies concepts of ecological climatology" (http://www.cesm.ucar.edu/models/clm/.)

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

Outcome #17

1. Outcome Measures

Evaluate how oyster farming and integrated multitrophic aquaculture impact seaweed communities in the New Hampshire's Great Bay Estuary.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
More than half of fish consumed by humans comes from fish-farming. However, fish-farming is a point source of excess nitrogen and phosphorous in estuarine and coastal waters. Integrated multi-trophic aquaculture (IMTA) is touted to mitigate this pollution, by using seaweeds, and filter feeders to absorb fish wastes. Research is needed to evaluate whether IMTA changes native seaweed biodiversity and biomass, and how eutrophication associated with aquaculture changes "impacts the occurrence and abundance of opportunistic/nuisance/introduced seaweeds."

What has been done
1. Mathieson and Dawes 2017 published a new seaweed flora for the North Atlantic.
2. Mathieson and Dawes (in press) summarized long-term (decadal) collections made between 1965-2017.
3. Glenn, Mathieson, Grizzle, and Burdick (in review) described the "native and introduced seaweed communities in four habitats in the Great Bay Estuary, New Hampshire:- i.e. oyster farm

gear, oyster reef, eelgrass bed, and mudflat."

Results

1. "Seaweeds of the NW Atlantic" provides an extensive and important baseline "regarding the floristic diversity of native and introduced seaweeds within the Northwest and documents the 32 introduced seaweeds presently known for this region."
2."Sixteen introduced and 177 native (seaweed) taxa were recorded, with peak numbers occurring within Little Bay, NH, a mid-estuarine area having the greatest numbers of oyster aquaculture sites (~ 20 locations)."
3. "Mean seaweed species richness was significantly and substantially lower on mudflats than the other three habitats, particularly those
associated with oyster farm gear."
4. "Four Asiatic seaweeds have recently been found growing abundantly near oyster aquaculture sites within (the NH) Great Bay Estuary System (i.e. within Little Bay proper), while they are less abundant at non-aquaculture sites. The four taxa include the brown alga Colpomenia peregrina plus three red algae, Dasysiphonia japonica, Gracilaria vermiculophylla, and Grateloupia turuturu). The North Pacific rhodophyte Agardhiella subulata is also a conspicuous introduced species within these same habitats. Initial biomass documentations confirm that D.japonica and G. vermiculophylla are the two dominant introduced taxa within the Great Bay Estuary System, while A. subulata, Gelidium crinale, and G. turuturu are the three most recent introductions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

UNHCE: There was no reported external impact
NHAES: Research was not impacted by external factors during the previous federal fiscal year.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE

We were able to Assess the impact of our Stewardship Network this year.
The Stewardship Training Guide Series has had 838 Downloads in 27 states and 6 countries across 4 continents (we added Europe this quarter w/ a download from Italy). Those numbers represent 289 organizations and 85 individuals (no affiliation given). In New Hampshire, the guides have been downloaded 406 times by 161 groups and 48 individuals.

Also notable in this quarter's downloads: We've had a lot of interest from Colorado where the guides have been downloaded 16 times. That's the most out of any non-New England state. Our biggest fans in New England are in Mass w/ 105 downloads, followed by Maine with 69 downloads.
The next step is to conduct periodic evaluations of how they are being used, which will help with future funding requests, improvements to the series, and more.

NHAES

Publication of peer-reviewed papers and success in obtaining external grants are typical measures of evaluating the quality of basic and applied research. The projects in this associated planned program have been exceptionally productive, with the combined publication of 77 peer-reviewed journal articles during FY 17.
The 10 projects associated with this Planned Program have leveraged Federal Hatch and State funds by competing for more than $1.2M in additional funding.

Key Items of Evaluation

NHAES: Multiple peer-reviewed papers were published in high profile journals including Science, Ecology Letters, BMC Genomics.
"MIcrobial-MIneral Carbon Stabilization model (MIMICS) with coupled N cycles and data synthesis to examine how climate-change driven alterations in precipitation patterns are likely to affect N cycling and losses in agricultural landscapes and to highlight promising interventions to minimize environmental N losses. Modeling showed that conventional, fertilizer-use- efficiency-based approaches are insufficient to mitigate N losses now, and will likely be even less effective under climate change scenarios."

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Supporting a Rural Economy

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	0%		10%	
205	Plant Management Systems	0%		23%	
403	Waste Disposal, Recycling, and Reuse	0%		13%	
601	Economics of Agricultural Production and Farm Management	0%		14%	
602	Business Management, Finance, and Taxation	10%		0%	
605	Natural Resource and Environmental Economics	10%		0%	
608	Community Resource Planning and Development	0%		7%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	30%		33%	
805	Community Institutions and Social Services	50%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	11.0	0.0	1.0	0.0
Actual Paid	11.0	0.0	1.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
140059	0	105034	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
140059	0	27667	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
866408	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

UNHCE

- Implemented Community Needs Assessment
- Facilitated training in Strengthening Skills & theater Laboratory
- Provided Leadership Coaching, engagement training and outreach in terms of workshops and seminaries
- Conducted Local engagement Community Profiles, Visioning, Coalitions, HEAL
- One-on-one business consultations and technical assistance
- Economic development technical assistance.

NHAES scientists will:

- Collaborate with Extension to identify key issues in local agriculture by using focus groups and surveys.
- Carry out greenhouse growth trials on ornamental crops to incorporate more sustainable substrates for production (coconut coir, wood fiber.)
- Document recent demographic trends in both rural and urban areas before, during and after the Great Recession and compare New Hampshire demographic trends to those in the region and nation. Disseminate this knowledge to local, regional, and national policymakers.
- Use general populations surveys to determine consumer willingness to pay, for local and/or organic foods.
- Carry out focus groups of farmers from Northern New England Tristate area, to determine current constraints for farming.
- Evaluate attitudes towards new policies to reduce municipal expenditures.

2. Brief description of the target audience

NHAES research and **UNHCE** target audiences include:

Scientists, undergraduate and graduate students, citizens, land use professionals, homeowners, landscapers, farmers, legislators, contractors, firms and rural residents, demographers, social and natural scientists as well as policy-makers and the media.

Community leaders, municipal board/committees, community volunteers, professional community development practitioners, active community members, municipalities, regional economic development corporations, regional planning commissions, and chambers of commerce.

Farmers, fishermen, food processors, forest products businesses, tourism businesses, industry sectors, potential entrepreneurs, business service providers, and greenhouse and landscape professionals.

3. How was eXtension used?

Our staff use eXtension as one of their primary sources for information. They also promote eXtension by refering clients to the website.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1620	51	30	6

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	6	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of one-on-one consultations with greenhouse growers and landscape professionals

Year	Actual
2017	151

Output #2

Output Measure

- Number of communities provided with technical assistance to enhance their decision making with regard to tourism and economic development plans, projects and activities

Year	Actual
2017	34

Output #3

Output Measure

- Number of people reached through risk management and farm management workshops

Year	Actual
2017	1458

Output #4

Output Measure

- Number of people reached through site/farm visits related to farm and forest management
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of Community Profiles (community-level strategic planning program, facilitated by UNHCE professionals)

Year	Actual
2017	17

Output #6

Output Measure

- Number of presentations at regional, national, or international scientific meetings

Year	Actual
2017	14

Output #7

Output Measure

- Number of workshops, training sessions and presentations to non-scientific stakeholders

Year	Actual
2017	29

Output #8

Output Measure

- Number of reviewed, bulletin, popular, news and other publications

Year	Actual
2017	100

Output #9

Output Measure

- Number of surveys or other means of gathering information and data from participants

Year	Actual
2017	10

Output #10

Output Measure

- Number of graduate students directly involved in research project.

Year	Actual
2017	5

Output #11

Output Measure

- Number of websites in which research project results have been incorporated
  Not reporting on this Output for this Annual Report

Output #12

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Actual
2017	32

Output #13

Output Measure

- Number of people participating in Extension's Economic Development Academy

Year	Actual
2017	27

Output #14

Output Measure

- Number of people attending workshops/twilight meetings
  Not reporting on this Output for this Annual Report

Output #15

Output Measure

- Number of community and economic development leaders and practitioners reporting increased skills or knowledge about tools and strategies for growing and sustaining local businesses and the economy.
  Not reporting on this Output for this Annual Report

Output #16

Output Measure

- Number of recommended practices implemented by communities aimed at retaining and/or expanding existing businesses.
  Not reporting on this Output for this Annual Report

Output #17

Output Measure

- Number of businesses (or industry sectors) that implement effective tools and strategies to grow or sustain their enterprises or industry sector.
  Not reporting on this Output for this Annual Report

Output #18

Output Measure

- Number of businesses that report that they were able to sustain or grow their enterprise partly as a result of the Business Retention and Expansion Program.
  Not reporting on this Output for this Annual Report

Output #19

Output Measure

- Number of presentations to civic and government entities to increase knowledge of demographics and migration in the region and nation.

Year	Actual
2017	6

Output #20

Output Measure

- Number of Master of Science and Ph.D. theses completed

Year	Actual
2017	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of community members who report new skills (e.g. leadership, group process, identifying resources, managing change, etc.)
2	Number of community leaders who develop a new understanding of the issues facing their community.
3	Number of NH growers who make informed decisions on production practices that result in business sustainability
4	Number of new businesses retained, started or expanded
5	Number of presentations to civic and government entities to increase knowledge of demographics and migration in the region and nation.
6	Disseminate results from greenhouse growth trials on ornamental and alternative crops
7	Number of NH farms that develop and implement a business plan
8	Disseminate results from 1) evaluations of attitudes towards new policies to reduce municipal expenditures and 2) testing the effects that social capital infrastructure has on different measures of environmental quality.
9	Results for regional industry focus groups will be collated and disseminated regarding growers concerns, issues regarding what is the best fresh produce grown for direct marketing (direct to consumer, such as farm stand, farmers market, CSA), what considerations go into deciding what production practices and methods to use, what information about consumers' fresh produce purchasing habits would be most useful, and obstacles to expanding operations. These analyzes will inform growers and allow producers to better tailor practices to improve economic outcomes.
10	Dollar value of volunteer hours committed by program participants to plan and implement community projects/activities.
11	Number of actions, policies, and/or plans adopted or implemented by communities or community groups
12	Number of community members who take on a new or expanded leadership role(s) in their community
13	Document demographic trends during and after the Great Recession as these have impacted rural(non-metropolitan) America. This includes the majority of the state of NH.
14	Evaluate whether supporting local agriculture may drive economic development in urban-fringe/rural areas.
15	Evaluate constraints on labor and markets for local production for Northern New England Farmers

Outcome #1

1. Outcome Measures

Number of community members who report new skills (e.g. leadership, group process, identifying resources, managing change, etc.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	226

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Economic development has become a key theme throughout New Hampshire. Of those communities who completed Master Plans within the last 10 years across the state, all identified economic development as a priority. As New Hampshire works to regain some of the economic prosperity that it enjoyed before the great recession, many communities, like the ones in Grafton County, struggle to figure out where and how to start their economic development efforts. UNH Cooperative Extension created a program call the Business Retention and Expansion (BR&E)program to assist communities to better understanding their existing economies, connect the community with the needs of its existing business sector and to jump start their economic development efforts.

What has been done
The community development team implemented workshops and trainings that address the following areas: Facilitation Skills, Collaboration Skills, Community Steering Committee Skills, First Impressions Committee Skills, Outreach and Engagement Skills and data collection skills.

Results
Among the participants of the 29 workshops and trainings that engaged 491 community members, 226 of those who responded to our survey reported they have gained new skills.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and

Communities

Outcome #2

1. Outcome Measures

Number of community leaders who develop a new understanding of the issues facing their community.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	60

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development

Outcome #3

1. Outcome Measures

Number of NH growers who make informed decisions on production practices that result in business sustainability

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	755

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Number of new businesses retained, started or expanded

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development

Outcome #5

1. Outcome Measures

Number of presentations to civic and government entities to increase knowledge of demographics and migration in the region and nation.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Multistate project W3001 evaluated how "recent demographic processes were impacted in U.S. rural areas, at several levels of geography, in the years before, during, and after the Great Recession in order to better understand linkages between job loss and demographic change in rural contexts;" and 2) "examining dynamics in rural housing markets in light of shifting rural population composition and new economic realities.In particular, researchers looked at how increased socioeconomic diversity in rural areas (age, race, household structure, class) alters the demand for different forms of rural housing, how poverty concentration in some areas and wealth in others creates housing stress, and how communities were differentially impacted by the housing-led recession."

What has been done

During the first 4 years of this project various demographic conducted. "The major activities of the final year of this project were the production and dissemination of policy briefs, articles, monographs and web postings."

Results
Professor Ken Johnson summarized his dissemination activities in the past year 1) by serving on the Advisory Panel an attending numerous meetings of the New Hampshire Legislative Demographic Study Committee; 2) giving a presentation to the New Hampshire Legislative Demographic Study Committee; 3) speaking about rural and urban demographic trends in New Hampshire to N.H. State House-Senate Joint Fiscal Orientation Meeting in Concord, NH. It was attended by approximately 100 people including numerous members of the NH State House and Senate as well as policy staff and media; 4) giving an invited lecture on rural demographic trends in turbulent economic times at the Pennsylvania State University 5) giving an invited presentation on Demographic trends in Northern New England at the Vermont State Housing Conference; 6) presenting research results on Demographic Transformations in the Forested Regions of Nonmetropolitan America to USDA Forest Service staff. This presentation informed US Forest Service planners as they develop future plans for managing the largely rural national forests.

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions and Social Services

Outcome #6

1. Outcome Measures

Disseminate results from greenhouse growth trials on ornamental and alternative crops

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Greenhouse operators see potential economic and environmental benefits to using new alternative materials in the growing media to produce high-value crops. Understanding the potential of these materials to influence the rooting media properties and plant growth is critical to developing improved media formulations as well as updated fertilization, irrigation, and pH management strategies.

What has been done

1. Greenhouse trials were conducted to test the effects of wood chips and fiber on the media pH buffering capacity
2. Greenhouse trials were conducted to test the potential of wood chips and fiber media to immobilize nitrogen and examine effects on plant performance.
3. Dissemination of results

Results

1.Media with greater proportions of alternative material, such as wood fiber, and less sphagnum peat had lower less pH buffering. These results indicate that commercial growers using media with high proportions of alternative wood fiber materials (>30% by volume) may need to adjust the acidity or basicity of their fertilizer program to stabilize pH and prevent nutritional disorders.
2. Across media suppliers, media containing 30% wood fiber resulted in plants with the least amount of growth and flowering and the lowest nitrogen concentrations in the dry tissue. Nitrogen concentrations measured in the media solution were also lowest in wood fiber media. However, wood fiber media did not affect leaf chlorophyll content, and all plants had green foliage and considered marketable.
3. Target audiences for our research results and updated strategies on managing resources (nutrients, water, energy, and growing media) for greenhouse crop production included commercial greenhouse growers, allied industries in horticulture, university academics and students, and the public. We reached these audiences using different communication platforms, including online newsletters (e-GRO) and reports, publications in popular trade magazines (GrowerTalks, Greenhouse Management, Produce Grower) publication in peer-reviewed scientific journals, presentations at scientific meetings, grower workshops and training, and university open house events.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #7

1. Outcome Measures

Number of NH farms that develop and implement a business plan

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	79

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Only 30% of New Hampshire farmers report net income from their operations. This suggests that the majority of farms operate at a loss. While many of these net loss growers are hobby farmers, others are simply growers struggling to make sustain their operation. It is important that farm operations are working from a business plan that lays out their products, strategies, markets, marketing channels, etc.

What has been done
UNH Cooperative Extension instituted the annual Agriculture and Natural Resource Business Institute to provide agriculture and natural resource business owners/managers with the skills to manage their business. A key component of the intensive course is business planning.

Results
Each year, 15-30 people participate in the agriculture and Natural Resource Business Institute. Not all participants of this institute end up starting a business, those with existing businesses commit to implementing best practices learned through the institute in their operations. And a few new businesses have been developed by course participants. Skills gained from the institute include increased efficiency of operations, new products, change in their product, enhanced marketing, and greater profitability. This year, 79 of our participants have developed and implemented 79 business plan. This is about four times the recorded number (22) last year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation

Outcome #8

1. Outcome Measures

Disseminate results from 1) evaluations of attitudes towards new policies to reduce municipal expenditures and 2) testing the effects that social capital infrastructure has on different measures of environmental quality.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
805	Community Institutions and Social Services

Outcome #9

1. Outcome Measures

Results for regional industry focus groups will be collated and disseminated regarding growers concerns, issues regarding what is the best fresh produce grown for direct marketing (direct to consumer, such as farm stand, farmers market, CSA), what considerations go into deciding what production practices and methods to use, what information about consumers' fresh produce purchasing habits would be most useful, and obstacles to expanding operations. These analyzes will inform growers and allow producers to better tailor practices to improve economic outcomes.

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Dollar value of volunteer hours committed by program participants to plan and implement community projects/activities.

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Number of actions, policies, and/or plans adopted or implemented by communities or community groups

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #12

1. Outcome Measures

Number of community members who take on a new or expanded leadership role(s) in their community

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #13

1. Outcome Measures

Document demographic trends during and after the Great Recession as these have impacted rural(non-metropolitan) America. This includes the majority of the state of NH.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The overall effect of the Great Recession has been to produce overall population loss in rural (nonmetropolitan) America for the first time in U.S. history. These events impacted rural unemployment, housing and job markets, and drove other socioeconomic changes.

What has been done
Demographic and socioeconomic changes were documented.

Results
Major findings from Professor Ken Johnson's research relevant include:
1)The overall effect of the Great Recession has been to produce overall population loss in rural (nonmetropolitan) America for the first time in U.S. history.
2)The Great Recession reduced fertility rates in the U.S. by 8% and fertility rates have not recovered in the post-recessionary period. As a result, nearly 500,000 fewer babies are being born annually now compared to the number that would have been born had pre-recession fertility trends continued. This has serious implications for rural America which depends on natural increase (births-deaths) for much of its population increase. In many parts of rural America, there are now too few births to offset deaths in a rapidly aging population.
2)The Great Recession also had the effect of "freezing people in place". This reduced migration in rural areas. The demographic implications this had for specific rural areas differed.
3)In regions with histories of rapid population increase through migration (recreational, retirement and metro fringe counties), the rate of population increase slowed because the recession reduced migration.
4)In rural areas with histories of population loss or slow growth (Farm areas), the Recession slowed the rate of population loss because migration losses diminished.
5)Detailed analysis of age-specific net migration patterns in rural counties documents distinct migration signatures for different types of rural counties with the sharpest contrast between rural farm counties and rural recreational counties.
6)"Rural America is becoming more racially and ethnically diverse. Though the Great Recession slowed this process due to reduced migration and diminished fertility, the process is continuing. The growth of the Hispanic population has been particularly important to rural demographic change. Hispanics represented just 7.6% of the rural population in 2010, but they produced 63% of the entire rural population gain between 2000 and 2010."

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #14

1. Outcome Measures

Evaluate whether supporting local agriculture may drive economic development in urban-fringe/rural areas.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Since the Great Recession 2008-2009, there has been interest in urban/rural fringe areas in increasing "local" food production. "Local" food production has been touted by advocates as reducing economic leakages via import substitution, promoting environmental quality, and facilitating the accumulation of social capital. Research is needed to measure the economic development potential for rural areas and to provide results of such researchers to policymakers.

What has been done
NHAES researchers working jointly with the University of Vermont and the University of Maine conducted surveys about public attitudes towards local agriculture. These surveys were compiled and presented to regional farm stakeholders

Results
Survey respondents in Massachusetts and New Hampshire indicate the willingness to pay a substantial premium for locally grown produce over imported produce; respondents place a higher value on supporting local farmers than the quality or freshness of local produce.

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse

601	Economics of Agricultural Production and Farm Management
608	Community Resource Planning and Development

Outcome #15

1. Outcome Measures

Evaluate constraints on labor and markets for local production for Northern New England Farmers

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers in Northern New England must deal with a variety of challenges, beyond poor soil and short growing sessions. Policymakers and town managers need to factor these challenges to better support their farmers and in projecting potential growth of local agriculture.

What has been done
Participants in NE1049 completed a series of focus groups of Maine, Vermont, and New Hampshire farmers to identify key issues and constraints in the region. Results of the focus groups were also used to construct general consumer surveys.

Results
Based on focus group commentary, current constraints for farmers of northern New England are related to:
labor and laborers (26%)
consumers (16%)
managing the business aspect of the operation (14%)
capital (12%)

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse
601	Economics of Agricultural Production and Farm Management
608	Community Resource Planning and Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities

Brief Explanation

UNCE: No reported extenal impact for this program
NHAES: no impacts of external factors on this research

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE

• A post-event surveys of the volunteer programs yielded a strongly positive response. Volunteers were grateful to the programs and to be recognized, and 100% said they would consider attending this kind of programs again in the future.
• Almost all volunteers (94%) reported gaining knowledge or skills and making a contribution through their Extension volunteer work
• The dollar value of volunteer hours committed by program participants to plan and implement community projects/activities: 1867 volunteer hours x 24.14 = $45,069.38. The dollar value of volunteer hours committed by program participants to plan and implement community projects/activities: 1867 volunteer hours x 24.14 = $45,069.38
• UNH Cooperative Extension engaged over 2,300 stakeholders across the state to discuss ways that UNH is currently having an impact on the economy (successes) and where it could improve it's engagement efforts to have a stronger impact on the state and regional economy. The plan, which was co-developed with UNH Innovation and the Office of Research, was submitted to the Association of Public Land Grant Institutions and UNH was recently designated as an Innovation and Economic Prosperity Institution as a result.

NHAES

One measure to assess the quality of basic and applied research is whether resulting manuscripts survive peer-review resulting in publication in discipline-specific journals, and in books. The three research projects in this planned program combined to publish 6 papers in peer-reviewed journals, five book chapters, and four theses.
In addition, the high quality of work of demographer Ken Johnson has been recognized in his selection as one just 33 Andrew Carnegie Fellows; this is considered the most prestigious social science fellowship.

Key Items of Evaluation

UNHCE

The dollar value of volunteer hours committed by program participants to plan and implement community projects/activities: 1867 volunteer hours x 24.14 = $45,069.38

NHAES: see evalution

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Youth and Family

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
724	Healthy Lifestyle	25%		0%	
801	Individual and Family Resource Management	10%		0%	
802	Human Development and Family Well-Being	25%		0%	
805	Community Institutions, Health, and Social Services	10%		0%	
806	Youth Development	30%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	20.0	0.0	0.0	0.0
Actual Paid	39.0	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
340728	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
340728	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
3120506	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- 4-H Youth Development staff and volunteer training (both in person and on-line)
- 4-H Youth Development projects, clubs, events, and camp (including NH Teen Council & Conference, National Congress & Conference, Barry Conservation Camp, healthy living and science projects)
- 4-H Youth Development staff and volunteer training (both in person and on-line)
- Afterschool Staff trainings
- Marine Docent educational work with schools and groups
- Science Literacy statewide educator training
- Seacoast SeaPerch

2. Brief description of the target audience

Youth, ages 5-18, 4-H members and volunteers, limited resource families and children, after school program staff, health practitioners

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	14551	23739	5381	8779

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of volunteers developed

Year	Actual
2017	918

Output #2

Output Measure

- Number of youth who participated in 4-H as a 4-H club, after school or special interest group member

Year	Actual
2017	14160

Output #3

Output Measure

- Number of youth attending Barry Conservation Camp

Year	Actual
2017	271

Output #4

Output Measure

- Number of educators and volunteers trained in youth development topics (e.g., Social Emotional Learning, STEM Education, Healthy Living, 4-H Positive youth development, etc.)

Year	Actual
2017	2298

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Proportion of youth (4-H members or others) who report an increase in their universal life skills
2	Proportion of youth participants who report an increase in healthier food choices
3	Proportion of adults participants who report an increase in healthier food choices
4	Proportion of youth participants reporting or demonstrating increased engagement in STEM
5	Proportion of participants completing the Youth Mental Health First Aid course who report increased confidence in their ability to address youth mental health issues
6	Proportion of youth who report an increase in subject matter skills or practices in the animal science project areas

Outcome #1

1. Outcome Measures

Proportion of youth (4-H members or others) who report an increase in their universal life skills

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	8636

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As the world becomes more technologically advanced and scientifically complex, a science-literate citizenry and workforce is vital. The Congressional report, Rising Above the Gathering Storm, states that building a workforce literate in science, technology, engineering and mathematics (STEM) is crucial to maintaining America's competitiveness in a rapidly changing global economy. In fact, national and state statistics show an increased demand for a more science-literate workforce. One way to address this national need has been the development of new science and engineering K-12 education standards, the Next Generation Science Standards (NGSS). As New Hampshire STEM programs look to meet 21st century needs, both in-school and out-of-school programs are working to shift science curriculum to align with the new vision of NGSS. This new shift to the NGSS is a challenge for many STEM programs. There is a need for high-quality, K-12 STEM programs that are grounded in the NGSS framework and that support the development of a more science-literate citizenry in NH and beyond. The need to provide impactful STEM programs for school age youth is more important than ever.

What has been done
Work by Science Literacy UNHCE staff focuses on STEM programs for youth. These engaging programs address the need for STEM enrichment, supporting the NGSS expectations and providing deeper understanding of science content. The Science Literacy STEM programs target school age youth. These STEM programs are offered statewide either during school or during out-of-school time. They feature a range of topics, including coding, sustainability, marine science, ecology, robotics, engineering, and computer science.

Results
Increased number of educators providing K-12 science programs as a result of UNHCE Science Literacy training.

- Approximately 428 educators, including volunteers with a focus on STEM topics, received science education training through a variety of Science Literacy programming (e.g., SeaPerch, Mousetrap Powered Cars, Marine Docents, STEM Docents, Inquiry Teaching Methods, Unpacking NGSS, Ocean Exploration Trust Educator Trainings).
UNHCE's Science Literacy professional development programs trained 43% more teachers in 2017 (n=428) than in 2016 (n=300).
Approximately 42% of educators trained were volunteers (Docents or 4-H leaders).

Percent increase of UNHCE volunteer-taught (4-H, Docents) science projects
- UNHCE?s Science Literacy supported 40% more STEM volunteer educators (Docents and 4-H leaders) in 2017 (n=178) than in 2016 (n=106).

Increased science literacy of K-12 educators in STEM programming or content as a result of UNHCE Science Literacy training.

- Overall according to post workshop surveys the majority of participating K-12 STEM educators report an increase in their science literacy in discrete STEM programming or content as a result of UNHCE Science Literacy professional development workshops.
For instance:
Of 26 STEM Docents surveyed following each of the trainings 96% were very satisfied overall with the content and pedagogical training and expressed confidence delivering the programs to youth. Field observations of youth STEM Docent programs confirmed an increase in most Docents' understanding of the curriculum and instructional approach over the period of program delivery.
92% of the Inquiry Teaching Methods participants (n=23) reported a greater capacity in STEM instruction grounded in inquiry and the NGSS science practices following the 8-session professional development course. These educators produced and taught a revised science lesson with the goal to engage their students in the science practices.
Marine Docents (n=16) reported increased understanding in marine science content and the associated SeaTrek Program.
Adults trained in SeaPerch (n=37) demonstrated enhanced understanding of robotics and applied their skills to implementing SeaPerch program with their students and showcasing their students? work at the Seacoast SeaPerch Challenge.
In May, the Ocean Exploration in the Classroom educator workshop in Conway introduced educators (n=11) to the Nautilus Exploration Program, the Community STEM Program, and the many marine education resources available to engage K-12 and informal educators in ocean exploration. Educators reported they would very likely implement at least one STEM Learning Module during the school year.
As a result of the ?Unpacking Next Generation Science Standards for Effective Science Education and Assessment? workshops K-12 educators (n= 43) reported an improved understanding of the new national standards and how they are organized.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #2

1. Outcome Measures

Proportion of youth participants who report an increase in healthier food choices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1085

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Overweight and obesity have greatly increased during recent decades. Contributing factors include physical inactivity, excessive food consumption, and unhealthy food choices. Many health related conditions exist in the NH SNAP eligible population including obesity, overweight, diabetes, pre-diabetes, and heart disease. The SNAP eligible population in NH also has higher rates of sugar sweetened beverages, time spent in sedentary activities, inadequate consumption of fruits and vegetables and physical inactivity. Health related conditions could be improved by following the US Dietary Guideline recommendations that are the guiding principles for this work at the individual, community and policy level. Modifiable risks for heart disease such as obesity, physical inactivity, and inadequate fruit and vegetable consumption are achievable through direct education. In addition, increasing fruit and vegetable consumption through efforts at farmers markets, food pantries and schools; working with community agencies, child care centers and schools to improve nutrition and physical activity supports; and working with community agencies and coalitions to make it easier for SNAP eligibles to eat healthier and be more physically active can reduce health related conditions over the long term.

What has been done
UNH Cooperative Extension Nutrition Connections staff implement nutrition and physical activity education for limited income adults and youth. Activities target physical activity, nutrition, community involvement and obesity awareness and prevention. Youth receive education in group settings; families and adults in groups and at home. Sustained behavior change through interventions that can reach individuals through multiple avenues is more effective. Longer lasting change can be achieved through ?collective impact strategies.? With this in mind, we seek to leverage our relationships by finding common outcomes that we share with our partners, volunteers and coalition members. We then hope to facilitate the pursuit of these outcomes in order to more efficiently focus our collaborative efforts.

Our model places an emphasis on food and nutrition efforts that focus on the Dietary Guidelines and MyPlate, specifically, increasing fruits and vegetables and increasing physical activity. Our model also places an emphasis on opportunities to reach larger numbers of people through community and volunteer efforts.

Results
Youth participating in 4H Healthy Living projects improved knowledge and behaviors:

82.6% (95 of 115) of youth increased their choices of healthier foods
96.4% (107 of 111) of youth increased their knowledge of healthier food choices
56.6% (64 of 113) of youth increased how often they were active

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. Outcome Measures

Proportion of adults participants who report an increase in healthier food choices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1168

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Our model places an emphasis on food and nutrition efforts that focus on the Dietary Guidelines and MyPlate, specifically, increasing fruits and vegetables and increasing physical activity. Our model also places an emphasis on opportunities to reach larger numbers of people through community and volunteer efforts.

What has been done

Our model places an emphasis on food and nutrition efforts that focus on the Dietary Guidelines and MyPlate, specifically, increasing fruits and vegetables and increasing physical activity. Our model also places an emphasis on opportunities to reach larger numbers of people through community and volunteer efforts.

Results
Four hundred and sixty-one adults (461) completed a series of lessons. Of those completing a pre/post food recalls and/or pre/post survey questions related to nutrition and physical activity behaviors, significant impacts included:

37.3% (172 of 461) of adults reported an increase in how often they eat fruit
36.7% (169 of 461) of adults reported an increase in how often they eat vegetables
26% (90 of 343) of adults reported an increase in physical activity

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
805	Community Institutions, Health, and Social Services

Outcome #4

1. Outcome Measures

Proportion of youth participants reporting or demonstrating increased engagement in STEM

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2638

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As the world becomes more technologically advanced and scientifically complex, a science literate citizenry and work force is vital. The Congressional report, Rising Above the Gathering Storm, states that building a workforce literate in science, technology, engineering and mathematics (STEM) is crucial to maintaining America?s competitiveness in a rapidly changing global economy. In fact, national and state statistics show an increased demand for a more science literate workforce. One way to address this national need has been the development of

new science and engineering K-12 education standards, the Next Generation Science Standards (NGSS). As New Hampshire STEM programs look to meet 21st century needs, both in-school and out-of-school programs are working to shift science curriculum to align with the new vision of NGSS. This new shift to the NGSS is a challenge for many STEM programs. There is a need for high-quality, K-12 STEM programs that are grounded in the NGSS framework and that support the development of a more science literate citizenry in NH and beyond. The need to provide impactful STEM programs for school age youth is more important than ever.

What has been done
Science Literacy UNHCE staff and faculty design and deliver STEM programs for youth. These engaging programs address the need for STEM enrichment, supporting the NGSS expectations and providing deeper understanding of science content. The Science Literacy STEM programs target school age youth. These STEM programs are offered statewide either in school or during out-of-school time. They feature a range of topics, including coding, sustainability, marine science, ecology, robotics, engineering, and computer science.

Results
. Overall a total of 2,998 youth participated in UNH branded STEM education programs and events offered by Science Literacy UNHCE throughout the state, including life science (e.g., forestry & ecology), physical science (e.g., rocketry), engineering, and computer science.

. Eighty eight percent (n=2639)of youth participants reported increased engagement in STEM

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #5

1. Outcome Measures

Proportion of participants completing the Youth Mental Health First Aid course who report increased confidence in their ability to address youth mental health issues

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	124

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Studies estimate that one half of all life time mental illnesses begin by age 14 and three-quarters by age 24. Many young people involved in the juvenile justice system have a diagnosable mental health need. In NH, suicide is the second leading cause of death in ages 10-34. Many young people do not seek out or connect with treatment on their own. Early intervention may help prevent the development of disorders.

Youth Mental Health First Aid (YMHFA) is an 8 hour public education program which introduces participants to the unique risk factors and warning signs of mental health problems and substance abuse disorder, builds understanding of the importance of early intervention, and teaches individuals how to help an adolescent in crisis or experiencing a mental health challenge. The goal of the course is to increase mental health literacy and decrease stigma.

What has been done

Three UNH Cooperative Extension Youth and Family Field Specialists became certified YMHFA instructors in 2014 and have since been offering the training in communities across the state. During this past program year the instructor team has completed 6 trainings certifying 128 Youth Mental Health First Aiders. Trainings were hosted by Sullivan and Cheshire County 4-H (Walpole), Lempster Community School (Lempster), Colby Sawyer College Medical Reserve Corp Club (New London), Austin17House (Brentwood), Nashua Prevention Coalition (Nashua) and the Upper Room Resource Center (Derry). We work in partnership with NH Department of Education Office of Student Wellness and the American Foundation for Suicide Prevention ? NH Chapter to deliver the course at no-cost.

Results

One hundred twenty eight (128) participants representing schools, after-school programs, health care, churches, social service organizations, as well as parents and ordinary citizens who care about, are connected to or work with youth in our communities completed the YMHFA training. 93 participants completed the evaluation survey:

?97% stated that they were more confident that they could recognize the signs that a young person may be dealing with a mental illness
?98% stated that they were more confident that they could reach out to a young person experiencing a mental illness
?99% stated that they were more able to actively and compassionately listen to a young person in distress
?98% stated that they increased their ability to assist a young person who may be dealing with a mental health problem to seek professional help
?96% stated that they increased their ability to assist a young person who may be dealing with a mental health problem to connect to appropriate community, peer, and personal supports

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development

Outcome #6

1. Outcome Measures

Proportion of youth who report an increase in subject matter skills or practices in the animal science project areas

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	8636

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
(see first outcome)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The UNH CE Volunteer survey would be used amongst 4-H staff to determine how volunteers perceive their experience as well as the needs volunteers have to be successful in their roles. Below are the results of the 2017 Volunteer survey, highlighting both the successes and opportunities for growth.

- 24% of the UNH Cooperative Extension Survey respondents were 4-H volunteers
- 95% indicated that they would 'definitely' continue to be 4-H volunteers in the coming years, a 5% increase from the previous year
- Of the 5% that would not be re-enrolling, most of them indicated the reason for not participating was because of relocation of their home and change in availability

When asked what areas of support our volunteers would like to see improved upon over the next year, 3 major themes surfaced:

- Increasing parent involvement in programming opportunities
- Create an onboarding process that does not take as long to complete
- Opportunities to learn from other volunteers about projects and approaches to working with youth

Key Items of Evaluation

In 2017, the number of enrolled (screened volunteers) increased from 713 to 896 volunteers, representing an approximate 20% increase in 4-H volunteers.
The economic value of 4-H Volunteer support for the program statewide totals $3,428,821.46. The total is calculated on the estimated number of 4-H volunteer hours as 142,039, multiplied by the current economic value of hourly rate of volunteers as $24.14.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
4	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
1683	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
47	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
3	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.