2018 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 FY2018 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. UNHCE's primary responsibility is disseminating best practices, yet many staff participate in integrated research and outreach activities.
UNHCE provides a direct link between UNH and people throughout the state of New Hampshire. In partnership with local residents and volunteers, UNHCE plans and conducts educational programs responsive to the issues they have identified and prioritized. In 2018, UNHCE implemented a regional model for program delivery established five years ago during organizational restructuring. Area of Expertise (AoE) teams were formed with 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 and it encourages non-Extension faculty involvement in programming. This has been well-accepted by stakeholders and allows field specialists to expertise in a given field.
UNHCE specialists serve as an outreach arm for UNH, providing applied research and practical education in agriculture, natural resources, youth and family, and community and economic development. This programming benefits participants directly and results in many indirect benefits for the public. As a university outreach program, we have a network of professional educators (University of New Hampshire staff) located in all ten New Hampshire counties. Staff work with local volunteers, stakeholders and campus-based specialists and faculty to design and conduct educational programs that meet societal, environmental and economic needs.
Further, eXtension has become a source of information for our clientele. A prominent link to eXtension.org is on our website. Further, eXtension webinars are cross-posted on our staff development calendar. UNHCE became a member of the newly formed eXtension organization and hopes to continue to promote resources found there.
During the fiscal year 2018, UNHCE reached a significant portion of New Hampshire residents with information or assistance. UNHCE recruits, trains and supports 5,481 trained volunteers in ten counties, who spent over 206,317 hours with staff to implement 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 is valued at $5.27 million in 2018.
Highlights
UNHCE

Community and Economic Development (CED)
The Community and Economic Development program provided educational programs and planning assistance to communities to communities to help them cultivate civic leaders; foster participation in community decision making; revitalize downtowns; and grown the local and regional economy. During the fiscal year 2018, CED staff helped provided technical assistance and planning support to 31 New Hampshire towns to address economic development opportunities by engaging local government, businesses, agencies, and citizens.

Food and Agriculture
UNHCE's Food and Agriculture program provided research-based information and education to people working or interested in the agricultural industry through 389 workshops, seminars or conferences and 3719 direct consultations with businesses. The team assists farm owners and operators with business planning, financial management, marketing, risk management, pest diagnostics, integrated pest management (IPM), soil health, soil testing, nutrient management, crop selection, animal husbandry, animal production, and more topics. The annual economic impact of just one program, sweet corn IPM, was $253,000 in 2018.

Natural Resources
UNHCE's Natural Resources program provided science-based advice on land management and stewardship practices to landowner, communities and state agencies. The natural resources team trains and supports 3,161 volunteers who spent more than 47,600 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 $427,000 in additional revenue for landowners, $1.2 m additional total production value and nearly $44,000 in additional tax revenue for municipalities in 2018.

Youth and Familiy
UNHCE's Youth and Family Program includes 4-H programming in healthy living, STEM, animal science, teen leadership, civic responsibility, shooting sports, horticulture, and more. In 2018, the team worked directly with 30,632 youth and family members to teach valuable skills; trained 1,960 volunteers and educators; and provided information and support to 746 schools, youth and family organizations.

UNH Professional Development & Training (PD&T)
In 2018, PD&T engaged a network of 200 instructors to help workers accelerate their careers through licensure renewal, job placement, and professional development. PD&T is proud to provide training to serve military personnel and U.S. Veterans. UNHCE's PD&T team provided 450 programs attended by over 4,000 New Hampshire professionals in rapidly developing workforce areas including education, business, leadership, technology, natural resources, and drone operation for first responders.

NHAES
NHAES is housed in the College of Life Science and Agriculture (COLSA). Two new external department chairs were recruited in the spring of 2018; both joined their new departments at the end of FY2018. Dr. David Mortensen, (https://colsa.unh.edu/spotlight/david-mortensen) is a prominent sustainable systems scientist who now chairs the Department of Agriculture, Nutrition and Food Systems (ANFS). Dr. Bonnie Brown is a creative ecological geneticist (https://colsa.unh.edu/spotlight/bonnie-brown); she is the new chair of the Department of Biological Sciences. Two new tenure-track faculty members were recruited to ANFS: Dr. Sherman Biogornia will contribute to human nutrition teaching and research, and Dr. Marta Lima brings expertise in metabolomics and crop physiology for both teaching and collaborative research with established NHAES researchers.
The Woodman and Kingman horticulture and agronomy farms provided support for 32 research projects; in FY 18, Macfarlane R greenhouse space was at a premium with 41 research projects. Fairchild Dairy hosted 19 research projects and the Organic Dairy Research Farm (ODRF) supported 11 research projects. The NHAES facilities accommodate UNHCE activities such as pesticide sprayer calibration, meetings of the landscape education committee, grape pruning, Master Gardeners meetings, and boat building for the Sea Grant docents.
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, 54 classes visited or carried out experiential learning at Macfarlane Research Greenhouses, Fairchild Dairy Research and Teaching Center, the ODRF, Kingman Farm and/or Woodman Farm. These venues are also popular for visits by the public and special events such as Granite State Dairy Promotion and School to Farm Day (3660; Fairchild Dairy), Spring Greenhouse Open House (~2500 Macfarlane Greenhouses), for Research Field Days (pumpkin and squash breeding field day, 25), Kingman Research farm; Durham Farm Day [80], and Under the Vines field day [100] at Woodman Horticultural Research Farm. There were 260 visitors to the ODRF including visitor groups from Stonyfield Dairy, UNHCE 4H, and Dover Middle School. Kingman Farm and the Organic Dairy Research Farm are popular with the public for cross-country skiing, hiking, and snowmobiling. Excess produce and fish from research projects at Macfarlane, Woodman and Kingman Farms 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/or federal) is used to maintain and/or upgrade research capacity at the farms, dairies, greenhouses and ancillary facilities. In FY18 State funds were used to complete construction three research greenhouses at Kingman Farm. In FY18 Other equipment purchases included a backup generator to provide power to new aquaponics greenhouses during a power ($29k), for Kingman farm; a Hay Baler ($23.5k) and a farm Loader ($16.8k) for the Organic Dairy Research Farm.
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, organized by associated planned program.

Global Food Security and Hunger Advances in Agroecology: #1006827 The Smith research group examined "the agronomic outcomes of several approaches to forage cropping system diversification including planting annual forage and cover crops in mixtures or 'cocktail'. In addition, this project assessed whether the pesticides that are commonly applied to crop seeds may undercut weed suppression benefits that often arise from diversifying feed grain cropping systems...The primary benefits of planting annual forage crops in mixtures rather than monocultures come in the form of enhanced consistency in biomass production rather than overall biomass production or weed suppression. Specifically, mixtures were found to produce more consistent levels of dry matter from year-to-year and plot-to-plot, in some cases more than two- to three-times more consistent, than did monocultures of the same crops. This means that as environmental conditions become less predictable from year-to-year, planting forage crops as mixtures rather than monocultures may be a risk-avoidance strategy for ensuring adequate dry matter production. Additionally, data from our project indicates that weed seed destruction by organisms that naturally inhabit crop fields (e.g., weed seed predators such as ground beetles, crickets, and field mice) can be as high as 90% but that pesticides applied to crop seeds can reduce seed predation by as much as 50%, indicating that seed-applied pesticides may undermine natural biological control of weeds. As a result of this project, we now have a compelling body of evidence that forage crop mixtures result in more stable dry matter production and that pesticide seed coatings likely result in non-target effects on natural enemies of weeds. These insights will contribute to alternative forage management practices that improve the sustainability of agriculture."
Conservation and Utilization of Plant Genetic Resources #233561: Two ongoing projects from Assoc. Prof. Iago Hale's group " 1)The development of kiwiberry cultivars for New England: Utilizing the kiwiberry germplasm currently present in North America, the NHAES has invested in a breeding

systematically identify kiwiberry accessions carrying promising genetics for New England [Result]; develop improved germplasm through strategic crosses and optimize production practices [Outcomes]; develop genomics resources to increase breeding efficiency of kiwiberries [Outcomes]; educate regional growers and consumers about this new horticultural product [Impact]; and work toward the establishment of a viable kiwiberry industry in the region, with its attendant supporting nursery and supplies industries [Impact]."
2)The development of genomics resources for barberry: The common barberry (Berberis vulgaris,which) was brought to the New World as an important hedgerow,..is the alternate host for the sexual stages of wheat stem rust. Common barberry persists in the region and poses now an unknown threat, as momentum builds for revitalizing small grains production for local consumption in New England. A related species, Japanese barberry (B. thunbergii), is an economically important ornamental plant also considered to be a serious invasive plant in the northeast; but unlike common barberry, this species exhibits non-host resistance to the stem rust pathogen." "Recent research has revealed that the two species naturally hybridize in the northeast, and these interspecific hybrids present both an unknown threat in terms of stem rust epidemiology but also a novel system for dissecting B. thunbergii's mechanism of resistance to the stem rust pathogen. The purpose of this research is to develop the genomics tools needed to support this research, as well as global barberry surveillance more generally [Outcome], to assess the risk posed by New England barberries to small grains production in and beyond the region [Result], to educate regional growers about this potential risk [Impact], and to support both the wheat rust research and barberry breeding communities through the development of molecular tools [Impact].
Climate Change: Measuring and Predicting Soil Organic Matter Formation and Nitrogen Mineralization, #1007001 Assoc. Prof. A. Stuart Grandy "The processes underlying the formation of soil organic matter (SOM) remains poorly defined, and the contributions SOM makes to plant N availability have not been quantified. Moreover, soil biogeochemistry models do not explicitly account for the contributions microbes make to SOM dynamics and nitrogen (N)availability. ..Humans add approximately three-fold more biologically available nitrogen (N) to terrestrial ecosystems than natural sources, primarily with synthetic fertilizers and legumes. This vast amount of N has substantially increased crop yields, but the majority of agricultural N inputs are not actually taken up by crops. Instead, much of this N is lost from agricultural fields, with wide-ranging impacts across local, regional, and global scales, including declines in water quality and biodiversity in terrestrial, aquatic, and marine ecosystems and increases in emissions of the greenhouse gas nitrous oxide (N_2O).... In an interdisciplinary review published this year, (Nature Sustainability volume 1, pages 399-408 (2018) we describe these processes, propose a set of agroecological principles to guide research and policy for decreasing nitrogen losses in the future, and describe the economic factors that could constrain or enable their implementation. Second, we published a conceptual framework (Biogeochemistry, doi:10.1007/s10533-018-0459-5) to challenge current assumptions about N mineralization, a key source of N in all soils. N mineralization involves the conversion of organic to plant-available inorganic N. Existing concepts ignores the role of microbial communities in N mineralization. We show that microbial communities and their physiology are strong controls over N mineralization and this N availability. This work could ultimately lead to managing soils to foster more N efficient microbial communities that deliver N to plants when they need it most."
Food Safety: Ecosystem Factors Affecting Vibrio parahaemolyticus Populations and Potential Impacts on Shellfish Safety #1010499 This project, under the direction of Research Assoc. Prof. Stephen Jones, addresses growing regional concerns about expanding Vibrio parahaemolyticus populations and potential impacts on shellfish safety... They use "improved Vibrio detection methods and (ecosystem) models based on environmental and biological conditions for predicting risks of Vibrio-borne illnesses. ..The highlights of this reporting period were the application of our study findings to set new policies at the State (of NH) level for shellfish importation" to limit risks to oyster aquaculture from introduced, pathogenic strains of Vibrio parahaemolyticus.
Supporting a Rural Economy: Enhancing Rural Economic Opportunities, Community Resilience, and Entrepreneurship #1015411 One of the area of emphasis of this project, lead by Professor John Halstead, is "identifying and analyzing constraints and opportunities for local agriculture in northern New England..."

Our goal is to identify how local agriculture could be made more profitable; to this end, we have been able to estimate the specific types of local produce which customers would pay premiums for (vs. nonlocal) as well as factors which might change their purchasing habits. We have completed a survey of restaurants in the seacoast area of NH that examines the role of intermediate distributors of locally grown produce to the general public, particularly grocery stores and restaurants. ..We elicited feedback on the types of information grower's and distributors would like to have from restaurateurs and grocery stores."

NHAES Communication Impacts

News and information about NHAES research and events reach a wide audience of stakeholders, including producers, policy makers, and industry representatives throughout the state and region as well as at the national level. Strategic communications efforts include traditional media relations, social media engagement, directed email, and multimedia storytelling.

Traditional statewide news media (newspapers, radio, and TV) and trade agricultural media regularly cover NHAES research. News releases are regularly picked up by local, regional, national and international venues, including the New York Times, Boston Globe, ABC News, Washington Post, Union Leader (largest newspaper in NH), WMUR, NH Public Radio, Foster's Daily Democrat, Concord Monitor, and Morning Ag Clip. The Associated Press writes stories about the majority of NHAES research stories, resulting in a distribution of NHAES news to hundreds of media outlets nationwide and hundreds of thousands of readers. Key news placements in FFY 2018 include:

- Boston Globe: Fall foliage forecast in New England looking good, researcher says
- Union Leader: Research highlights 'baby ginger' at UNH
- Morning Ag Clips: UNH earns Quality Milk Award from Dairy One
- Eagle-Tribune: 800 miles of Merrimack watershed tainted by road salt
- Valley News: Gardeners Gently Reshape Landscape to Promote Pollinators
- Union Leader: UNH scientists experiment with drones to collect forestry data
- NHPR: Something Wild: What Happens to Trees in Drought?
- ABC News: Pine-killing southern beetle may be more deadly in North
- New York Times: Pine-Killing Southern Beetle May Be More Deadly in North
- Boston Globe: Researchers develop way to keep track of New England cottontail in effort to save them
- Union Leader: UNH study sheds new light on saltmarsh sparrows
- Washington Post: Parasite transmitted by ticks found in Canada lynx
- Union Leader: New England's white pines being damaged by disease
- Union Leader: UNH scientists join effort to identify most common weeds
- NHPR: Warmer Winters Negatively Impact Tourism and Forest Health
- Fosters: UNH Organic Dairy Research Farm takes home the gold
- Fosters: UNH Research: Beetles bear offspring based on food scarcity
- Union Leader: UNH scientists will present latest research at Farm and Forest Expo
- Union Leader: New scales give UNH scientists clues about NH's snowpack
- WMUR: Drastic drop seen in NH bumblebee population, UNH study shows
- Boston Globe: UNH researchers say effects of climate change are coming sooner than we think
- Washington Post: One of the oldest climate change experiments has led to a troubling conclusion
- Union Leader: UNH professor recognized for 50 years of food research

NHAES research news is regularly publicized by the USDA, Ag is America, and UNH Cooperative Extension via social media, and the NH Department Agriculture, Markets & Food and the NH Farm Bureau via newsletters. In FFY 2018, NHAES saw an 11 percent increase in page likes (people who follow our Facebook page and want to receive our research news). Nearly 200,000 people engaged with our NHAES Facebook page in this period, meaning they clicked on a story on our page or engaged with the page in some other way. NHAES Facebook content reached more than 2.2 million Facebook users during this period, meaning they saw it in their news feed or on a friend's page. This is a 10 percent increase over last year. Twitter impressions (number of times someone on Twitter saw one of our tweets) surpassed, 290,000, a near 70 percent increase over FFY 2017.

NHAES has expanded multimedia storytelling on its website. NHAES also continues to experience healthy traffic to its website. In the current reporting period, the NHAES website logged more than 43,600 page views. Last year, NHAES partnered with USDA Climate Hubs for a series of videos that tell the story of how NHAES horticultural research is helping to mitigate the impact of climate variability. These videos were well received by constituents. In addition, NHAES has expanded the use of video to further communications efforts. A sample of these high-impact videos and animations, which increase awareness on social media about our research, is below. NHAES research often is featured on high-traffic UNH websites such as the UNH Home Page and NHAES has expanded multimedia storytelling on its website. NHAES also continues to experience healthy traffic to its website. In the current reporting period, the NHAES website logged more than 43,600 page views. Last year, NHAES partnered with USDA Climate Hubs for a series of videos that tell the story of how NHAES horticultural research is helping to mitigate the impact of climate variability. These videos were well received by constituents. In addition, NHAES has expanded the use of video to further communications efforts. A sample of these high-impact videos and animations, which increase awareness on social media about our research, is below. 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 office contributes regularly to America is Ag. High-impact videos:

- NH Agricultural Experiment Station: Improving NH Lives Through Innovation and Partnership https://www.youtube.com/watch?v=4zMmdqOwAcU

- Serving New Hampshire: Research, Teaching, Outreach https://www.youtube.com/watch?v=X7C4GFqSfeM

- New Guidelines Provide Farmers in Nation's Breadbasket a Roadmap in Changing World https://www.youtube.com/watch?v=7KUPo7sivbc&t=2s

- Feeding Prepartum Dairy Cows Niacin Improves Quality of Their Colostrum https://www.youtube.com/watch?v=hh-lFi1Q9yg

- Variety Trials at UNH: Supporting Sustainable Agriculture in New Hampshire https://www.youtube.com/watch?v=h32yQRoKWE0

- Ready to pick fresh, NH-grown strawberries until November? https://www.youtube.com/watch?v=B2Zj-lhWWG0

- We're Crazy For Kiwiberries! https://www.youtube.com/watch?v=cWoQ6XuIDnE

- Pay-As-You-Throw Trash Policy Cuts Solid Waste Disposal https://www.youtube.com/watch?v=OmsMMuG86EA

Directed email efforts reach more than 1,000 key stakeholders, including state agricultural policymakers and staff, NH state legislators, governor's office, members of the congressional delegation and their staff, USDA-NIFA representatives, university and New Hampshire higher education leaders, producers, faculty, researchers, students, and the public.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	84.0	{No Data Entered}	22.0	{No Data Entered}
Actual	121.0	0.0	34.3	0.0

II. Merit Review Process

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

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

2. Brief Explanation

UNHCE
UNHCE has a county advisory council in each of our 10 counties, made up of citizen volunteers as well as one county commissioner and one state legislator from the county. These councils meet monthly provide input to staff on educational needs in their communities. NH state statute identifies county Extension advisory councils as the legal entity to request county funding on behalf of UNHCE, therefore, councils have a critical role in county Extension operations. Members advise staff on the educational needs of the region and provide input in searches for new staff. Additionally, a state advisory council consisting of two members from each county council meets with Extension administration twice per year to advise on statewide educational needs. Extension program teams leaders and state staff also meet regularly with county councils.
NHAES The New Hampshire Agricultural Experiment Station (NHAES) carries out a formal, competitive, internal peer-review process for proposed research projects. The competition for NHAES research 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 and the NHAES director. 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 (i.e. kiwiberries) in Northern New England, improvement in strawberry and kiwiberries cultivars using marker-assisted breeding, the release of disease-resistant squash, pumpkin, and melon cultivars with improved nutritional value, dissemination of new agricultural practices including season extension in strawberries. 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
- Targeted invitation to non-traditional stakeholder individuals
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Other (County Advisory Councils, comments from research proposals and manuscript reviews.)

Brief explanation.

UNHCE
UNHCE strives to connect with the communities in New Hampshire. To do so, UNHCE staff, volunteers and county advisory councils engage with stakeholders, assess their needs and programs are developed in response to those needs. To facilitate their engagement, UNHCE specialists work with stakeholders throughout the state of New Hampshire. In addition, Extension administration meets with state and regional partners regularly to ensure stakeholder input is considered when making broad organizational decisions.
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. These meetings are a good opportunity to introduce new NHAES researchers to representatives of agricultural and forestry producers in the state.
the NHAES 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 NHAES 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 New England Farmers Union, and large commercial growers in the state. The NHAES communications manager publicizes research outcomes to broad state, regional and national audiences. Establishing good lines of communications about NHAES research activities to an important part of engaging stakeholders.
As part of the annual Durham Farm Day, August 18, 2018 members of the community, as well as visitors as from as far as Massachusetts and New York, toured research plots at Woodman

Horticultural Farm (~80 people)
Individual Project Directors offered specialized field day events on campus:

- Assoc. Prof. Iago Hale: # 233561, NH00611-R Annual kiwiberry field day (100 participants)
- NHAES Research Faculty and UNHCE Extension Prof. Becky Sideman#1006928, NH00635, "Under the vines; field days" Seedless table grapes and fall strawberries (40 growers)

Individual project directors participated in regional and national growers meetings. For example, NHAES Research Faculty and UNHCE Extension Prof. Becky Sideman#1006928, NH00635 presented her research results and interacted with stakeholders at:

- Specialty crops and season extension for NH. NH Vegetable & Berry Growers' Association Annual Meeting. Feb 2018. Manchester NH. (75 growers)
- Extending Strawberry Season using Day-Neutral Varieties and Low Tunnels. Orde, K. NJ Vegetable Growers Association Annual Meeting. Feb 2018. Atlantic City, NJ. (40 growers)
- Extending Strawberry Season using Day-Neutral Varieties and Low Tunnels. Orde, K. and B. Sideman. Feb 2018. NH
- Agricultural Experiment Station Research Profile, NH Farm & Forest Expo. Manchester, NH. (15 scientists)
- High tunnel tomato nutrient management: lessons learned. Sideman, B., B. Hoskins, M. Hutton, H. Bryant and E. Sideman. Mid-Atlantic Vegetable & Fruit Growers' Convention. Jan 2018. Hershey, PA. (85 growers)
- Increasing success with Brussels sprouts: varieties, topping and insect management. Sideman, B., T. Levy and A. Harris.Mid-Atlantic Vegetable & Fruit Growers' Convention. Jan 2018. Hershey, PA. (75 growers)
- Overwintering onions. Mid-Atlantic Vegetable & Fruit Growers' Convention. Jan 2018. Hershey, PA. (50 growers)
- Starting your own vegetable seedlings. Workshop for ORIS (Organization for Refugee and Immigrant Success). Jan 2018. Manchester, NH. (10 growers)
- Selecting varieties for high tunnel production. Dec 2017. New England Vegetable & Fruit Conference, Manchester NH https://unh.app.box.com/s/5boumr8smr1u9qsk9znmm62us6sqhvib (150 growers)
- Specialty crops and season extension at UNH. Dec 2017. New England Vegetable & Fruit Conference, Manchester NH. https://unh.app.box.com/s/ju9kwnsa41oqq59hl6qs7pig22rc3xme (120 growers)

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 specialists and volunteers have established relationships with stakeholders including individuals, NGO's, state and regional associations, and state departments. Specialists interact with stakeholders on an ongoing basis throughout each program year. Input is collected informally through discussions and formally through program evaluations and surveys. Extension administration meets with state department commissioners and directors on a regular basis.

NHAES
The 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. 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. Examples of NHAES projects using focus groups include: #1010114, 1015411, and 1013736.

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
Stakeholder input was solicited mainly through counties and state advisory councils. One hundred twenty citizen volunteers participate in county and state-wide Advisory Councils. These councils not only advise local Extension staff on the priorities of people living in the county, but also participate in hiring of new staff and performance reviews of existing staff. In addition, Extension administration meets with each of these groups regularly (face-to-face and via video conferencing)
to insure stakeholder input is considered when making broad organizational issues as well. Further, specific groups (after school providers, volunteers, landowners, decision makers, etc.) are asked for input on program quality and direction.
NHAES: Individual NHAES researchers engage directly with stakeholders. Identification of stakeholders varies with the nature of each research project.
Examples include:
Professor Pete Erickson (#1001283; NH00615-R): An open house at the Fairchild Dairy provided stakeholders an opportunity to view ongoing research and to meet with Project Director. Professor Erickson's part-time appointment in UNHCE provides additional opportunities for him to meet with stakeholders at meetings, via phone or face to face.
Research Assoc. Prof. Stephen Jones # 1010499, NH00647 presented his research results and engaged in discussion with stakeholders at the following:

• Shellfish industry and state regulatory agencies were the targeted audiences for presentations about pathogenic Vibrios at the Northeast Shellfish Sanitation Association annual meeting in April 2018
• Shellfish growers of Maine were the audience for a presentation at the Maine Shellfish Working Group's annual meeting in October 2017
• Shellfish growers of NH were the audience at the NH Marine Aquaculture meeting held by NHDES and NHDHHS in early 2018,
• A wide audience for a presentation at the Eastern Climate Preparedness Conference in May 2018.
Senior Lecturer Jesse Stabile Morrell #1010738 conducted two focus groups with Extension professionals working with low-income communities in New Hampshire, as a preliminary step in

developing a new behavioral perceptions survey for low-income communities.
Assistant Professor Catherine Ashcraft #1011028 As part of objective 1: Analysis continued of the federal and New Hampshire policies for flood risk management and of responsibilities of state and federal regulatory agencies governing flood management. "A strategy for characterizing relevant current municipal policies was developed, which includes the development of an interview protocol and plans for three phases of interviews with municipal planners and board officials. Potential interviewees were identified. The first phase of interviews within New Hampshire's coastal communities was initiated; seven interviews were conducted and transcribed. A framework for analyzing the interviews is under development."

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.

UNHCEFor UNHCE, specific input on the budget and programmatic priorities are solicited. Potential advisory council members are identified based on input from other council members, stakeholders and staff. Effort is being made by every county advisory council to diversify the councils. Extension administration is providing professional development for staff on topics related to cultural proficiency. We understand our advisors must be truly representative of the population they serve.
NHAES
Individual research projects use feedback from stakeholders as appropriate to the project. Examples include:

• #1011028, Asst. Prof. Ashcraft's "Negotiating conflicts over adaptive and integrated flood management in New Hampshire's watersheds" are interacting directly with stakeholders (NH Department of Environment Services and Strafford County Regional Planning Commission) by providing information and training to "Protecting Drinking Water Supply Lands Workshop" in Rochester, New Hampshire. This provided an opportunity for three-way interactions between stakeholders (NH DES, Strafford County Regional Planning Commission, Town Planners, and Dr. Ashcraft's students working on this project).
• #1015411 Professor Halstead "completed an in-depth overview the major facets of the study objective regarding local agriculture expansion potential involving direct contacts with farmers, surveys of New Hampshire restaurants, and surveys of the general public in New England"..."We elicited feedback on the types of information grower's and distributors (sellers) would like to have from restaurateurs and grocery stores (purchasers)." This feedback will be used to assess opportunities to improve commerce between these groups.

Brief Explanation of what you learned from your Stakeholders

UNHCE:
A few examples of information learned from stakeholders:

1. The low-grade timber industry is failing because markets for products have dried up. The industry is looking for alternative uses for low-grade timber.
2. Agricultural businesses are struggling to find dependable, skilled labor and seek to find ways

to retain labor despite the seasonal nature of their industry.

3. The opioid crisis has taken a large toll on families. Many grandparents are struggling to raise grandchildren in this quickly changing world.

4. Communities are struggling to get citizens engaged in civic life.

NHAES:

"Greenhouse and ornamentals are a major part of NH's agricultural economy, primarily through two large ornamental plants production enterprises. In 2018, some members of the NHAES external advisory group expressed concern about University support for training future floral and landscape (as opposed to food) horticultural workers. A significant aspect of this was related to the fact that the 2-year Thompson School of Applied Sciences was being restructured and the number of Associate Degree programs reduced. Education is primarily an issue for the college rather than the NHAES per se. However, the NHAES director is also the dean of the College of Life Science and Agriculture.

The economics of offering an associate's degree in horticulture at the main University campus have not been viable for several years in NH, as enrollments had dropped below sustainable levels. Last year we had 8 students in the plant-focused concentration, and 9 in the landscape design concentration, with only 4 freshmen across the two focal areas. Average tuition and living expenses for an associate's degree in Durham are high and for most students, necessitate large student loans. The indebtedness exceeds the amount new graduates are likely to be able to pay back based on expected industry salaries. The less expensive NH community colleges do not have the facilities or faculty with appropriate experience to offer associate degrees in horticulture, though there are multiple inexpensive regional institutions that do. Thus, the most viable alternative is to rely on associate degree programs in neighboring states."

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	1373534	0	1861032	0
Actual Matching	1373534	0	1895473	0
Actual All Other	3938267	0	1467428	0
Total Actual Expended	6685335	0	5223933	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	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: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	11.0	0.0	0.1	0.0
Actual Paid	12.0	0.0	0.4	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	22187	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	781	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
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.

NHAES: Researchers used the College Health and Nutrition Assessment Survey to profile weight- related factors in student populations with special foci on students with disabilities and those from low-income communities. NHAES researchers, in collaboration with 11 other members of this multi-state program, are evaluating various tools to assess the healthfulness of college campuses. The collaborators are also developing evidence-based tools to disseminate their findings for future application at similar campus communities and to adapt these tools for implementation in low-income communities.

2. Brief description of the target audience

UNHCE

- Youth and family with limited resource
- Young adults (undergraduate students)
- Disabled and low-income students at Land Grant Universities and nearby community colleges.

NHAES

- Young adults (18-24 years of age)
- Undergraduate students and dietetic interns
- Community leaders and campus administrators
- Research Scientists and professional organizations

3. How was eXtension used?

UNHCE
eXtension was not used in this program

NHAES did not use eXtension in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1049	30	6098	0

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

Patent Applications Submitted

Year: 2018

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	4	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
2018	306

Output #2

Output Measure

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

Year	Actual
2018	699

Output #3

Output Measure

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

Year	Actual
2018	450

Output #4

Output Measure

- Conference papers presented on related to healthy eating, behaviors and campus environment research carried out by NHAES researchers

Year	Actual
2018	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	Validation of audits and tools to evaluate Health Campus Environments

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
2018	596

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 improve 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 eligible 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
Six hundred and ninety-nine adults (699) enrolled in a series of lessons and three hundred and ninety-one (391) completed the series. Of those completing a pre/post food recalls and/or pre/post survey questions related to nutrition and physical activity behaviors, significant impacts.

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
2018	664

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Same as previous

What has been done
Same as previous

Results
. 70% of youth increased their choices of healthier foods
. 95% of youth increased their knowledge of healthier food choices

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
2018	1215

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 improve 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
Six hundred and ninety-nine adults (699) enrolled in a series of lessons and three hundred and ninety-one (391) completed the series. Of those completing a pre/post food recalls and/or pre/post survey questions related to nutrition and physical activity behaviors, significant impacts included:
.60% (230 of 382) of adults reported an increase in healthier food choices
.35% (120 of 339) of adults reported an increase in physical activity
.29% of 1735 of youth reported an increase in how often they eat vegetables; grades 3-12
.18% of 1735 of youth reported an increase in knowledge about vegetables; grades K-2
.70% of 1735 of youth increased their choices of healthier foods

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

Validation of audits and tools to evaluate Health Campus Environments

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
(1010738)"Young adults, especially college students, have a high risk of weight gain. Rapid changes in their physical and social environments influence their eating and exercise habits. To improve the understanding of the individual and environmental factors associated with weight gain in young adulthood, as well as improve the reach and sustainability of community programming, 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."

What has been done
Several tools for evaluating college campus environments for factors that promote health were developed and validated: 1) Convenience Store Supportive Healthy Environment for Life-Promoting Food (SHELF) Audit. 2) Full Restaurant Evaluation Supporting a Healthy (FRESH) Dining Environment Audit was developed and validated to assess cafeterias and restaurants 3)Development and Validation of the Policies, Opportunities, Initiatives and Notable Topics (POINTS) Audit 4)Development and Validation of the Vending Evaluation for Nutrient-Density (VEND)ing Audit.

Results
1)The SHELF sub-scores were highly correlated with other audit tools indicating convergent validity. Conclusion: "The SHELF convenience store audit is a valid, reliable tool for assessing the degree to which convenience stores support healthfulness regarding Fruits/Vegetables, Healthy Foods, and Supports for choosing healthy." 2) FRESH: Cafeterias consistently scored higher than other restaurant types on healthy foods (29.45 ± 12.17 SD) and environmental supports (22.10 ± 5.27 SD). 3) "The student-focused POINTS audit was validated using the Healthier Campus Initiative?s survey. Conclusions: POINTS is a web-based audit tool... is useful for pre-assessment, advocacy, benchmarking, and tracking policies for health and well-being for students (campus) and employees (worksite).4) "The VENDing audit uses unique, valid, and reliable nutrient-density scoring to evaluate snacks/beverages along a continuum of healthful criteria and comprehensively evaluates the full vending environment."

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Other (Staff turnover)

Brief Explanation

UNHCE: Staff change slowed the implementation of programs
NHAES No external factors affected outcomes

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE

Six hundred and ninety-nine adults (699) enrolled in a series of lessons and three hundred and ninety-one (391) completed the series. Of those completing a pre/post food recalls and/or pre/post survey questions related to nutrition and physical activity behaviors, significant impacts include:

- 60% (230 of 382) of adults reported an increase in healthier food choices
- 35% (120 of 339) of adults reported an increase in physical activity

Six thousand, ninety-eight youth (6,098) participated in a series of lessons. Of those completing a pre/post survey related to nutrition and physical activity behaviors, significant impacts included:

- 29% (502 of 1735) of youth reported an increase in how often they eat vegetables; grades 3-12
- 18% (57 of 325) of youth reported an increase in knowledge about vegetables; grades K-2
- 29% (476 of 1654) of youth reported an increase in how often they are active, grades 3-12
- 29% (136 of 463) of youth decreased sedentary activities

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

- 70% (52 of 74) of youth increased their choices of healthier foods
- 95% (57 of 60) of youth increased their knowledge of healthier food choices
- 62% (38 of 61) of youth increased how often they were active
- 36% (4 of 11) of youth decreased sedentary activities

A number of schools assessed policies and documented changes.
In Coos County, the Colebrook School district comprised of two schools, assessed their wellness policies and made changes affecting 367 youth, including changes in fundraising and school events, celebrations and rewards; farm to school policy; and physical activity offered in school meets current standards.
In Merrimack County, the Franklin School district comprised of four schools assessed their wellness policies and made changes affecting 1100 youth, including celebration guidelines improved; students will have 60 minutes of physical activity; the physical education program improved; classrooms will have activity breaks; leadership, implementation, accountability and community engagement improved; and changes were made to meet or exceed standards for foods marketed during the school day.
In Strafford County, the Farmington School district comprised of three schools assessed their wellness policies and made changes affecting 1000 youth including their policy will be assessed every three years using UNHCE wellness assessment tool and checklist.
In Belknap County, the Laconia School district comprised of five schools assessed their wellness policies and made changes affecting 2000 youth including; youth have more time to eat breakfast; more time to eat lunch; promotion of non-food rewards; and food is not used as reward or punishment.
A number of trainings were held throughout the state during FY 18 for professionals and volunteers. A total of 256 out of 309 (those who completed post surveys) gained skills to improve their work in the areas of youth development, creating appeal for school meals;

making food fun for children; improving school wellness policies and nutrition for children.
NHAES " The 11 participating SAES in NC1193 completed the development of four audit tools to assess factors contributing to the healthfulness of college campuses and evaluated the reliability of each audit: 1) Convenience Store Supportive Healthy Environment for Life-Promoting Food (SHELF) Audit.(n=124) "The SHELF sub-scores were highly correlated with other audit tools indicating convergent validity. Conclusion The SHELF convenience store audit is a valid, reliable tool for assessing the degree to which convenience stores support healthfulness regarding Fruits/Vegetables, Healthy Foods, and Supports for choosing healthy." "2) Full Restaurant Evaluation Supporting a Healthy (FRESH) Dining Environment Audit was developed and validated to assess cafeterias and restaurants (n=362) 3)Development and Validation of the Policies, Opportunities, Initiatives and Notable Topics (POINTS) Audit (115 student-focus audits, 32 employee-focused audits) found while "there was little evidence of policy presence beyond stimulant standards (smoking and alcohol), there were extensive examples of health initiatives." And 4)Development and Validation of the Vending Evaluation for Nutrient-Density (VEND)ing Audit (n=228). "The VENDing audit uses unique, valid, and reliable nutrient-density scoring to evaluate snacks/beverages along with a continuum of healthful criteria and comprehensively evaluates the full vending environment."

Key Items of Evaluation

See evaluation results
NHAES (# 1010738) As part of NC1193, NHAES researchers helped to develop and validated audit tools representing four out of seven components of an overall Healthy Campus Environment assessment (vending, restaurant/dining, hall, small stores, recreation services, policies, and demographics).

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
102	Soil, Plant, Water, Nutrient Relationships	5%		0%	
205	Plant Management Systems	10%		0%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		0%	
212	Diseases and Nematodes Affecting Plants	10%		0%	
213	Weeds Affecting Plants	5%		0%	
216	Integrated Pest Management Systems	10%		0%	
301	Reproductive Performance of Animals	10%		0%	
302	Nutrient Utilization in Animals	10%		0%	
307	Animal Management Systems	5%		0%	
308	Improved Animal Products (Before Harvest)	0%		34%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	0%		33%	
601	Economics of Agricultural Production and Farm Management	15%		0%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		33%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	2.0	0.0
Actual Paid	3.0	0.0	2.5	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**
41413	0	158579	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
41413	0	70672	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
117978	0	58092	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Cooperative Extension 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:

- Developing, refining, and applying methods for the detection and enumeration of pathogenic and benign strains Vibrio parahaemolyticus and Vibrio vulnificus.
- Develop models of the ecology of pathogenic and benign Vibrios in a fluctuating environment.
- Evaluating, through a variety of means, how cyanobacterial toxins beta-Methylamino-L-alanine (BMAA) and microcystins 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

Cooperative Extension 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 (Northeast Shellfish Sanitation Conference) and shellfish regulatory agencies (National Shellfisheries Association), Piscataqua Regional Estuaries Partnership, NH and Maine Oyster farmers, graduate and undergraduate students, K-12 students, faculty collaborators, and other scientists.
- For microcystins and beta-Methylamino-L-alanine (BMAA) from cyanobacterial blooms, 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 (US EPA Region 1, NH Department of Environmental Services, Maine Department of Environmental Protection).

3. How was eXtension used?

UNHCE
eXtension was not used in this program

NHAES did not use eXtension in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3063	1100	8	33

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	5	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of people who participate in ServSafe workshops

Year	Actual
2018	208

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
2018	1731

Output #3

Output Measure

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

Year	Actual
2018	974

Output #4

Output Measure

- Number of undergraduate students directly involved in the research projects

Year	Actual
2018	32

Output #5

Output Measure

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

Output #6

Output Measure

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

Year	Actual
2018	2

Output #7

Output Measure

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

Year	Actual
2018	159

Output #8

Output Measure

- Number of graduate students directly involved in the research.
  Not reporting on this Output for this Annual Report

Output #9

Output Measure

- Number of reviewed, bulletin, popular and other publications

Year	Actual
2018	8

Output #10

Output Measure

- Number of websites in which project results have been incorporated

Year	Actual
2018	8

Output #11

Output Measure

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

Year	Actual
2018	60

Output #12

Output Measure

- Postdoc and other scientists trained in cutting edge research method

Year	Actual
2018	3

Output #13

Output Measure

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

Year	Actual
2018	110

Output #14

Output Measure

- Users of cyanos.org, three coordinated monitoring projects to locate and understand harmful cyanobacteria.

Year	Actual

2018	3489

Output #15

Output Measure

- An online, visual key for citizen scientists to identify cyanobacteria and freshwater algae, including toxin producing micro-organisms with other aquatic protists, marine, benthic, and macro-organisms.

Year	Actual
2018	272427

Output #16

Output Measure

- Views of an Image-Based key to the Zooplankton Of North America for freshwater to identify organisms collected from lakes, in order to monitor freshwater lakes.

Year	Actual
2018	592050

Output #17

Output Measure

- Views of online key Toxic cyanobacteria of New England "The dirty dozen" to introduce the major types of cyanobacteria most commonly observed in New England water bodies. For monitoring algal blooms in freshwater lakes.

Year	Actual
2018	2998

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
7	Evaluate whether bacterial viruses integrated in the genome of Vibrio parahaemolyticus contribute to the competitive fitness and virulence of the ST36 group.

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
2018	239

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
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, schools, 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. The Food Safety Team works with most sectors of the food industry. Starting in FY 2019, we will be working more closely with food processors.

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
- 273 food handlers attended one of 21 safe food handling workshops for food service workers held throughout the state.
- Of the 147 people completing the evaluation, 131 (89%) scored 75% or higher on the food safety knowledge questions.
- Of those completing the evaluation, 85 (76%) indicated a desire to change a variety of food

safety-related behavior including preventing cross-contamination of food (27 people), preventing time? temperature abuse of foods (23 people), practicing good personal hygiene (27 people) and using better cleaning and sanitizing techniques (8 people). Of those food workers indicating an intent to change, 92% said it was somewhat to very likely they would make these practice changes to improve food safety.
- 45 different facilities reached, including 27 schools

4. Associated Knowledge Areas

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

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
2018	85

3c. Qualitative Outcome or Impact Statement

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

What has been done
(See the previous outcome)

Results
. Of the 147 people completing the evaluation, 131 (89%) scored 75% or higher on the food safety knowledge questions.
. Of those completing the evaluation, 85 (76%) indicated a desire to change a variety of food safety-related behavior including preventing cross-contamination of food (27 people), preventing time-temperature abuse of foods (23 people), practicing good personal hygiene (27 people), and

using better cleaning and sanitizing techniques (8 people). Of those food workers indicating an intent to change, 92% said it was somewhat to very likely they would make these practice changes to improve food safety.

4. Associated Knowledge Areas

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

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
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1010499 "This research project is focused on the development of ecosystem models to improve risk prediction to prevent shellfish-borne
Vibrio parahaemolyticus illnesses in consumers. The results are providing shellfish program managers, public health agencies and the shellfish industry with a better understanding of this issue. The projects results are being used to inform improved management strategies for pre-harvest practices based on how climate and ecosystem conditions influence Vibrio-associated health risks in harvested oysters."

What has been done
"Evaluate key planktonic and estuarine microbiome factors that affect V. parahaemolyticus population levels and diversity in oysters."
The Project Director and students are nearly finished with a paper on microbiome factors and have added new data on V. parahaemolyticus populations in paired juvenile and adult farmed oysters. Samples are now being processed for 16S microbial community analysis to determine differences in life stages of oysters."

Results
"A reverse ecology approach is also underway to determine if association with different ecosystem matrices is a function of physiological differences between V. parahaemolyticus strains."

4. Associated Knowledge Areas

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

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
2018	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1010449 "Oyster aquaculture in northern New England has realized substantial increases in the number of producers and overall production in the past 10 years, yet the associated economic benefits are threatened by the northward emergence and increased incidence of V. parahaemolyticus-borne illnesses in consumers of oysters from New England states. The most affected states have initiated monitoring programs to track this and other Vibrio species, and are instituting increasingly more stringent management practices on farmers to reduce public health risks. There are significant limitations to the existing state of knowledge for much of this, including the, until recently, the lack tools to track the rare strains of V. parahaemolyticus that actually cause illnesses.

What has been done
Use of newly developed pathogen detection methods will aid our understanding microbial dynamics in estuarine ecosystems to address long-outstanding scientific questions about how and why these pathogens emerge and proliferate, and for reducing concerns by shellfish consumers about the safety of what they eat.Develop predictive models of risks associated with

V. parahaemolyticus and provide outreach to help shellfish programs and growers reduce human illnesses through harvest management.

Results
"The highlight of this reporting period was the application of our study findings to set new policies at the State (NH) level for shellfish importation". NHAES researchers "have continued to work with extension specialists from UNHCE to inform oyster farmers in the Northeast about harvest management options to reduce risks from pathogenic Vibrios to consumers. We have continued to inform the NH Shellfish Program Manager and FDA in several local meetings about our research findings to help them optimize best management practices for oyster growers to reduce risks from Vibrios in their harvest practices."

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

#1007227 "Toxins produced by cyanobacteria (blue green algae) pose a growing risk to public health as well as the health of farm animals
and wildlife. Little is known about the potential problems of these nerve (beta-Methylamino-L-alanine, BMAA) and liver toxins (microcystins,MCs) such as their accumulation in crops that are irrigated with cyanobacteria contaminated water."

What has been done

1)"An on-lake experiment was conducted to examine whether MC and BMAA would accumulate on two hydroponic crops,lettuce, and radishes, from lake water used as for irrigation. The experiment consisted of four portable greenhouses constructed on a platform dock on a eutrophic lake with moderate to low levels of both cyanotoxins."
2)"The goal of this project was to begin characterizing naturally occurring, lake generated cyanobacteria aerosols, and to begin investigating what factors influence the process of aerosolization of cyanobacteria cells and cyanotoxins. Eight lakes with varying trophic status were selected across New Hampshire and into Northern Massachusetts to capture a range of natural cyanobacteria levels in the water."

Results

1)Both MCs and BMAA were detected in the roots, stems, and leaves of lettuce and radishes, with highest levels in leaves of both plants. BMAA
accumulated at roughly 1000x higher levels than MCs, with an average of 7.5 pg BMAA g-1 dw in the lettuce leaves compared to 7.1 microgram per g-1 dw for microcystins. Levels of MCs in above lake aerosols suggest that aerosolized MC contributed to much of the MC accumulation whereas BMAA contamination appears to have been primarily from direct uptake from the water. Microcystin concentrations were highest in the lettuce leaves but were well below the limit for daily consumption recommended by the World Health Organization. Thus far, no limits have been set for human exposure to BMAA.
2)Total Microcystins in the water from the eight study lakes ranged from 2.8 ng L-1 in oligotrophic Lake Christine (Stark, NH) to 88.9 ng L-1 in eutrophic Lake Attitash (Amesbury, MA). Aerosol toxicity ranged from 0.93 pg m-3 in mesotrophic Nippo(Barrington, NH) to 3.8 pg m-3 in eutrophic York Pond (Milan, NH) and daily adult human inhalation rates of roughly 20-760 pg MC per day (assuming 20 m3 air inhaled per day). The toxicity in the different size fractions of the water was determined if they are related to the size of aerosolized cyanobacteria. Water toxicity from any size fraction can be used to predict aerosolized toxicity, however, the best predictor of the aerosolized toxin is the toxin in the <50 micrometer fraction (p-value: 0.006, Adj R2: 0.39)."

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Evaluate whether bacterial viruses integrated in the genome of Vibrio parahaemolyticus contribute to the competitive fitness and virulence of the ST36 group.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1013479 "An unprecedented rise in infections caused by the bacterium Vibrio parahaemolyticus has occurred on the Northeastern Atlantic
(NEA) coast starting in the summer 2012 that is attributed to an invasive strain, sequence type (ST) 36, that is endemic to the
Pacific Northwest (PNW). This strain has established resilient populations in several shellfish harvest areas in the Gulf of Maine
and Long Island Sound and now causes recurrent infections every year from the region",,"at least three different subpopulations have established in the Atlantic, where the two northernmost populations of this pathogen, one in Duxbury Bay and one in Katama Bay, harbor unique bacteriophage (viruses) integrated into their genome. This association of phage with successful establishment of local populations could mean the phage provide some benefit to the host pathogen in success either in their ecosystems or in human infection. "

What has been done
1)"Examine the dynamics of Vipa26 and Vipa36 phage production and (their) impact on viable cell growth in different strain backgrounds, and determine their natural distribution, and host susceptibility range."
2)"Determine the impact of chronic phage infection on intra-species competitiveness, anti-predation, and virulence of host strains."

Results
1) " ..have determined the natural distribution of each of the two associated phages, which we call Vipa26 and Vipa36 based on the
bacterial isolate from which they were first detected, demonstrating that Vipa26 was present in isolated populations of the Gulf
of Maine for several years prior to the first infections by ST36, suggesting it was acquired post-

invasion. In contrast, Vipa36
has not yet been identified in any other strain of V. parahaemolyticus."
2) "Preliminary studies utilizing natural seawater microcosm communities from the Great Bay Estuary did demonstrate that strains harboring the phage survived better than strains without phage, which is the first evidence of a fitness benefit that could help explain the invasiveness of the Pacific ST36 strains harboring the phage." ..Collectively, these data specifically indicate that phage native to the Atlantic Vibrio parahaemolyticus population were acquired by ST36 prior to its clonal expansion in aquaculture areas of the Gulf of Maine, that the phage are active and can both leave the chromosome and infect other bacteria, and the phage confer improved survival in natural seawater, suggesting the phage contributed to the success of ST36."

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (none)

Brief Explanation

UNHCE: No external factor that affected outcomes was reported for this program
NHAES: No external factor that affected outcomes was reported for this program

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE:
We used surveys to assess program impact. The largest gains were in understanding food safety regulations (74%), recordkeeping & labeling (74%), understanding the cold chain & temperature control (68%) and knowledge gain on safe facilities for slaughtering (68%).
NHAES The three research projects in the Food Safety have been successful and effective as judged by their publication of in peer-reviewed journals, and by their impacts through various community and regional outreach activities.

Key Items of Evaluation

Professor Jim Haney and two members of UNH Center for Freshwater Biology (CFB) received a 2018 Environmental Merit award from EPA New England. CFB is a collaborative activity of Prof. Jim Haney (NHAES) and UNHCE (Dr. Jeff Schloss, Dr. Shane Bradt). "UNH CFB staff have been instrumental in ongoing research, and developing tools and techniques for understanding the increasing global proliferation of harmful cyanobacteria blooms, and educating the public on the associated impacts to human health and the environment "(Hilary Snook, EPA Region 1 coordinator).

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%	
112	Watershed Protection and Management	0%		1%	
133	Pollution Prevention and Mitigation	0%		6%	
136	Conservation of Biological Diversity	0%		3%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		8%	
202	Plant Genetic Resources	0%		4%	
205	Plant Management Systems	10%		11%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		7%	
212	Pathogens and Nematodes Affecting Plants	10%		11%	
213	Weeds Affecting Plants	5%		3%	
216	Integrated Pest Management Systems	10%		3%	
301	Reproductive Performance of Animals	10%		8%	
302	Nutrient Utilization in Animals	10%		12%	
304	Animal Genome	0%		5%	
305	Animal Physiological Processes	0%		1%	
307	Animal Management Systems	5%		11%	
402	Engineering Systems and Equipment	0%		3%	
403	Waste Disposal, Recycling, and Reuse	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: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	0.0	14.0	0.0
Actual Paid	27.0	0.0	18.8	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**
428035	0	1058122	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
428035	0	947966	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
715556	0	704108	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

NHAES·

- Conduct applied and discovery research in plant breeding, agroecology, dairy cattle nutrition, development of neonatal calf immune systems, aquaponics, animal management, pumpkin and squash breeding, rootstock grafting for better melon production; pest control, and pollinator health and habitat.
- Undertake engagement with stakeholders in multiple aspects of plant and animal agriculture, related genetics and genomics, and various types of aquaculture at a varieties/modalities: research field days, local farm days, twilight meetings, seminars and education sessions at the NH Farm and Forest Expo. Some of these presentations will be made available via YouTube videos.

2. Brief description of the target audience

Cooperative Extension 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?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	31346	369702	1363	956

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	43	43

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2018	1709

Output #2

Output Measure

- Number of Pesticide Applicators attending recertification training

Year	Actual
2018	1873

Output #3

Output Measure

- Number of soil and plant analyses conducted by diagnostic labs

Year	Actual
2018	3231

Output #4

Output Measure

- Number of people reached through educational workshops

Year	Actual
2018	7855

Output #5

Output Measure

- Number of undergraduate students directly involved in the research projects

Year	Actual
2018	121

Output #6

Output Measure

- Number of graduate students directly involved in research projects.

Year	Actual
2018	41

Output #7

Output Measure

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

Year	Actual
2018	39

Output #8

Output Measure

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

Year	Actual
2018	21

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
2018	47

Output #11

Output Measure

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

Year	Actual
2018	19

Output #12

Output Measure

- Number of surveys or other methods used to collect data from participants conducted for research projects
  Not reporting on this Output for this Annual Report

Output #13

Output Measure

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

Year	Actual
2018	8

Output #14

Output Measure

- Number of websites views of research projects

Year	Actual
2018	30294

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	Expand biological and biochemical knowledge leading to new approaches to create "next-generation" nematicides to better control nematode-mediated crop damage.
21	To develop economically viable alternatives to traditional pesticides by ..increasing understanding of how agricultural practices influence biopesticide efficacy will allow for site-specific best-practices for extension specialists and growers to improve performance.
22	Develop research-based recommendations for wildflower seed mixes suitable for New England that will contribute to the creation and conservation of high-quality pollinator habitat.
23	Understand the interplay between genetics and behavior that underlies larval settlement, in order to develop effective strategies to mitigate fouling by marine organisms, impacting aquaculture

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
2018	1561

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 by 36%, and the number of orchards increased by 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 multi-day 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
- A high percentage of growers reported that UNHCE-sponsored on-farm Twilight Meetings helped them increase their ability to identify, diagnose or manage pests (50-54%), adopt or try new methods of preventing or managing pests (35-48%), adopt or try new growing practices (38-60%), increase their knowledge of nutrient management (21-33%), and improve marketing strategies (25-30%).

- Even more growers reported that meetings, workshops, and conferences sponsored by UNHCE helped them increase their ability to identify, diagnose or manage pests (33-73%), adopt or try new methods of preventing or managing pests (30-70%), adopt or try new growing practices (29-65%), increase their knowledge of nutrient management (25-50%), and improve marketing strategies (35-38%).

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.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2835

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Between 2002 and 2007 the number of vegetable farms increased by 36%, and the number of orchards increased by 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
- Increase use of soil/tissue testing and implementation of recommendations based on results

- Educate growers about the effective use of soil and tissue tests as nutrient planning tools

- Educate growers about how to identify and correct nutrient imbalances in vegetable/fruit crops

Results
During the 12-month period from October 2017 to September 2018, UNHCE issued recommendations for:

- 1,773 home grounds and gardens samples
- 220 commercial fruit growers? samples
- commercial corn, forage and pasture samples
- 216 commercial vegetable growers? samples
- 94 commercial high tunnel samples

4. Associated Knowledge Areas

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

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
2018	384

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 by 36%, and the number of orchards increased by 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 multi-day 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
. Based on soil test results, 208 commercial fertilization recommendations were made for 50 full and/or part-time operations during the 2018 growing season in Hillsborough County. Responsible

for approving all tree fruit recommendations for the state = 107 soil and tissue samples. Knowing the current level of available nutrients in the soil for plant growth is essential. Soil testing determines the rate at which the farmer/grower should apply a particular plant nutrient to soil to assure good plant growth without any negative effects to the environment. Soil Test recommendations were made from non-UNH Soil Test Results on 8 farming operations.

. NH Division of Pesticide Control recertification credits which were processed for 25 sessions at 21 meetings held in New Hampshire where individuals received pesticide credits. A total of 59.5 credits offered with 350 out of 808 individuals (43%) attending receiving credits for a total of 1155 credits given to individuals.

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
2018	2040

3c. Qualitative Outcome or Impact Statement

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

What has been done

Results
Of those food workers indicating an intent to change, 92% said it was somewhat to very likely they would make these practice changes to improve food production.

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
2018	670

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Animal production is an important part of agriculture in New Hampshire that includes commercial farms in a wide range of scales and production systems, and it also includes small-scale ?homestead? operations focused on limited marketing or home food production. The value of products from dairy, livestock, and poultry operations from these farms across the state exceeds $116 million. The forage, pasture, and silage corn crops that support this sector covers over 100,000 acres, more than 90% of the cropland in the state. In order for these farms to be profitable, producers need information that enables them to adopt practices in raising healthy animals, managing their operations as efficient businesses, and producing crops in a manner that protects soil and water resources. With our capacity to provide unbiased information and our relationships with colleagues throughout the land-grant university system, UNHCE's Animal Husbandry and Forage Crop Area of Expertise is best suited to provide producers with this information.

What has been done
. Delivered 12 Risk Management and Biosecurity on Livestock Farms
. Annual Dairy Management Conference
. Farm visits.

. One-on-one assistance to dairy producers

Results
. Over 30 producers learned about the economics of no forage diet to raise dairy beef steers
. 157 beginning farmers and students who participated at the ?Biosecurity on Livestock Farms? increased their knowledge of different areas of biosecurity on farms, risk management, and how insurance should be incorporated into the risk management farm plan.
. Over 600 NH growers increased their knowledge and/or skills in dairy, livestock or equine management practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

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 Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
1006928 "Over 680 NH farmers harvest fruit and vegetable crops on " highly diversified farms "from over 3700 acres statewide, and berry crops are grown on over 400 farms, on an additional 1000+ acres...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.

What has been done

1.Evaluate eight hardy table grape cultivars grown in three distinct training systems (vertical-shoot positioning (VSP), top-wire cordon (TWC) and modified Munson (MM)) to determine hardiness, disease incidence, yields, and maintenance time required.
2.Conduct replicated variety trials for additional high-value crops: Overwintering scallions.
3. "Evaluate the feasibility of using low tunnels to improve different aspects of production of ... day-neutral (fall-bearing) strawberries."in collaboration with researchers at PSU and U of Minnesota.. with relevant information to local growers seeking to extend their growing season using this low-cost method.

Results
1.Table grapes: " the first yield data were collected for all training systems for all varieties.... Significant differences (were observed) among varieties in the incidence of diseases such as powdery mildew, downy mildew, and anthracnose. The VSP training system reached harvest maturity at least one year earlier than the other systems, thus increasing early yield potential.
2."In two years 2017 and 2018), experiments ..(compared) the overwinter survival of several scallion varieties planted at three different fall planting dates... Varieties differed in overwinter survival and spring vigor, as well as bolting resistance".
https://extension.unh.edu/resources/files/Resource006811_Rep9838.pdf
3. Day-neutral strawberries: Based on this work, a detailed extension bulletin, titled "Low tunnel strawberry production guide" was published for growers
https://extension.unh.edu/resources/files/Resource007429_Rep10703.pdf

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 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
1001855 Researchers are "interested in advancing the knowledge regarding bioavailability of rumen protected-amino acids (RP-AA) and the use of RP-AA in low-protein diets with the overarching goal to reduce nitrogen (N) excretion to the environment. Concerns about excess N pollution have prompted the dairy industry to find ways to improve N use efficiency in lactating dairy cows, which can be achieved by decreasing the dietary protein fed to animals. However, milk production usually declines when cows are fed low-protein diets so that RP-AA can be used to provide limiting AA to maintain or improve animal productivity. Researchers aimed to investigate the interactions between rumen-protected (RP) MLH and starch level on performance of dairy cows fed MP-deficient diets.

What has been done
Sixteen multiparous Holstein cows (138 ± 46 days in milk) were used in a factorial replicated 4 × 4 Latin square design with 21-day periods. .." to investigate the interactions between rumen-protected (RP)Methionine Lysine and Histidine (RPMLH) and starch level on performance of dairy cows fed MP-deficient diets.

Results
Compared with restricted starch diets, feeding high starch increased yields of milk (37.9 vs. 40.1 kg/d) and milk true protein (1.07 vs. 1.16 kg/d) and decreased dry matter intake (25.4 vs. 24.7 kg/d). Feed and milk N efficiency were greater in cows fed HS vs. RS diets. The concentration of milk true protein increased, while that of milk fat
decreased with HS vs. RS diets. Both milk urea N and plasma urea N were lowered is HS vs. RS diets. Supplementation with RPMLH improved milk true protein concentration. The immediate impact of our research is that farmers, nutritionists, and feed companies now have reliable information regarding the bioavailability and performance of several RP-AA products sold in the market which can increase milk protein production and farm profitability.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes

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
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#106924 "The primary project goal is to develop locally adapted strawberry varieties for New Hampshire and the Northern New England region. The approach will be that of conventional breeding supplemented by a DNA fingerprinting approach known as marker-assisted breeding (MAB). 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."

What has been done
"Researchers obtained SNP (Single Nucleotide Polymorphism) marker genotyping data from the IStraw35 genotyping array for 64 samples for the purposes of identifying marker-trait association for resistance to verticillium wilt disease and for parent selection or planning crosses. Samples with resistance that were also genotyped were favored as parents in making crosses for further studies."

Results
".. Dr. Nahla Bassil (USDA-Corvallis) provided SSR (Simple Sequence Repeat) marker genotyping markers results on 95 samples for trait associations and validation of parentage and pedigree associations. The markers included marker FaPFRU for everbearing fruit production, marker FaRPc2 for crown rot disease, markers FaOMT and FaFAD1 for flavor and aromatics, and a fingerprinting set of 6 SSR markers." "In August 2018, (researchers) submitted 106 plant tissue samples to Dr. Bassil's lab for DNA isolation and IStraw90 genotyping for identifying marker-trait association or quantitative trait loci for sugar content and acidity, for which (researchers)have also generated phenotypic data for use in marker-trait association analysis."

4. Associated Knowledge Areas

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

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
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1003341 Controlling reproduction either by improving efficiency in desirable aquaculture species (black sea bass) or preventing population increases of unwanted species is of critical importance to fisheries."" (controlling) reproduction it is essential to understand the underlying mechanisms of neuroendocrine control...The goal is to identify key reproductive hypothalamic and pituitary hormones black sea bass and in the parasitic lamprey eel, representative of a very ancient fish lineage.

What has been done
"The (Sower)laboratory completed several multi-year studies on hypothalamic and pituitary hormones and respective receptors in the lamprey and hagfish (Sower 2018)."

Results
1. "Cloned and characterized a second lamprey pituitary glycoprotein hormone called thyrostimulin."
2. "..determined the expression of two glycoprotein hormone receptors in gonads and thyroid tissues of larval, parasitic and adult sea lampreys."
3. "..determined the co-localization of lamprey gonadotropin releasing hormone I, II and III in brains from larval, parasitic and
adult sea lampreys."
4. .. "completed phylogenomic and phylogenetic analyses on glycoprotein hormones and receptors."
5. .."determined that lampreys (basal vertebrates) have onlly two pituitary glycoprotein hormones, lamprey GpH and lamprey thyrostimulin in contrast to jawed vertebrates (gnathostomes) that have three classical pituitary hormones called luteinizing hormone, follicle stimulating hormone and thyroid stimulating hormone."

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
305	Animal Physiological Processes

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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1010296 "Winter squash is an important crop throughout the Northeast, but continued viability of this crop depends upon the continued improvement of varieties in terms of productivity, eating quality, and disease resistance. A recent approach initiated at the NH Agricultural Experiment Station has been to develop interspecific hybrids between two species of squash, Cucurbita maxima (buttercup and Golden Delicious types) and C. moschata (butternut, and Dickinson Field types). 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.

What has been done
" A major thrust of the interspecific hybrid project is development and evaluation of new breeding lines of C. moschata with improved culinary traits and new bush breeding lines of C. maxima with higher seed yields in interspecific combinations. Using traditional breeding methods, increase the diversity of C. maxima and C. moschata inbred lines that can be used for making interspecific hybrids for fresh market, processing, and rootstocks for melon grafting."

Results
1)"Increased diversity of C. moschata and C. maxima breeding lines for making compatible interspecific crosses. In C.moschata, four new inbred lines, NH. 176-29-1, NH.127-9-6-2, NH.125-1-10-7, and NH.116-33-7-3, have been tested for cross-compatibility with NH65, and the highest seed yields were obtained in 2017 with NH.116-3-7-3. Another set of bush C. maxima lines has been derived from a cross of NH65 to the variety 'Banana'. Fruit from sister lines selected from this population exhibited high seed yields, between 400 and 550 seeds per fruit, but only one line, NH.Ban273, had the requisite white seed type. Seed yields from greenhouse crosses of NH65 to NH.Ban273 in spring of 2018 suggested good cross-compatibility. As such, several sister lines

from NH.Ban273 were evaluated in 2018, resulting in several F6 selections with high seed yield." "2) (Advanced) interspecific hybrids as rootstocks for grafting melons and squash."In the 2018 study, researchers used a new post-grafting method (healing stage), whereby grafted plants were grown under Illumitex Eclipse LED lights, F6 type (49.5% blue, 49.% red, and 0.5% green spectrum) for the 12 days following grafting, prior to acclimating the seedlings in natural lighting for two days before transplanting...This post-grafting protocol produced stocky, dark green plants that showed rapid early growth in the field. Fresh weight melon yields of grafted plants of 'Honey Sak', 'First Kiss', and 'Sugar Cube' were respectively, 49%, 59%, and 132% higher than that of non-grafted plants."

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems

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
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1004515 " The value of pollination to agriculture is estimated at over $200 billion/year worldwide. The abundance of and diversity of pollinators are declining in many agricultural landscapes across
the United States. The National Research Council has called for regional, national and international monitoring programs to allow
tracking the status and trends of pollinators. This study aims to initiate long term monitoring of bee biodiversity in New Hampshire and identify species in need of more research.

What has been done
This past year (the UNH Bee lab) "has continued wild bee surveys for the state of New

Hampshire as well as bee taxonomy identification outreach and education events. 1) "Determined the floral resources used by wild bees in New Hampshire through sweep netting bees from focal plant species. ..examined pollen using molecular approaches to determine the nutritional value and diversity of wild bee-collected pollen from nests" 2) "determine(d) the effects of interactions among various factors affecting pollinator and honey bee colony health 3) "developed and recommended "best practices" for beekeepers, growers, land managers and homeowners to promote honey" bee and pollinator health."

Results
1)"determined that conventional farms have negative effects on bee foraging efficiency and brood productivity as well as brood body size and overwinter survival 2)Studied "the microbiome of bees and found that wild bee in (NH) harbor many beneficial bacteria thought to be probiotics, but also many potential pathogens."
3)"Provided floral association data for recommendations for wild bee pollinator gardens and also suggestions for best practices for pollinator sustainability including reduced mowing, planting wildflowers, reduced pesticide, herbicide and fungicide use by land managers and homeowners"

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
304	Animal Genome

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
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#233561 "Brought to the New World by colonists as an important hedgerow, food, and medicinal plant, the common barberry (Berberis vulgaris) quickly naturalized and spread.."Due to its role in

generating new virulent races of wheat stem rust, efforts were made to eradicate the plant;" however "common barberry persists in the region and poses now an unknown threat, as momentum builds for revitalizing small grains production for local consumption in New England...A related species, Japanese barberry (B. thunbergii), is an economically important ornamental plant also considered to be a serious invasive plant in the northeast; but unlike common barberry, this species exhibits non-host resistance to the stem rust pathogen.

What has been done
1 "Genotypic characterization of a natural population of B. xottawensis inter-specific hybrids in western MA confirmed their hybrid status, phenotypic characterization under controlled inoculation with Puccinia graminis [Pg]"
2)Using the de novo (i.e. reference-independent) genotyping-by-sequencing (GBS) pipeline previously developed in (the Hale lab)
(GBS-SNP-CROP), 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.
3) Used newly-generated genetic maps and two years of controlled inoculations with Pg to evaluate inheritance of rust resistance in hybrid barberry."

Results
1) "..revealed that such hybrids segregate for the apparent non-host resistance to Pg exhibited by B. thunbergii. This work establishes the hybrid as a viable genetic system in which to dissect the mechanism of this resistance and calls into question the assumed irrelevance of B. thunbergii to stem rust epidemiology."
2)"developed genetic linkage maps for both parents, the first such maps constructed for any barberry species"
3)"the first QTL analysis of Pg non-host resistance in barberry was performed, revealing a single, well-defined resistance locus in B. thunbergii".

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.

Not Reporting on this Outcome Measure

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 Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
233561 "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 opportunity for the development of cultivars and entirely new horticultural products that may not perform well on the global market, where the qualities of freshness and diversity are often secondary to size and storability (i.e. extended postharvest life). The cold-hardy kiwiberry has been recognized by horticulturalists ...as possessing great economic potential, particularly in northern climates.

What has been done
.."NHAES has invested in a breeding program for kiwiberries for New England. Through this long-term research,(the Hale lab) are working to systematically identify kiwiberry accessions carrying promising genetics for New England" and is "developing improved germplasm through strategic crosses and optimize production practices develop genomics resources to increase breeding efficiency of kiwiberries".

Results
1. Sex-linked molecular markers for Actinidia arguta and A. Kolomikta discovered in the research are being adapted in conjunction with LGC Genomics (UK) to high-throughput pipeline for genotyping to adopted from European kiwiberry programs.
2. A MS thesis "Growing kiwiberries in New England: a guide for regional producers" including an enterprise budget and detailed current best cultivation practices is being converted to a user-friendly website to support prospective growers.
3. F1 crosses have matured to produce berries permitting the first round of selection. "Out of >60 female progeny evaluated, approximately 10 were selected for ongoing evaluation".
4. "The entire core collection was screened for oxalate content using a

rapid screen involving clearing of fruit tissue with lactic acid and imaging oxalate crystals under a microscope. This work led
to the identification of high and low oxalate varieties that will be used for generating bi-parental mapping populations for this
important trait."
The most recent kiwiberry field day was attended by 100 gardeners and potential growers.

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
2018	873

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Between 2002 and 2007 the number of vegetable farms increased by 36%, and the number of orchards increased by 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

SWD (Drosophila suzukii) populations were earlier this year than we experienced in 2015 and 2016. We used the Trece lures and traps with the bait/drowning fluid called Suzukii Trap. To make it easier and faster in the field, we only counted the males.

Update telephone 603-862-1734 that runs continuously from April 1 through mid-September each year.

Results
We had 64 SWD traps, on 15 farms, in three counties during 2017 growing season. All of the farms were in the southern part of New Hampshire.

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
2018	61

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 by 36%, and the number of orchards increased by 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
. Soil testing
. One-on-one assistance to farmers
. Workshops
. growers weekly reports of their catches
. Online information about the trap catches
. Reporting the latest results at monthly grower twilight meetings from June-September
. alerts of major flights in Weekly Market Bulletin
. presentations at formal grower meetings throughout the year

Results
Sixty-one farmers who report adopting practices resulting in better forage crop quality and yield.

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.

Not Reporting on this Outcome Measure

Outcome #20

1. Outcome Measures

Expand biological and biochemical knowledge leading to new approaches to create "next-generation" nematicides to better control nematode-mediated crop damage.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
1008769 "Roundworms (nematodes) that feed on plants cause approximately $100 billion in annual global crop damage. Current chemical nematicides are highly toxic to humans, hence the need for "next-generation" nematicides that lack adverse effects on agricultural workers and the environment.

What has been done
" NHAES researchers determined which of the 11 phosphodiesterases (PDEs) in nematodes control the signaling pathways responsible for nematode motility and reproduction. Researchers used a combination of bioassays and atomic level protein structure studies to identify subtle differences in the protein sequence of nematode PDEs and those of other organisms."

Results
Researchers "believe that, by showing nematode PDEs have sufficient differences in their sequence and structure,chemical nematicides may be developed that selectively target plant-parasitic nematodes. These nematicides would be effective and likely have fewer adverse environmental consequences than those currently in use."

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #21

1. Outcome Measures

To develop economically viable alternatives to traditional pesticides by ..increasing understanding of how agricultural practices influence biopesticide efficacy will allow for site-specific best-practices for extension specialists and growers to improve performance.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1012772 "The challenge for sustainable agriculture is to develop economically viable alternatives to traditional pesticides without compromising yields. One strategy is to harness the power of naturally occurring antagonistic microbes as biopesticides, to reduce crop loss from disease. Inconsistent field performance of biopesticides however, has been a barrier to grower uptake."

What has been done
Initial "activities focused on developing a model system to study the effect of cultivar and substrate on biopesticide efficacy. Four isolates of Pythium species were obtained from collaborators and recovered from diseased plant material submitted to the UNH diagnostic clinic. These pathogen isolates were screened in greenhouse experiments for pathogenicity on tomato,cucumber, strawberry, petunia and calibrachoa." Selected cultivars were evaluated for efficacy of differential biocontrol and the effect of growing substrates on biocontrol efficacy..

Results
1. "Preliminary analyses suggest a significant effect of cultivar on plant growth promotion by the fungal biocontrol agent (Trichoderma
harzianum) and then bacterial biocontrol agent (Bacillus subtilis).
2..."Substrate had an effect ($P<0.005$) on Pythium root disease severity and biopesticide efficacy on cucumber and calibrachoa. Differences were not observed on petunia. Overall, there was less disease observed on plants propagated in Oasis and peat, but greater disease suppression was observed in coco coir." Plant health/growth was not significantly different between plants treated with products compared to water, indicating that these products can be applied in propagation. This was an important finding as many growers report hesitation to use products in propagation due to concerns over phytotoxicity."

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #22

1. Outcome Measures

Develop research-based recommendations for wildflower seed mixes suitable for New England that will contribute to the creation and conservation of high-quality pollinator habitat.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1010449 "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. Prior research identified appropriate species selection,..site preparation and weed management are the biggest challenges to successfully planting wildflower meadows." These wildflower meadows are likely to improve the health of honey bees and other pollinators"(NIMSS 2015)

What has been done
#1010449 1)"Investigate the relative attractiveness of native perennial species and their cultivars to key pollinators. An.. experiment was conducted on a subset of eight cultivars of purple coneflower (Echinacea purpurea)/The selected cultivars represented a range of traditional to highly modified forms and colors of this popular garden plant.

Results
1)"Results were similar to the 2017 trial, documenting that some but not all cultivars bred or selected for modified form, color and size
have lost characteristics that make them attractive resources for pollinators. Honey bees exhibited different preferences than bumblebees or solitary bees. Lists of pollinator-friendly plants need to

reflect differences at the cultivar level in order to be useful to people choosing plants for their pollinator gardens.
2)"Based on nine years of trials, a custom UNH seed mix for medium to dry sites has been developed and is now published online." Using a dependable regional mix such as this, in combination with recommended site preparation and planting methods, increases the success rate for (establishing wildflower meadows by) landowners and managers, and provides a continuum of blooms for pollinators to forage on throughout the season."https://extension.unh.edu/resource/establishing-wildflower-meadow-seed-fact-sheet"

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #23

1. Outcome Measures

Understand the interplay between genetics and behavior that underlies larval settlement, in order to develop effective strategies to mitigate fouling by marine organisms, impacting aquaculture

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#10134336 "Ectopleura larynx (is) one of the most economically important fouling species in several nascent Gulf of Maine aquaculture industries...The process of settlement that gives rise to fouling is a result of the precise integration of sensory cues (taste, vision and mechanoreceptors" from the environment by the larval nervous systems of marine fouling species." (This) study will offer immediate guidelines, to be tested ...on the effects light, chemical and surface features of aquaculture equipment with the goal of limiting larval settlement by E. larynx.

What has been done
Using RNAseq methods, transcripts were identified that show increased expression levels during the formation of the sensory system and metamorphosis, compared to earlier stages of development. These last two stages in development are the most relevant to larval settlement.

Results

" (Researchers) have identified a set of genes that are involved in the development of Ectopleura larvae from early stages, to later stages that are competent to settle. These, surprisingly, include numerous members of the insulin signaling pathway, a finding that is new to science. (Researchers) have also identified the target sensory genes, opsins and Taste 1 receptor, from these data.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Other (equipment malfunction, construction delays and staff turnover)

Brief Explanation

UNHCE: Staff change delayed program implementation.

- SWD (Drosophila suzukii) populations were earlier this year than we experienced in 2015 and 2016.
- This year the first adult was trapped June 18 (three to four weeks earlier than previous years).

NHAES: Equipment malfunction for #1010110 derailed a long-term study. This study was further delayed by an weather-related six-month pause in construction of new aquaponics greenhouses.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE:
At the end of the season, all 25 growers (100%) completed an end-of-year summary of this IPM program. All 25 sweet corn growers stated they were confident in the spray recommendations based on the IPM trapping program. Eleven growers (or 44%) reported that they shared their trapping information with another 40 growers who also indirectly benefited from the program information.
NHAES: There are 22 diverse research projects in the Applied Planned Program.

- The first level of evaluation of the success of these projects is publications of results in high impact, peer-reviewed journals (43), and as conference papers (21).
- Another measure off impact is are the adoption and adaptation of NHAES cucurbit germplasm by vegetable seed companies from Maine to the Midwest and as far as New Zealand (#233554, 1010296).
- Increasing interest in kiwiberry as high value niche crop for Northern England. 100 potential growers and gardeners attended the 4th annual kiwiberry field day. A significant increase over the previous year. (#233561)

Key Items of Evaluation

UNHCE: Growers using the IPM program sprayed 2.73 fewer sprays than they did prior to the current IPM program. This saving was a value of $24,678 for pesticides and $34,276 for labor and equipment costs.
The participating growers in the IPM program planted 503 acres of sweet corn and harvested 453 acres (90.06% of the planted acreage). Comparing the acreage planted and harvested to the 2017 USDA NASS statistics data, **the participating farms in the IPM program had 50.3% of the sweet corn acreage planted and harvested in the state of New Hampshire**.
NHAES:

- #1006827 "diversification of planting of annual forage and cover crops..the primary benefits of planting annual forage crops in mixtures rather than monocultures come in the form of enhanced consistency in biomass production rather than overall biomass production or weed suppression....This means that as environmental conditions become less predictable from year-to-year, planting forage crops as mixtures rather than monocultures may be a risk-avoidance strategy for ensuring adequate dry
matter production."
- #1006827 "this project assessed whether the pesticides that are commonly applied to crop seeds may undercut weed suppression benefits that often arise from diversifying feed grain cropping systems..."indicates that weed seed destruction by organisms that naturally inhabit crop fields (e.g., weed seed predators such as ground beetles, crickets, and field mice) can be as high as 90% but that pesticides applied to crop seeds can reduce seed predation by as much as 50%, indicating that seed-applied pesticides may undermine natural biological control of weeds."
- #233554 over the five year period of this project:
  - Eight hybrid melons developed in part by NHAES are marketed "by several major catalog seed companies in the Northeaster US": First Kiss, True Love, Shock Wave, Cleopatra, Milan, Afterglow,
Ambassador, and Honey Sak,... all with resistance to prevalent races of fusarium wilt and powdery mildew (PM) disease. Gynoecious (highly female) melon breeding lines with good external appearance and
culinary traits have been developed for use as seed parents for reducing production costs for hybrid seed.
  - Yellow summer squash with reduced spines (gl-2); two new glabrous hybrids with improved fruit shape and (powdery mildew resistance) PMR, 'Smooth Operator' and Blonde Beauty', were introduced by two seed companies in 2017.
  - New acorn squash varieties: release of.. three hybrid acorn varieties with good eating quality and small fruit (600 to 800 g) designed for serving in the half shell.
  - Breeding butternut and related cultigens: In C. moschata, improvements in overall eating quality and nutrition, and better pest resistance have been identified as important goals, especially for popular butternut varieties. We have also initiated a breeding program to develop varieties with round fruit, similar in appeal to popular buttercup squash, but with much better
pest resistance and shelf life. As a result of these efforts, one butternut variety, Gabrielle, and Butterkin, a variety with round, tan fruit, have been commercialized. Both varieties have intermediate PMR.
  - Pumpkins: During the past five years, breeding lines developed at UNH have been utilized in the release of 8 new orange-fruited pumpkin hybrids, two yellow-fruited hybrids and two hybrids with white fruit.
- #233561 Through this long-term research,(the Hale group is_ "working to systematically identify kiwiberry accessions carrying promising genetics for New

England [**result**]; develop improved germplasm through strategic crosses and optimize production practices [**Outcome**] ; develop genomics resources to increase breeding efficiency of kiwiberries [**Outcomes**]; educate regional growers and consumers about this new horticultural product [Impact]; and work toward the establishment of a viable kiwiberry industry in the region, with its attendant supporting nursery and supplies industries [Impact]

- #233561 "The development of genomics resources for barberry. (Berberis vulgaris).."Due to its role in generating new virulent races of wheat stem rust, efforts were made to eradicate the plant; but common barberry persists in the region and poses now an unknown threat, as momentum builds for revitalizing small grains production for local consumption in New England. A related species, Japanese barberry (B. thunbergii), is an economically important ornamental plant also considered to be a serious invasive plant in the northeast; but unlike common barberry, this species exhibits non-host resistance to the stem rust pathogen.Over a five year period the Hale group : developed the genomics tools needed to support this research, as well as global barberry surveillance more generally [**Outcome**], to assess the risk posed by New England barberries to small grains production in and beyond the region [**Result**], to educate regional growers about this potential risk [**Impact]**, and to support both the wheat rust research and barberry breeding communities through the development of molecular tools [**Impact**].

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%		9%	
102	Soil, Plant, Water, Nutrient Relationships	0%		29%	
112	Watershed Protection and Management	20%		6%	
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%	
133	Pollution Prevention and Mitigation	0%		3%	
136	Conservation of Biological Diversity	0%		9%	
206	Basic Plant Biology	0%		9%	
216	Integrated Pest Management Systems	10%		0%	
307	Animal Management Systems	0%		18%	
605	Natural Resource and Environmental Economics	10%		0%	
610	Domestic Policy Analysis	0%		7%	
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: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	14.0	0.0	5.0	0.0
Actual Paid	31.0	0.0	10.4	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**
339667	0	516611	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
339667	0	709607	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1208096	0	705228	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

UNH Cooperative Extension will carry out applied research, field trials and publishing research reports including:

- 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.

NHAES researchers will:

- Study the diversity of Streptomyces, a major member of microbial decomposer communities, in farm soils and composting operations, for the potential to enhance biofuels production. (#1013432)
- Analyze opportunities and barriers to adaptive and integrated flood management in NH, which is being promoted as an effective approach to managing risks from climate change. (#1011028)
- Investigate climate impact on soil C cycling to improve the Community Land Model, a component of climate change assessments. (#1003421)
- Identify effective mitigation strategies and supporting policies required for an integrated understanding of the processes underlying potential agricultural N responses to climate change (#1007001)
- Investigate the physiology of Frankia, the bacterial partner of the actinorhizal symbiosis, and its ability to help these plants colonize harsh environments. (#1006507)
- Investigate the impact of integrated multitrophic aquaculture on native seaweed flora.(#1007230)
- Examine how wind turbine-induced vibration influences subsoil-breeding beneficial insects; testing the

sensory pollution hypothesis.(#1010114)

• Measure how different landscapes and vegetation types in New Hampshire affect climate, locally as well as globally (#1006997)

• Quantify the nutrient fluxes from watersheds of different land use and drainage area and the impact of reservoirs on nutrient retention using measurements of inputs and
outputs; and the ability of entire networks of surface waters within watersheds to mitigate nutrient fluxes. (#1013433)

2. Brief description of the target audience

UNHCE
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.
NHAES
Audiences for NHAES researchers include agricultural producers, natural resource managers and consumers, land managers, scientists, 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, and the Soil Health Institute.

3. How was eXtension used?

UNHCE:
The following is a list activities implemented using eXtension:
Webinars

- 2 events, 170 participants
- 10/31/17, What's new with Story Maps? (85 participants)
- 11/20/17, Make your Story Maps shine (85 participants)
- 2/22/18, The National Extension Web-mapping tool (NEWT), 41 participants
- 4/12/18, The National Extension Web-mapping Tool (NEWT), 6 participants

Publication:
Bradt, S. and J. McGee. 2018. The National Extension Web-mapping Tool: From Data Exploration and Discovery to Decision Making. Journal of Extension 56(5): 5TOT4 - https://joe.org/joe/2018september/tt4.php
eXtension Impact Collaborative:

- 10/19/17 - Delaware First Designathon, Dover, DE - Story Map key informant
- 2/5/18 to 2/6/18 - Designathon One, Portsmouth, NH - participant
- 7/10/18 to 7/12/18 - Impact Collaborative Facilitator Training - participant

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	33005	1588619	2012	214

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	2	36	38

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of undergraduate students directly involved in the projects.

Year	Actual
2018	177

Output #2

Output Measure

- Number of graduate students directly involved in the projects.

Year	Actual
2018	30

Output #3

Output Measure

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

Year	Actual

2018	25

Output #4

Output Measure

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

Year	Actual
2018	67

Output #5

Output Measure

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

Year	Actual
2018	396

Output #6

Output Measure

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

Year	Actual
2018	49

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
2018	1215

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
2018	3161

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
2018	48

Output #10

Output Measure

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

Year	Actual
2018	304

Output #11

Output Measure

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

Year	Actual
2018	1566219

Output #12

Output Measure

- Number of postdocs trained in cutting edge research.

Year	Actual
2018	4

Output #13

Output Measure

- Number of views of websites related to NHAES research projects on Climate change and sustaining natural resources

Year	Actual
2018	10511

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	Identify opportunities and barriers to the new flood management approach in NH.
14	Develop and apply a general conceptual model for supply and demand (of water quality) at river network scales that integrates point and non-point sources (supply) from agriculture and urban areas, and aquatic sinks (demand).
15	Revise existing model of soil N processes to include the role of soil microbial communities on N mineralization and N availability to plants.
16	Establish whether there are significant impacts of wind turbine seismic vibration on the reproductive health of subterranean invertebrates such burying beetles.

17	Assess the impact of integrated multitrophic aquaculture (IMTA) on native seaweeds in NH

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
2018	77849

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 a 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
1.77849 acres of forest management plans meet or exceed NH forest stewardship standards
2.8,000 acres of forest management plans written using the NH Forest Stewardship standards
3.55 forest owners received federal or state financial incentives for implementing conservation practices, including management plans
4.150 new landowners hired a forester or natural resource professional for the first time in 10 or more years
5.140 licensed foresters increased skills and knowledge by attending at least one natural resources workshop.
6.120 professional loggers increased skills and knowledge by attending at least on workshop through the NH Certified Professional Logger program.
7.811 volunteers in conservation (Coverts and Natural Resource Volunteers) extend the reach of the UNH Cooperative Extension Forestry and Wildlife program in their own communities, by actively managing over 150,000 acres and reaching out to over 12,000 people.

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
2018	1524

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

View the previous outcome

What has been done
View the previous outcome

Results
1524 Coverts Cooperators and Natural Resource Stewards volunteers contribute to more than 33,000 hours in their communities, through open space initiatives, participating in local land trusts, town boards and other community-based initiatives. Volunteers actively manage over 150,000 acres and reached out to over 12,000 people with a message of sound forest stewardship and wildlife conservation.

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	1524

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Volunteers contribute significantly to, and in some cases provide the backbone for many Extension programs, including those in youth development, food and agriculture, natural resources, community development, and more. Directly engaging citizens in UNH Cooperative

Extension's work - including outreach, education, research, and natural resources stewardship - helps increase awareness of local issues and threats. As local citizens become more aware of problems that threaten New Hampshire, they are increasingly motivated to see that these problems are solved. Extension's volunteer programs provide the training necessary to convert awareness and enthusiasm into action and impacts. In addition, Extension research consistently shows volunteerism providing significant benefits to the volunteer, including stronger social networks, healthier lifestyles, improved interpersonal relationships, self-esteem and leadership skills1. As such, it is the goal of UNH Cooperative Extension to promote strong volunteer programs that empower citizens to engage in problem-solving across all program areas.

What has been done
Efforts of this staff team in recent years have included improvements such as:
. Hosting volunteer recognition events for hundreds of volunteers that programs, such as the "Great Volunteer Getaway" or "Stories from the Field: Celebrating Citizen Science in NH."
. Use of consistent database technology for volunteer management and record keeping
. Pooling stories and blog posts that focus on volunteers (for web publication)
. Providing continuing education opportunities open to all Extension volunteers
. Sharing ideas among volunteer programs through professional development and networking events for volunteer managers.

Results
. In 2018, UNH Extension engaged with a total of 5,481 volunteers, of which 3,844 were enrolled in a long-term program (70%). In total, volunteers contributed 206,317 hours of volunteer time in 2018, representing $5.27 million worth of value to New Hampshire communities2.
. 1524 volunteers who provided conservation work in NH communities# of hours they contributed it is 42,834

4. Associated Knowledge Areas

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

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
2018	119

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The health of New Hampshire's environment depends on sound land use, strong conservation organizations and citizens engaged in natural resource management and conservation to maintain clean water, diverse natural areas and connected wildlife habitats. New Hampshire is currently experiencing a wide range of issues such as sprawling development, loss of natural areas, climate change, invasive species and declining rates of community and citizen engagement. These challenges require an interdisciplinary approach at multiple scales to improve the ecological health of New Hampshire. The Communities & Natural Resources team will work to build the capacity of community leaders and volunteers to protect and manage natural resources and strengthen community resilience.

What has been done
. Workshops
. Direct technical assistance to communities groups and community leaders

Results
. A total of 230 individuals in more than 70 communities participated in 6 workshops
. 11 communities and one watershed group received direct assistance
. Communities making progress in community-based natural resource protection and climate resiliency programs and projects

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
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
(#1003421) "Agricultural soils globally have lost a significant fraction of their soil organic matter reserve due to intensive cultivation, with agricultural soils in the U.S. having lost 25-50% of their original soil carbon (C) over the past century...Soil microorganisms are the engines of organic matter cycling in soils. The growth, turnover, and efficiency of soil microbes are important controls of organic matter decay and soil C storage...small changes in microbial efficiency can have large effects on soil C levels. Yet how microbial growth, turnover, and efficiency respond to environmental factors (e.g., temperature, nutrient availability, substrate quality, moisture) is still poorly understood.

What has been done
Methods for assessing microbial growth and efficiency were compared:13C and 18O isotope tracing approaches which directly estimate microbial growthand efficiency; calorespirometry that infers growth and efficiency from heat flux and respiration; metabolic flux analysis which determines microbial efficiency from the balance between biosynthesis and respiration using position-specific carbon dioxide production of added substrates; and stoichiometric modeling, which derives microbial efficiency from elemental ratios of biomass and substrate.

Results
The microbial 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 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. This research provides researchers with information on the pros and cons of each method, so they can better determine which method is most appropriate for their specific research question.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
131	Alternative Uses of Land

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

Not Reporting on this Outcome Measure

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.

Not Reporting on this Outcome Measure

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
2018	293

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The health of New Hampshire's environment depends on sound land use, strong conservation organizations and citizens engaged in natural resource management and conservation to maintain clean water, diverse natural areas and connected wildlife habitats. New Hampshire is currently experiencing a wide range of issues such as sprawling development, loss of natural areas, climate change, invasive species and declining rates of community and citizen engagement. These challenges require an interdisciplinary approach at multiple scales to improve the ecological health of New Hampshire. The Communities & Natural Resources team will work to build the capacity of community leaders and volunteers to protect and manage natural resources and strengthen community resilience.

What has been done
. Workshops
. Direct technical assistance to communities groups and community leaders

Results
. 293 Extension participants engaged with a licensed forester and/or a certified logger.

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
2018	97

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Forests are critical to sustaining New Hampshire's forest products industry and forest-related tourism and recreation which contribute more than $2 billion to the economy. New Hampshire's

forests also provide habitat for wildlife, protect water quality, and help to define the character of our communities. Increasing population, fragmentation of the resource base and changes in land ownership all affect the ability of New Hampshire's forests to meet the diverse needs of the people. Each year, New Hampshire loses approximately 13,000 acres of forest land. With increased pressures on our forest lands, comprehensive management and planning for the future is critical to maintaining the resource base and the benefits it provides. Eighty percent of New Hampshire's forestland is owned by approximately 120,000 private forest landowners. Education about forests and land stewardship is key to informed decision making by these landowners, yet a recent study found that 73 percent of New Hampshire landowners (owning 10+ acres) don't have a plan for managing their land. This program endeavors to: increase the amount of permanently protected land to provide habitat for wildlife, protect water quality, maintain our forest-based economy and help to define the character of our communities, and increase the amount of land managed using good forest stewardship
practices.

New Hampshire is the second most forested state in the nation?84% forested and 80% is privately owned?2/3 of New Hampshire. Private lands and landowners provide important environmental and economic benefits and services. An estimated 120,000 people own at least an acre of forest. UNH Cooperative Extension increases the public value received from private lands and yet the majority of forest land and landowners haven?t sought advice from us. The Forest Stewardship AOE proposes to extend our reach to ?new audiences.?

What has been done
. Workshops
. One-0n-One consultations (Site visits to landowners, fishermen and natural resource professionals)
. Volunteers training
. Technical Assistance to state agencies/organizations

Results
1. 8,000 acres of forest management plans written using the NH Forest Stewardship standards
2. 55 forest owners received federal or state financial incentives for implementing conservation practices, including management plans
3. 150 new landowners hired a forester or natural resource professional for the first time in 10 or more years
4. 140 licensed foresters increased skills and knowledge by attending at least one natural resources workshop. 5. 120 professional loggers increased skills and knowledge by attending at least on workshop through the NH Certified
Professional Logger program.
6. 811 volunteers in conservation (Coverts and Natural Resource Volunteers) extend the reach of the UNH Cooperative Extension Forestry and Wildlife program in their own communities, by actively managing over 150,000 acres and reaching out to over 12,000 people.

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.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
(#1006997)"New Hampshire, along with the rest of northern New England, has already experienced changes in climate over the past thirty
years, with conditions becoming both warmer and wetter on average, albeit with longer period of drought. How do different landscapes and vegetation types in New Hampshire affect climate,locally as well as globally?.. By understanding these processes more thoroughly, we hope to improve the accuracy of models and better understand how our climate will change as patterns of land use change in the future."

What has been done
"1.Continuous measurements of carbon dioxide (CO2) and water exchange between ecosystems and the atmosphere were made at the forest, field pasture, and cornfield sites in Durham, NH. 2.Concurrent with continuous measurements of CO2 and water fluxes, solar radiation, albedo, and heat fluxes have been made at all three of our flux tower sites: forest (Thompson Farm, Durham), field/pasture (Kingman Farm, Madbury) corn/agriculture (Moore Fields, Durham)."

Results
When looking at surface energy fluxes across land cover types, we find that forested sites are darker than all other land cover types, and absorb even more of the sun's energy than a dark

asphalt parking lot. Compared to the albedo (reflectivity) of other land cover types, the low reflectivity of forests has a warming effect on climate. However, despite absorbing more of the sun's energy, forests have the coolest surface (or skin) temperature of any other land surface in our study because forests have a very rough surface compared to other sites with shorter vegetation. Surface roughness of forests promotes turbulent mixing of air that carries heat away from the surface of the forest. It's a forest's ability to "sweat" as well as its rough surface that allows it to exchange heat with the air and enables it to maintain cooler surface temperatures than other land surfaces. We find that different land cover types and different vegetation types (deciduous versus perennial or evergreen vegetation)respond differently to climate. This is especially true during warming winter climate where different land cover types can release more or less CO2 into the atmosphere, potentially impacting climate at the global scale.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate

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
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
(#100637) "Nitrogen fixation by actinorhizal plants is an important part of the nitrogen budget of the planet. The plants involved are also of
economic significance with respect to land reclamation, reforestation, soil stabilization, landscaping, fuel, and as a food source for ruminant animals. Actinorhizal plants provide an excellent mechanism to restore disrupted environmental sites."

What has been done

"1)To understand the mechanisms by which Frankia aids the plants to overcome harsh environmental conditions, NHAES researchers have examined Frankia cultures grown under harsh environmental conditions.
2)A comparative genomics approach was used to detect regions in Frankia genomes homologous to a known dioxin-degrading operon (bph) in a closely related species, Rhodococcus RAH1.

Results
1)Selenite is a major contaminate of some soils and several Frankia strains are tolerant to selenite.These strains reduce selenite to elemental selenium, a nontoxic toxic form, and generated nanosphere particles containing selenium.
2)"Only six of the 39 available Frankia genomes, including Frankia strains EUN1f and EuI1c contain the bph operon with the putative biphenyl and dioxin-like compound degradation genes. Frankia strains EUN1f and EuI1c were able to metabolize dioxin-like compounds as a sole carbon and energy source". .."These assays confirm that Frankia is able to maintain cellular functions after dioxin-like compound exposure to respire when dioxin-like compounds are the only carbon source available."

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology

Outcome #13

1. Outcome Measures

Identify opportunities and barriers to the new flood management approach in NH.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1011028 "Flooding already threatens agriculture, infrastructure and ecosystems in NH. Shifting away from the flood defense approach toward a flood management approach can lead to more resilient river systems, for example by bringing nutrients to 'bottomland' and preserving floodplains for farm use that can also absorb the immediate impacts of flooding. Achieving (flood management).. benefits requires information about how to manage trade-offs among different

floodplain services."

What has been done
1."Analysis continued of the federal and New Hampshire policies for flood risk management and of responsibilities of state and federal regulatory agencies governing flood management.
2.Data available for mapping flood risk management for geospatial analysis using Geographic Information System mapping technology have been identified (ongoing). A database is being developed of flood risk management projects on agricultural land."

Results
1."A strategy for characterizing relevant current municipal policies was developed, which includes the development of an interview protocol and plans for three phases of interviews with municipal planners and board officials...The first phase of interviews within New Hampshire's coastal communities was initiated and seven interviews were conducted and transcribed. A framework for analyzing the interviews is under development.
2. 21 (Flood risk)locations were identified through available literature, interviews, and municipal meeting minutes."

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #14

1. Outcome Measures

Develop and apply a general conceptual model for supply and demand (of water quality) at river network scales that integrates point and non-point sources (supply) from agriculture and urban areas, and aquatic sinks (demand).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

#1013433 "Water quality problems are known to result from a variety of human activities such as agriculture and urbanization...However, many water quality problems are reduced because of processes in water bodies themselves. As pollutants travel through river systems, the probability that pollutant loads are at least somewhat reduced by freshwater ecosystems increases. The factors that control this function are poorly understood. The role of river networks in attenuating water quality problems is also under appreciated by many policy makers and land managers that are trying to address water quality problems."

What has been done

1."Develop and apply a general conceptual model for supply and demand at river network scales that integrates point and non-point sources (supply) from agriculture and urban areas, and aquatic sinks (demand)."
2."Develop models for each of these variables to understand their variation in time and space throughout river networks and the role of aquatic processes in defining these distributions."
3. "Quantify the relative importance of different factors that control supply and demand of different variables in river networks."

Results

"Key findings and implications include: 1) river networks have a finite capacity to attenuate nutrient fluxes from agricultural or urban land because supplies overwhelm demand, but that ponded waters significantly increase capacity. These results suggest that natural resource managers should prioritize loading reductions in watersheds with fewer ponded waters first, and that function of the entire range of water bodies from small streams to large rivers should be protected. 2) River networks are
able to retain a large proportion of nutrient inputs during small storms and much less during large storms. This indicates that if extreme flow events increase, we will be able to rely less on retention by aquatic ecosystems, and that stormwater controls that reduce flood peaks will result in increasing aquatic nutrient retention. 3) A large proportion of rivers in New Hampshire are impaired by high salt concentrations, mostly during summer, due to road salt applications in winter...improvements. 4) Model projections show that climate will have a greater influence on future aquatic ecosystem services than plausible changes in land cover, though the latter exacerbates impacts. Minimal changes in aquatic environmental indicators are predicted through 2050, after which the high emissions scenarios show rapidly intensifying impacts."

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #15

1. Outcome Measures

Revise existing model of soil N processes to include the role of soil microbial communities on N mineralization and N availability to plants.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
1007001 .."(H)umans add approximately three-fold more biologically available nitrogen (N) to terrestrial ecosystems than natural sources.. ..(M)uch of this N is lost from agricultural fields, with wide-ranging impacts across local, regional, and global scales..N mineralization involves the conversion of organic to plant-available inorganic N (in the soil). Existing concepts ignores the role of microbial communities in N mineralization...The long-term goals are to identify effective mitigation strategies and supporting policies requires an integrated understanding of the processes underlying potential agricultural N responses to climate change."

What has been done
" .. (A) commonly overlooked but potentially important source of (soil) nitrogen (is)organic matter bound to clay particles. Although generally considered inaccessible to plants, NHAES researchers explore(d) how plant root exudates drive the microbial and non-biological release of nitrogen from clay associations, (using) laboratory incubation in which exudate-like compounds (were added) to soils composed of only sand and physically-isolated, mineral associated organic matter (MAOM). The use of stable isotopically-enriched carbon additions allowed... detect(ion)of the proportion of CO2 respired that was derived from externally-applied carbon or from the soil organic matter."

Results
"Carbon additions stimulated microbial activity, extracellular enzyme production, and the subsequent breakdown of MAOM-derived carbon and
nitrogen... C additions stimulated CO2 respiration and MAOM degradation...(NHAES) researchers observed a net positive priming
effect indicating that microbes were releasing C from MAOM at a faster rate than in the control. The magnitude of this priming effect was significant: increases of 200-400% in glucose treatments and up to 280% in oxalic acid treatments...gross ammonium production
was positively associated with the priming of MAOM-C. (These)results indicate that common root exudates, like glucose and oxalic acid, can significantly increase the turnover and potential release of C and N from MAOM."
Impact: "Show(ed) that microbial communities and their physiology are strong controls over (soil) N mineralization and this N availability. This work could ultimately lead to managing soils to foster more N efficient microbial communities that deliver N to plants when they need it most."

4. Associated Knowledge Areas

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

Outcome #16

1. Outcome Measures

Establish whether there are significant impacts of wind turbine seismic vibration on the reproductive health of subterranean invertebrates such burying beetles.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
1010114 "Wind energy is increasingly promoted and viewed as a sustainable compliment 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 NHAES researchers 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."

What has been done
1.The Howard laboratory has thus far completed four sets of replicate experiments testing vibrational noise effects on burying beetle
reproductive behavior, which is directly related to soil nutrient cycling, with intensities from low (5 mm/s) to high (~40 mm/s).

Results
1.Findings thus far 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. As vibrational intensity increases, however, beneficial soil invertebrates begin to incur a cost related to exposure to soil seismic disturbance. Carcass handling times increases and the size of the brood decreases in noisy conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

Outcome #17

1. Outcome Measures

Assess the impact of integrated multitrophic aquaculture (IMTA) on native seaweeds in NH

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1007230 "Comparisons of historical and recent floristic/ chemical evaluations can provide a valuable baseline for future assessments and remediation of many Gulf of Maine sites, including those within the Great Bay Estuary System of Maine and New Hampshire... (Do) these polyculture system cause direct introductions of nonnative seaweeds? In addition does enhanced eutrophication associated with these systems cause enhanced algal blooms and/or impact native vegetation?"

What has been done
"(Compared) historical and recent seaweed biodiversity patterns at four to six New Hampshire sites, including IMTA at UNH's Coastal Laboratory in Newcastle and selected sites in Great Bay proper, plus other stressed and non-stressed sites (and in the southern part of the Gulf of Maine)..(Summarized) the occurrence and abundance of several opportunistic/ nuisance/introduced species (e.g. ulvoid green algae, the brown alga Pilayella litorallis, and Asiatic Gracilaria taxa) that occur in aquaculture, stressed, and non-stressed habitats, including shallow warm embayments.

Results
"A synopsis of native and introduced seaweed taxa from 14 open coastal and estuarine sites in southern Maine and NH was also summarized by Mathieson and Dawes (2018c). Their findings were based upon long-term (decadal) collections made between 1965-2018. Sixteen introduced and 177 native 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)...Glenn et al. (submitted) described "Native and introduced seaweed communities in

four habitats within the Great Bay Estuary, New Hampshire". These included seaweeds found on oyster farm gear, plus in situ native oyster reefs, eelgrass beds, and
mudflats. Mean species richness was significantly and substantially lower on mudflats than the other three habitats, particularly those associated with oyster farm gear. Four Asiatic seaweeds were found growing abundantly near oyster aquaculture sites within the Great Bay Estuary System (i.e. within Little Bay proper), while they are less abundant at nonaquaculture sites."

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Competing Programmatic Challenges
- Other (System structure)

Brief Explanation

UNHCE: In order to address the needs of minority groups, the program leaders, purposely restructured the program by identifying specific outcomes that target those needs.
NHAES: no impact of external factors on research

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE:
172 people responded to the 2018 conference evaluation:

- 96% of the 179 people who completed the conference evaluation said they increased their knowledge of land conservation issues.
- 95% of respondents said the conference met their expectations and were satisfied with the variety of workshops offered.
- 96% of respondents said they learned something they will apply in their work.
- 96% of the participants said the workshop topics were relevant to their interests.

NHAES: There are 11 diverse research projects in the Applied Planned Program.

- The first level of evaluation of the success of these projects is publications of results in peer-reviewed journals (36), and as conference papers (32).
- High impact research resulted from several NHAES research projects
- The Grandy Lab has made major strides in illuminating how soil microbes contribute to N mineralization and the availability of Nitrogen to Plants. The impact of more fully understanding agricultural N responses to climate change resulted in two major review publications:
- An interdisciplinary review: Bowles, T.M., Atallah, S.S., Campbell, E.A., Gaudin, A.C.M., Wieder, W.R. and A.S. Grandy. 2018. Agricultural nitrogen losses in a changing climate: Processes, predictions, and agroecological solutions, Nature Sustainability, 1:399-408. Featured in USDA NIFA Blog. https://nifa.usda.gov/blog/unh-recommendations-seek-help-farmers-curb-agriculturalnitrogen-losses (#1007001)

• a conceptual framework to challenge current assumptions about N mineralization, a key source of N in all soils: Jilling, A., Contosta, A.R., Frey, S., Scimel, J., Schnecker, J., Smith, R.G., Tiemann, L., and A.S. Grandy. Minerals in the rhizosphere: overlooked mediators of soil nitrogen availability to plants and microbes, Biogeochemistry, doi:10.1007/s10533-018-0459-5 (#1007001,#1003421)

• NHAES researcher Wil Wollheim works on how water quality is impacted by agriculture and urbanization reached several key findings and resulting implications: "Key findings and implications include: 1) River networks have a finite capacity to attenuate nutrient fluxes from agricultural or urban land because supplies overwhelm demand, but that ponded waters significantly increase capacity (to attenuate nutrient fluxes). These results suggest that natural resource managers should prioritize loading reductions in watersheds with fewer ponded waters first, and that function of the entire range of water bodies from small streams to large rivers should be protected. 2) River networks are able to retain a large proportion of nutrient inputs during small storms and much less during large storms. This indicates that if extreme flow events increase, we will be able to rely less on retention by aquatic ecosystems, and that stormwater controls that reduce flood peaks will result in increasing aquatic nutrient retention. 3) A large proportion of rivers in New Hampshire are impaired by high salt concentrations, mostly during summer, due to road salt applications in winter. The annual snowfall amount, which drives road salt loading, was a driver of chloride impairment in headwater streams during summers, whereas summer runoff from forested watersheds determines chloride levels in larger rivers. Future declines in snowfall have a delayed impact on stream chloride due to large groundwater storage pools. These results suggest that the amount of road salt applied to New Hampshire roads should be optimized and that managers will need to be patient to see environmental improvements. 4) Model projections show that climate will have a greater influence on future aquatic ecosystem services than plausible changes in land cover, though the latter exacerbates impacts. Minimal changes in aquatic environmental indicators are predicted through 2050, after which the high emissions scenarios show rapidly intensifying impacts. These findings suggest that actions that mitigate climate change are important to implement now and that we should prepare for our natural ecosystems to begin to drastically change in the near future. (#1013433)

Key Items of Evaluation

UNHCE:

• 8,000 acres of forest management plans written using the NH Forest Stewardship standards

• 55 forest owners received federal or state financial incentives for implementing conservation practices, including management plans

• 150 new landowners hired a forester or natural resource professional for the first time in 10 or more years

• 140 licensed foresters increased skills and knowledge by attending at least one natural resources workshop.

• 120 professional loggers increased skills and knowledge by attending at least on workshop through the NH Certified Professional Logger program.

• 811 volunteers in conservation (Coverts and Natural Resource Volunteers) extend the reach of the UNH Cooperative Extension Forestry and Wildlife program in their own communities, by actively managing over 150,000 acres and reaching out to over 12,000 people.

NHAES:

- NHAES researcher A. Stuart Grandy gave the keynote address at the 2018 Soil Health Institute " Microbial Physiology Regulates How Much Crop Residue Becomes Soil Organic Matter" https://www.youtube.com/watch?v=-W4C1vte4eA&feature=share
- NHAES research Scott Ollinger (#1006997) is synthesizing the results of long term monitor of surface energy fluxes to improve climate change modeling: "When looking at surface energy fluxes across land cover types, we find that forested sites are darker than all other land cover types, and absorb even more of the sun's energy than a dark asphalt parking lot. Compared to the albedo (reflectivity) of other land cover types, the low reflectivity of forests has a warming effect on climate. However, despite absorbing more of the sun's energy, forests have the coolest surface (or skin) temperature of any other land surface in our study because forests have a very rough surface compared to other sites with shorter vegetation. Surface roughness of forests promotes turbulent mixing of air that carries heat away from the surface of the forest. So it's a forest's ability to "sweat" as well as its rough surface that allows it to exchange heat with the air and enables it to maintain cooler surface temperatures than other land surfaces."

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%		8%	
133	Pollution Prevention and Mitigation	0%		10%	
205	Plant Management Systems	0%		17%	
216	Integrated Pest Management Systems	0%		13%	
403	Waste Disposal, Recycling, and Reuse	0%		5%	
601	Economics of Agricultural Production and Farm Management	0%		10%	
603	Market Economics	10%		0%	
605	Natural Resource and Environmental Economics	0%		12%	
608	Community Resource Planning and Development	80%		0%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%		25%	
805	Community Institutions and Social Services	10%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	11.0	0.0	1.0	0.0
Actual Paid	10.0	0.0	2.2	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**
141091	0	105533	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
141091	0	166447	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
259827	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

UNHCE will conduct:

- Workshops and seminars
- One-on-one business consultations and technical assistance
- Twilight meetings
- Development and dissemination of business resources and publications (web and print)
- Media releases (news and radio)
- Technical assistance in Economic development.
- Economic development planning.
- Community planning forums/charettes.

NHAES researchers:

- Identified and analyzed constraints and opportunities for local agriculture in Northern New England.
- Document nonmetropolitan demographic changes and disseminate information about demographic trends in rural America to policy and academic audiences.
- To support NH's rural industry of production greenhouses of plants for sales in garden centers: Evaluated the impact of alternative potting materials (wood chips, coconut coir, bark, perlite) replacing sphagnum moss of high-value greenhouse crops for garden planting.
- Use chemical ecology principles with economically attractive implementation approaches to provide apple growers with options to integrate environmentally friendly, non-pesticidal control of various agricultural pests and improve management of pollinator services.

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 local, state, regional and federal 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, greenhouse and landscape professionals.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3520	10000	95	0

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	3	5	8

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
2018	248

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
2018	33

Output #3

Output Measure

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

Year	Actual
2018	792

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
2018	16

Output #6

Output Measure

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

Year	Actual
2018	19

Output #7

Output Measure

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

Year	Actual
2018	10

Output #8

Output Measure

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

Year	Actual
2018	6

Output #9

Output Measure

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

Year	Actual
2018	24

Output #10

Output Measure

- Number of graduate students directly involved in research project.

Year	Actual
2018	6

Output #11

Output Measure

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

Year	Actual
2018	2

Output #12

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Actual
2018	16

Output #13

Output Measure

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

Year	Actual
2018	29

Output #14

Output Measure

- Number of people attending workshops/twilight meetings

Year	Actual
2018	462

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.

Year	Actual
2018	127

Output #16

Output Measure

- Number of recommended practices implemented by communities aimed at retaining and/or expanding existing businesses.

Year	Actual
2018	14

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.

Year	Actual
2018	2

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.

Year	Actual
2018	3

Output #19

Output Measure

- First draft of an NH apple enterprise budget to use agrobiodiversity as a tool to control pests :

Gala and cider apple production in NH sample costs and profitability analysis

Year	Actual
2018	1

Output #20

Output Measure

- Construction of a computational model that can be used in Decision Support System in apple pest management.

Year	Actual
2018	1

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	Evaluate the potential for local agriculture expansion and regional restaurants demands for locally produced food, in order to make local food production more profitable.
14	Evaluate the effects of wood chips and fiber on growing media pH buffering capacity for high value greenhouse crops.
15	Evaluate the impact of wood chips and fiber medium to immobilize Nitrogen and resulting impacts on high-value greenhouse crops.
16	Documentation of non-metropolitan demographic change.

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
2018	461

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, Business Retention and Expansion, Outreach and Engagement Skills and data collection skills.

Results
Among the participants of over 20 workshops and trainings that engaged 689 community members, 461 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
2018	104

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
See the previous outcome

What has been done
See the previous outcome

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
2018	997

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
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
2018	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
See previous outcome

What has been done
See previous outcome

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
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 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1013434 "This NHAES project examines recent New Hampshire demographic trends in both rural and urban areas. As part of the larger W-4001 multistate project, it also helps us to understand how the patterns of demographic change in New Hampshire fit into the broader regional and national patterns of rural demographic change. This research is important because New Hampshire has long depended on fertility and an influx of well educated, high-income migrants to expand its human capital base. There is significant evidence that these demographic processes were disrupted by the Great Recession and this has significant implications for the state's future".

What has been done
"document nonmetropolitan demographic change and disseminate information about these demographic trends in rural America to critical academic and policy audiences."

Results
"The project director" contributed to the accomplishment of this goal of disseminating information.. in the past year by: 1) speaking about rural and urban demographic trends in New Hampshire to N.H. State House-Senate Ways and Means and Finance Committees Joint Meeting in Concord, NH. (100 people).. "and presenting research results on demographic trends in New Hampshire to the Cooperative Extension and Sea Grant program staff, as well as to the New Hampshire Senior Leadership and Society Committee."

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Disseminate results from greenhouse growth trials on ornamental and alternative crops

Not Reporting on this Outcome Measure

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
2018	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
601	Economics of Agricultural Production and Farm Management

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.

Not Reporting on this Outcome Measure

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.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	23064

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
See previous outcome

What has been done
See previous outcome

Results

4. Associated Knowledge Areas

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

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

2018	27

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
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
2018	127

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

Outcome #13

1. Outcome Measures

Evaluate the potential for local agriculture expansion and regional restaurants demands for locally produced food, in order to make local food production more profitable.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
What are new ways to make local (regional) agriculture more profitable?

What has been done
1015411 "An in-depth overview of the major facets regarding local agriculture expansion potential was completed, with direct contacts with farmers, surveys of New Hampshire restaurants, and surveys of the general public. Further work included examining the role of intermediate distributors of locally grown produce to the general public, including grocery stores and seacoast area restaurants.

Results
"Preliminary results indicate that even in relatively similar and geographically proximate states, demand functions may differ considerably. Feedback was elicited on the types of information growers and distributors would like to have from restauranteurs and grocery stores."

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #14

1. Outcome Measures

Evaluate the effects of wood chips and fiber on growing media pH buffering capacity for high value greenhouse crops.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1012018 "There are often economic and environmental benefits to using new alternative materials in the growing media to produce
high-value greenhouse 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
"..a range of horticultural growing media formulated using different proportions of sphagnum peat, coconut coir, bark, perlite, and wood
fiber were evaluated for their pH buffering in a laboratory titration procedure. pH buffering was measured by dosing samples
of each media with hydrochloric acid and recording the amount of decrease in pH."

Results
"Media with greater proportions of alternative material, such as wood fiber, and less sphagnum peat had lower less pH buffering. This was verified in a greenhouse experiment where impatiens were grown in each media and irrigated with acidic and basic reaction fertilizers that lowered and raised pH, respectively. 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."

4. Associated Knowledge Areas

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

205 Plant Management Systems

Outcome #15

1. Outcome Measures

Evaluate the impact of wood chips and fiber medium to immobilize Nitrogen and resulting impacts on high-value greenhouse crops.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1012018 "There are often economic and environmental benefits to using new alternative materials in the growing media to produce high-value greenhouse 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 management strategies."

What has been done
"Flowering petunia were grown in containers in the greenhouse in media containing up to 30% or 50%(by volume) wood fiber, wood chips, and coconut coir from multiple suppliers (the remainder of the media was sphagnum peat). We evaluated the effects of alternative media materials on plant performance and the potential to immobilize
fertilizer nitrogen, making nitrogen unavailable for root uptake."

Results
"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."
"Petunias were grown in media with up to 50% wood chips and fiber and were supplied fertilizer with low, moderate, high, and very high levels of nitrogen. Again, a reduction in growth and flowering were measured. Across media suppliers, media containing 50% wood fiber resulted in plants with the least amount of growth and flowering and the lowest nitrogen."

4. Associated Knowledge Areas

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

Outcome #16

1. Outcome Measures

Documentation of non-metropolitan demographic change.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
#1013434"Rural populations are changing in both size and structure and affects a wide range of social and economic outcomes. .. To analyze longitudinal rural demographic change over such a vast and diverse region, researchers need to be cognizant of the complex interplay between migration and natural increase that influences contemporary rural population redistribution trends and of the social, economic and environmental forces that both influence demographic change and are impacted by such population change. The economic shock of the Great Recession and its aftermath has had serious implications for population change, fertility and migration trends in New Hampshire and rural America more generally.This research is important because New Hampshire has long depended on fertility and an influx of well-educated, high-income migrants to expand its human capital base. TThere is significant evidence that these demographic processes were disrupted by the Great Recession and this has significant implications for the state's future."

What has been done
Demographic analyses have been carried out for rural America for periods before and after the Great Recession, tweezing apart migration rates and rates of natural increase.

Results
1)A slow down in net migration (in the United States)...and the rate of natural increase have occurred in both rural and urban America--although rural America has been more significantly impacted. 2)Nearly a third of all rural counties in the U.S. are depopulating. 3)The Great

Recession "froze people in place" by reducing migration and diminishing fertility gains. There is some evidence migration is picking up again, at least in rural areas.4) "In rural areas with histories of population loss or slow growth (farm areas), there is no evidence of population gains and nearly 80% of the farm counties are depopulating".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. 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
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Other (Staff change)

Brief Explanation

UNHCE:

- Three new hires on a team of ten people. This requires a lot of onboarding
- One county provided additional financial support for a new position
- Grant landscape has changed and work to support enterprise development is harder to access

NHAES: no external factors impacted outcomes

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNHCE:
The following is the highlights of our programs to Supporting A Rural Economy:
Communities: We provided programs, training, technical assistance and/or teaching in Sullivan County, North Country, Lancaster, Gorham, Pittsfield, Tilton, Alton, Northfield, North Hampton, Milton, Exeter, Farmington, Canterbury, Bradford, Henniker, Andover and Bristol. We had 175 community members indicate they had a new or expanded leadership role due to this programming.
Community Action: We worked with 16 action committees on various topics such as regional identity, quality of life, workforce development, river district, economic development, business diversity and visual appearance. Four communities have gone on to seek additional funding. Ten projects have been implemented by communities including the LoveSullivan asset mapping, holiday decorations in Gorham, Portsmouth working with

businesses to recruit UNH students and more. Much more is in the planning stages with local volunteers leading the way to making positive change to economy and community.
Volunteers: We worked with 237 community volunteers. These citizen leaders are a part of community task forces, steering committees and municipal boards that participate in our programs to expand the economic opportunities for their community. The dollar value of volunteer hours committed by program participants to plan and implement community projects/activities: 2043 volunteer hours x 24.14 = $49,318

NHAES: Research progress may be measured as: publications in peer-reviewed journals (4), graduate dissertations (1), book chapters (2), and papers presented at professional conferences (12).
Other indirect measures of research results are noted as communication of research results to stakeholder communities.

1. A important goal of W4001-R is "to document nonmetropolitan demographic change and disseminate information about these demographic trends in rural America to critical academic and policy audiences." #1013434. The Project Director's contribution to dissemination included "speaking about rural and urban demographic trends in New Hampshire to N.H. State House-Senate Ways and Means and Finance Committees Joint Meeting in Concord, NH. It was attended by approximately 100 people including the Chairs of both committees, numerous committee members from both the House and Senate and policy staff and media." He has also discussed rural population change and the impact of these demographic trends in rural America, in the state of New Hampshire and in the U.S. "This includes numerous media mentions of my work in the past year. These media mentions include major national media such as the New York Times (4 times); Wall Street Journal (2 times); Washington Post; US News (3 times); USA Today (2 times); and National Public Radio (2 times). "
2. #1015411 Dr. Halstead work on improving the profitability of local food production has provided opportunities both to collect data and convey their results to local farmers. "Through our focus groups, we have constructed a network of about 50 farmers in Vermont, New Hampshire, and Maine. While these farmers have served to provide us with information on practices, constraints, history, etc., they have also been a way for us to reach out to the local agricultural community." He also reports community planners, Towns in New England and elsewhere are very interested in our work on managing plastic bag waste ... There is also substantial interest in our work expanding markets for recycled paper in the region."
3. #1012018 Asst. Extension Specialist Ryan Dickson communicated his results of the impacts of substituting wood fiber and coir for sphagum moss in high-value greenhouse crops "via Online newsletters and reports were written for e-GRO (electronic grower resources online), which is an online source for applied research and extension that reaches growers and academics nation-wide. In addition, articles were published in the
national trade magazines GrowerTalks, Greenhouse Management, and Produce Grower, as well as for New Hampshire Cooperative Extension and the New Hampshire Communicator."

Key Items of Evaluation

NHAES: Prof. Ken Johnson, project director for #1013434 was "... selected as an Andrew Carnegie Fellow by the Carnegie Corporation... and was one of just 33 recipients of the award which is considered the most prestigious fellowship for social science research. "

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%	
806	Youth Development	40%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	20.0	0.0	0.0	0.0
Actual Paid	44.0	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**
423328	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
423328	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1636810	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 - including N.H. Afterschool Professional Development Career System and Certification Process
- Marine Docent educational work with schools and groups
- Science Literacy statewide community of practice for agencies/organizations involved in this work
- 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

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	9259	30078	20633	313

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of volunteers developed

Year	Actual
2018	1480

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
2018	14250

Output #3

Output Measure

- Number of youth attending Barry Conservation Camp

Year	Actual
2018	240

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
2018	1960

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
2018	93

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent research indicates that youth are spending less time outside than ever before. A growing body of research also indicates that direct exposure to nature is essential for healthy childhood development and for the physical and emotional health of children. Barry Conservation 4-H Camp (BCC) gets kids unplugged and outdoors. It provides a non-threatening environment for youth to be active, to develop competence in life skills, to learn about and enhance their own abilities and to benefit from meaningful participation in a community designed just for them. In New Hampshire, there are many youth residential camps which are American Camp Association accredited, but few focus on the combination of environmental education and positive youth development.

What has been done
UNH Cooperative Extension, 4-H youth development partners with New Hampshire Fish and Game to provide the residential, environmental, educational camp in the White Mountain of New Hampshire, Barry Conservation 4-H Camp. Trained and certified staff and volunteers provide week-long experiences for youth 10-17 years of age. Program focuses include fishing, shooting sports, hunter certification, basic environmental education and wilderness exploration, wildlife law enforcement, plus a mini-camp experience for young campers age 8-12. Camp provides children with a community of caring adults, who nurture experiential education that results in self-respect and appreciation for human value. All of the outcomes - self-identity, self-worth, self-esteem, leadership, and self-respect - build personal competencies. These personal competencies are reflected in the four "C's" of the camp community: compassion, contribution, commitment, and character. These "C's"? of personal development mirror the positive youth development that happens in other 4 H experiences.

Results
.89% say that if someone is being picked on, young people try to stop it

.90% indicate young people never or rarely keep others from being part of activities or groups

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
2018	554

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
UNHCE's 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. 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
Six hundred and ninety-nine adults (699) enrolled in a series of lessons and three hundred and ninety-one (391) completed the series.
Of those completing a pre/post survey related to nutrition and physical activity behaviors, significant impacts include:
.29% (502 of 1735) of youth reported an increase in how often they eat vegetables; grades 3-12
.18% (57 of 325) of youth reported an increase in knowledge about vegetables; grades K-2

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
2018	60

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 include:
.60% (230 of 382) of adults reported an increase in healthier food choices

4. Associated Knowledge Areas

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

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
2018	92

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
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 a 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 marine science, ecology, robotics, engineering, and computer science.

Results
.92 % of youth surveyed (n=215) and who participated in one of UNHCE's Science Literacy related programs reported "I really enjoyed this science activity/project".

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

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

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

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Other (Staff change)

Brief Explanation

Implementation of our program was impacted by ongoing staff change that requires onboarding and training.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A total of 196 participants completed the end of the program survey.

- 98% stated that they were more confident that they could recognize the signs that a young person may be dealing with a mental illness
- 95% 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
- 94% 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

Key Items of Evaluation

- Educating and equipping adults with knowledge and skills to address youth mental health issues can increase mental health literacy, decrease stigma and insure that more young people will access treatment and recover.

- Connecting young people with the proper supports for their mental health or substance abuse disorder early on may help to prevent future disability or loss of life due to suicide, lower health care costs, lessen involvement in and decrease costs associated with juvenile justice and other social services.

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)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
1561	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)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
4	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.