2018 University of Maine Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The University of Maine Cooperative Extension and the Maine Agricultural and Forest Experiment Station (MAFES) have served the people of Maine for over 100 years. Over 160 faculty and professionals contribute to the outreach, research, and development programming benefiting the people of Maine. We ensure our research and extension outreach programs meet local needs by grounding them with input from a variety of advisory groups, regular meetings with constituency groups at field days and other events, county extension advisory committees, and through direct faculty interaction with cooperators and constituents.

UMaine Extension is a partnership of county, state and federal funding. By conducting Extension programs in every Maine county, we support UMaine's public education and service role as a land grant and sea grant institution. Extension helps support, sustain, and grow the food-based economy, and conducts the most successful out-of-school youth educational program in Maine through 4-H.

MAFES is the College of Natural Sciences, Forestry, and Agriculture's center for applied and basic research. MAFES faculty and scientists use cutting-edge tools to address new challenges for Maine's natural resource based industries and develop the new knowledge that fuels innovation.

In 2018, UMaine Extension and MAFES programs continued to focus on 5 planned program areas:

Maine Food System through research and outreach related to agriculture, aquaculture, food processing and distribution, business education, food safety, and human nutrition.
Positive Youth Development through 4-H programs with a focus on the STEM disciplines.
Sustainable Community and Economic Development through programs related to small & home based businesses, household resources, community assets, farm business management, natural resource-based industries, and commercial fisheries.
Climate Change by conducting research to understand changing global and regional climate patterns, and how these changes impact the state's agricultural and natural resources.
Natural Resources in agriculture and food sciences, forestry and wood products, fisheries and aquaculture, wildlife, outdoor recreation, and rural economic development.

Supporting Maine's Traditional and Changing Agricultural Economy

Maine agriculture is diverse with important sectors that include potatoes, wild blueberries, maple, dairy, grains, livestock, poultry, fruits, vegetables, and ornamental horticulture. Even though Maine is 90 percent forested, the state has over 8,200 farms, the largest number of any New England state. UMaine Extension played pivotal roles in supporting a majority of these farms over the past year.

The Maine potato industry encompasses over 500 businesses employing over 2,600 people and providing over $112 million in income to Maine citizens. The economic impact from our pest monitoring and educational programs for the 2018 season is estimated to be more than $8 million.

Maine's wild blueberry industry, with 500 growers on 44,000 acres produces 100 million pounds of blueberries and has a direct and indirect economic impact of over $250 million to the state's economy. UMaine Extension outreach and research efforts improved crop productivity and efficiency by addressing pollinator population enhancement, weeds, pest insects, and diseases. The research-based knowledge provided to growers has enabled growers in Maine to remain competitive in the world marketplace and maintain a significant contribution to the State's economy.

Maine has the third largest maple production in the United States, behind Vermont and New York. Our maple industry has an annual statewide economic contribution of $48 million in output, 805 full and part time jobs, and over $25 million in labor income. UMaine Extension leadership in an annual International Maple Syrup Institute Maple (IMSI) Grading School supports this important internationally recognized industry.

Maine's dairy industry generates more than $570 million a year for the state's economy and contributes more than $25 million in state and municipal taxes. Dairy farms employ more than 1,300 people statewide, and the industry provides more than 4,000 jobs for Maine people. For public safety and quality control reasons, all dairy producers must keep pathogenic bacteria out of their dairy animals and their dairy products. At the The UMaine Veterinary Diagnostic Laboratory (VDL), Extension staff screen both large and small dairies for mycoplasma, one of the most problematic pathogens for producers of milk or beef. Farmers avoid antibiotic use by culling animals with incurable infections, such as Staphylococcus aureus or Mycoplasma bovis. This protects public health, jobs, and this sector of the state's economy.

The expanding interest in locally grown grains among consumers and food businesses represents a new economic opportunity for grain growers looking for higher value and diversified markets. However, these new grain markets are dispersed and often seeking specific types and varieties of grain unfamiliar to Maine growers. UMaine Extension connects growers with buyers in high value markets and provides the production information needed to help growers succeed, creating increased revenue for Maine growers.

Interest in agriculture and starting new farms in Maine has increased dramatically over the past fifteen years. Since 2011, UMaine Extension has provided educational outreach through its "So You Want to Farm in Maine" series to enhance the skills, business management knowledge, confidence of new and established farmers. The SYWTFIM series has reached over 500 participants from all Maine counties and out-of-state. A survey sample of participating farmers (n=158) revealed 88 new jobs, with estimated wages of $612,000 annually, and an estimated total market value of agricultural products sold by these farms of over $2.2 million annually. In 2017, when the training qualified as FSA borrower training, farmers with FSA loans were able to complete their loan requirements and received nearly $313,000 in farm loans. In 2018, this figure rose to $1.4 million in farm loans.

In 2012, UMaine Extension used a SARE professional development grant to focus on increasing the ability of individual agricultural service providers (ASPs) to meet the needs of new and beginning farmers. This sparked the formation of the Beginning Farmer Resource Network of Maine (BFRN), a coalition of Maine agriculture agencies and organizations working together to connect aspiring and beginning farmers to resources for farm business success. In 2018, an impact survey of BFRN members showed that as a result of BFRN, over 800 farmers have made changes (e.g. business planning and accessing technical assistance), affecting about 40,750 acres and 47,265 animals, and resulting in a total value over 5 years of over $8 million.

Coordinating and Investing in Agricultural Research and Extension Outreach

The Maine Food and Agriculture Center is a partnership of Cooperative Extension and MAFES, and is located on the University of Maine campus in Orono. The center utilizes the 16-county reach of Extension,

and many of Extension's recommendations to the state's agricultural community come directly from research conducted at Experiment Station farms. This research-extension partnership has been working for over 100 years and is as vital today as it was early in the 20th century. With $5 billion in overall economic impact, agriculture, commercial fishing, and food processing include Maine's largest, fastest growing, and most promising industries. The Maine Food and Agriculture Center is growing to encompass all sectors of the burgeoning food economy, establish first-contact access to the programs and expertise available at all seven of Maine's public universities, and create opportunities for cross-campus and cross-discipline coordination and program development based on emerging needs in Maine's food economy.

A large investment in infrastructure and programming was realized in June 2018 with the opening of the University of Maine Cooperative Extension Diagnostic and Research Laboratory. Funded by an $8 million bond referendum, the lab occupies a 28,000-square-foot commercial laboratory building located a few miles from campus, and houses our Veterinary Diagnostic Lab, Aquatic Animal Health Lab, Arthropod Lab, and Plant Disease Diagnostic Laboratory. This facility is the most bio-secure location within the UMaine System. The new lab brings together scientists researching animals, agriculture, insects, and plants under one roof. The unique combination of researchers provides many teaching opportunities for students, as well as premier research and outreach facilities. By allowing for research contributions to agriculture, public health, communities, and wildlife, the lab will benefit Maine in a variety of ways, including protecting the natural resource- and food-based economies, adding to food safety and human health, and providing unique diagnostic and testing services to farmers, homeowners and the public.

Offering Assurances of Healthy Animals and Products

The University of Maine Veterinary Diagnostic Lab (VDL) provides services to the veterinarians, livestock producers, and animal owners of the state. The lab performs a variety of diagnostic services, including necropsy, microbiology, virology, pathology, and special research support. It offers diagnostic support to veterinary clinicians, and assists in finding solutions for agricultural producers using UMaine Extension resources. In 2018 UMAHL tested over 6,000 samples, the great majority of which were from farm animals. Our salmonella and mastitis labs test poultry farm environmental swabs and milk, allowing farms of all sizes to operate with more assurance of healthy animals and healthy products. The new Diagnostic and Research Laboratory has expanded the VDL's services, outreach, and positive impact on Maine's farms.

Helping Farms to be Safe and Accessible

UMaine Extension provided farm safety training to 294 youth and farmers, including 167 in tractor safety. To support this programming, Extension collaborated with legislators, Maine Farm Bureau, the New York Center for Agricultural Health and Medicine, tractor dealerships, and local farms. In 2018, 70 individuals completed the 5 week, 20 hour, National Safe Tractor and Machinery Operation Program curriculum. Forty-nine people took the abridged Tractor Safety Short Course.

Maine AgrAbility helps farmers, loggers and fishermen facing physical or cognitive challenges, to enhance their ability to farm and live independently. AgrAbility specialists assess issues and offer adaptive recommendations. They provide education about safe work methods and connect people with other resources. Since the project began in 2010, Maine AgrAbility has provided technical information to 754 farmers and conducted on-site assessments for 92 agricultural workers. The diverse agricultural operations include dairy and livestock operations, Christmas tree farms, fruit orchards, agritourism, vegetable and maple syrup production, hay sales, managing woodlots and lobstering. Clients reported increased knowledge of their conditions and increased accessibility for their daily work.

Mobilizing Support for Food Insecure Citizens

Maine has the highest rate of food insecurity in New England and ranks 7th worst in the United States. The USDA estimates that more than 208,000 individuals (16.4%) in Maine are food insecure and that we have the 3rd worst rate of very low food insecurity in the nation. Twenty percent of Maine children and 23% of seniors experience food insecurity. Since 2000, UMaine Cooperative Extension's statewide Maine Harvest for Hunger (MHH) program has mobilized gardeners, farmers, businesses, schools, and civic groups to grow, glean, and donate high quality produce to distribution sites (pantries, shelters, low income senior centers, etc.) and directly to neighbors in need, to mitigate hunger, improve nutrition and health, and help recipients develop lifelong positive nutritional habits.

In 2018, MHH also focused on educational programs that engage food pantry recipients, seniors and community gardeners in growing more of their own produce and learning practical methods of cooking and utilization of fresh produce. Since 2000, MHH participants have distributed 2.9 million lbs. of food to citizens grappling with hunger. In 2018, donations of 231,752 lbs. of fresh produce from over 100 Maine farms went to 187 hunger alleviation distribution sites. A corps of 512 volunteers logged 2664 hours and the value of the produce was over $391,660.

Training Master Gardener Volunteers

UMaine Extension's Master Gardener Volunteer (MGV) program provides participants with research-based horticulture training and connects them with meaningful service projects in their community. Maine has 910 active MGV, 87 of whom were trained in 2018. In total, they donated nearly 28,000 hours to a variety of educational and food security projects throughout the state including supporting 56 community gardens, 54 school gardens, 65 demonstration gardens, and 28 programs involving 796 youth in horticulture. Those involved with food security projects distributed 213,770 pounds of food to 165 food distribution agencies and countless neighbors in need as part of the Maine Harvest for Hunger program. Many volunteers enter the MGV program with the goal of improving their gardening skills for personal benefit and then become deeply involved and passionate about community projects.

Reducing the Risk of Foodborne Illness in Vulnerable Populations

Since 2013, 1,225 volunteer quantity cooks from across Maine have attended UMaine Extension Cooking for Crowds: Food Safety Training for Volunteers workshops. On average, these volunteers feed 500 people a week. Cooking for Crowds is an innovative program that blends food safety education with food security efforts to reduce risk of foodborne illness within vulnerable populations. Program participants have increased their knowledge base to reduce food borne illness in the 5 million meals they serve annually to Maine's food insecure population. Assuming that foodborne illness patterns mirror population patterns and that Cooking for Crowds reduces foodborne illness in Maine by even just 1 percent, the program is estimated to prevent more than $640,000 in economic losses and 1,977 cases of foodborne illness each year.

Helping Youth Make Good Nutritional Choices

In 2018, over 2,500 youth participated in the Maine Expanded Food and Nutrition Education Program (EFNEP). Youth participated in an average of 6 classes over a time frame of two months. Ninety-seven percent of participating youth completed a pre and post survey. As a result of participating in EFNEP:

- 73% of youth improved their abilities to choose foods according to current Dietary Guidelines.
- 47% youth used safe food handling practices more often.
- 29% youth improved their daily physical activity practices.
- 64% youth improved their ability to prepare simple, nutritious, affordable food.

Teaching Broad Life Skills to Youth

Last year more than 17,700 youth participated in the Maine 4-H program by attending 4-H camps and learning centers, 4-H community clubs, school, after school, and special interest programs. We reached more under-served and underrepresented youth than ever before. With many youth participating in multiple ways, UMaine Extension faculty and staff, and more than 1,500 volunteers, provided positive learning experiences for:

- 5,400 youth through our 4-H Camp and Learning Centers
- 2,100 youth through our 4-H clubs
- 3,100 youth through our FoodCorps program
- 2,500 youth through our Eat Well program
- 5,500 youth through our Special Interest/Short Term programs
- 7,600 youth through our School Enrichment Programs

Building STEM Literacy in Youth

Relevant, meaningful, and authentic experiences in science, technology, engineering and math (STEM) are important to developing positive attitudes, increasing knowledge, and preparing Maine youth for the estimated 9 million STEM-related occupations projected between 2012 and 2022. Developing Maine youth's STEM literacy is vital to ensuring that our state continues to thrive economically and socially. Given the remote and diverse communities to which Maine youth belong, informal education can help minimize inequities in rural youth STEM education and career pipelines.

The 4-H STEM Ambassador program trained 120 college students in the development and delivery of informal STEM-based educational experiences. Combined, these volunteers worked with over 1,000 youth at 66 schools and community sites, and committed 2,400 hours of time including training, preparation and program delivery. Through this program, youth ages 8-14 come to view these Ambassadors as mentors and leaders in their community while also developing skills in STEM through hands-on activities. The program occurs through all 7 campuses of the University of Maine System.

Follow a Researcher® was created by UMaine Extension and collaborators to increase youth understanding of the research process by engaging them directly with UMaine researchers in the field. FAR® is a UMaine 4-H program using technology and social media to facilitate real-time conversations between youth and graduate student researchers working in remote locations around the world. The program is now a proven model that utilizes technology to engage new audiences with authentic scientific research, humanize the researcher, and make the research process personally relevant. Since 2015, 4,560 youth ages 7 to 18 and over 150 educators have engaged with researchers during expeditions to Peru, the Falkland Islands, Antarctica, and along the coast of Maine. In development is the Follow a Researcher® network, that will enable us to manage expeditions from multiple sites from our new website (followaresearcher.org) and engage 4-H programs and researchers from other universities to share expeditions with youth and educators from around the world.

Tech Wizards is a youth mentoring program that uses STEM education and service learning to help youth learn life and workforce skills, improve academic performance, and aspire to post-secondary education, productive careers, and community engagement. Extension coordinates the program in Maine, with funding from the U.S. Department of Juvenile Justice. In 2018, Maine's Tech Wizards program matched 120 youth along with 10 adult mentors. Youth learned invaluable STEM skills, participated in ongoing fieldwork, citizen science initiatives, service learning, and were empowered to engage with their communities and contribute their time and skills to address important scientific questions, and to recognize that environmental stewardship is both the platform for their learning and an overarching life ethic.

4-H Summer of Science is an effort to increase science proficiencies in local communities and prevent

summer learning loss. Extension staff use summer of science experiential learning activities to address summer learning loss and work toward youth engagement and interest in science. The program focuses on programming where youth already are, and uses positive 4-H youth development programs to reduce barriers to involvement in STEM. In 2018, Maine 4-H Summer of Science adult volunteers and 34 teens facilitated activities with over 2,700 youth at 40 unique sites in 9 counties.

4-H Community Central addresses the increased vulnerability that children in public housing experience due to their environment. The program places Extension staff in public housing sites in the state's two largest cities, Portland and Lewiston, where they engage youth with their parents, elders, school, and community through hands-on 4-H projects in science, leadership, and citizenship. In four years, the program has involved over 7,900 school-age participants. In their local communities, youth in grades 3-8 received over 780 hours of 4-H STEM programming taught by teen mentors and community leaders. Ninety-six teens (82% of color), in grades 9-12 dedicated over 440 hours of mentoring and leadership to young people in their communities. Participating youth have demonstrated knowledge, skills, attitudes, and behaviors necessary for fulfilling, contributing lives.

UMaine Extension 4-H Camp and Learning Centers provide programs and opportunities for youth, many from underserved populations, with transformational experiences designed to develop a sense of place and belonging, and confidence in the outdoors. In 2018, the 4-H summer camps served 1,888 youth from all 16 counties in Maine, 22 states, and 6 countries. Through living and working together, campers and staff became part of an interconnected community committed to a sustainable future. Youth and program alumni report that the 4-H Camp and Learning Center experience has helped them develop greater self-confidence, civic engagement, and personal and academic success. The Camps' Open Air Classroom programs provide residential, nature and school-based programs that help schools to meet learning standards, and engage students in active learning. In 2018, the 4-H Camp and Learning Centers provided programming for 3,305 students from over 60 Maine school groups.

Developing Career Awareness for Students with Disabilities

As a global leader in the aquaculture industry, Maine is uniquely positioned to engage youth in aquaculture education programs that will help grow and strengthen the local business and economy. Maine aquaculture generates over $137 million in sales output, 1,078 full and part-time jobs, and $56 million in labor income, and there is an increasing need to grow the local workforce to support the growing industry. Hancock County in particular has a thriving aquaculture industry due to its coastal location and access to the UMaine Center for Cooperative Aquaculture Research (CCAR). UMaine Extension partnered with the UMaine Center for Inclusion and Disability Studies and CCAR to deliver a six-week, paid Aquaponics Internship Program for high school students with disabilities. Located on the CCAR campus, this workforce development project was designed to give youth an opportunity to develop skills relevant to the aquaculture industry and cultivate career awareness. The youth Interns connected with experts in the local aquaculture industry, and were introduced to local employment opportunities in related fields.

Providing Access to Capital: $8 Million Invested in Local Communities

UMaine Extension supports improved access to financing for Maine business through its collaboration with a regional economic development agency that provides SBA loan guarantees for prospective borrowers. As an active member of the Loan Review Committee, Extension provides guidance and oversight on credit and lending strategies, reviews loan applications and along with other business and community leaders arrives at a loan recommendation. In 2018, the Loan review Committee approved 40 loans of over $3.5 million to 27 businesses. Over $7.1 million was leveraged bringing the total investment to over $10.6 million. One hundred-fifty-one jobs were created or retained, and seven of Maine's 16 counties benefited from the program.

Helping Rural Entrepreneurs Increase Profitability

Research shows that helping rural entrepreneurs improve their business skills will improve their chances for success. One of the most important business management skills is pricing, yet many small business owners lack the knowledge and skills necessary to develop a profitable pricing strategy. In 2018, UMaine Extension conducted pricing workshops across the state, presented a pricing webinar in collaboration with the Maine Food Strategy, and taught a pricing seminar at a statewide conference for entrepreneurs.

Promoting Community Based Adult Education through Extension Homemakers

In many Maine counties Extension Homemakers remain a traditional and vital part of the community fabric. They also provide direct and indirect benefits in terms of volunteer hours, fundraising, and material donations. In 2018, over 550 Extension Homemakers from over 40 Local Extension Homemaker Groups met and delivered or engaged in Extension programming involving over 2,300 participants and 321 programs including food, personal and community; nutrition and health; gardening and environmental, financial planning and consumer; personal growth; and cultural and creative arts. The total estimated monetary value of the Extension Homemaker program to their communities was over $939,000.

Supporting Coastal Communities

As a designated Sea Grant College, the University of Maine hosts the Maine Sea Grant College Program, a federal-state partnership funded by the National Oceanic and Atmospheric Administration and the state of Maine. The Marine Extension Team is a collaboration between Sea Grant and Extension and includes 9 professionals located in coastal communities statewide. MET members work with communities to provide research and outreach addressing problems and responding to opportunities in four major areas: ecosystem health; sustainable coastal communities; fisheries and aquaculture, and coastal community resilience. The MET provides coastal communities and other stakeholders with scientific information and assistance, and ensures that researchers are aware of the most pressing issues facing the state. Information is transferred to and from citizens by Marine Extension Associates who design and deliver local outreach programs. Through this process, communities gain the capacity to make informed decisions on the management of coastal and marine resources that promote ecological and economic sustainability.

Building Facilitation and Leadership Skills

UMaine Extension worked with Maine Sea Grant, and UNH Extension to make the five-part, 20-hour training "Strengthening Your Facilitation Skills" available in southern Maine. This collaboration is making it possible for new programming and services to become available to communities, such as peer learning programs and opportunities to build a network of co-facilitators. In 2017 and 2018 UMaine and UNH Extension collaborated to pilot the Community Engagement Academy in the Seacoast Region of Southern Maine and NH.

Expanding Outreach through Online Presence

In 2018, UMaine Extension's website at extension.umaine.edu - a composite of 60+ interconnected websites - received over 2 million pageviews, 80 percent of which came from the United States and nearly 40 percent of which from Maine. UMaine Extension instructional videos have been viewed more than 4 million times. Nearly 24,000 followers followed or were subscribed to UMaine Extension's 53 county and program-specific social media accounts on Facebook, Twitter, YouTube, Pinterest, and Instagram. More than 175 educational videos were available to visitors on our YouTube and Kaltura channels; many were also embedded in our web pages. Our YouTube videos received 5,900 views and nearly 12,000 watch-time minutes.

Enhancing Program Impacts with Extension Volunteers

Volunteers are the heart of UMaine Extension, giving their valuable time, effort, and expertise to greatly magnify the value of our work to the people of Maine. All of our volunteers commit time to appropriate training prior to their service. In 2018, over 4,200 Maine people volunteered more than 84,000 hours with us in a myriad of ways from 4-H clubs to fundraising, from growing food to managing county Extension office budgets. This remarkable effort equates to over 44 full-time staff members.

Continuing to Bring Research-based Knowledge to Maine People

We are proud to report that the faculty and staff of the Experiment Station and UMaine Extension continue to perform excellent work as we bring research-based knowledge and practical solutions to the people of Maine. We are committed to working successfully with a broad range of partners to meet the needs of Maine people, and we understand that community-based collaboration is key to achieving measurable results. We believe that the need for University research and outreach through committed, enthusiastic, and energized Experiment Station and Cooperative Extension programs has never been greater.

Executive Summary--Maine Agricultural & Forest Experiment Station

The Maine Agricultural and Forest Experiment Station has been conducting research and providing outreach to Maine and its people for over 125 years. Experiment Station research and development focuses on the natural resources that have been key elements of Maine's economy, including agriculture and food, forestry and wood products, in-shore marine fisheries and aquaculture, wildlife and the environment and natural area conservation that makes Maine a unique destination.

The Maine Agricultural and Forest Experiment Station regularly seeks input from a variety of advisory groups, regular meetings with constituency groups, at field days and other research-associated events, and through direct interaction of faculty with cooperators and constituents. Below is a summary of activities and accomplishments in major areas; documentation of work in related areas is included in the body of the annual report.

Research and Outreach Support for Maine's Crop-Based Agriculture

Maine wild blueberry growers have been working closely with the University of Maine and Experiment Station since the 1940s. The industry grew an average of over 92 million lbs. during the last five years (2013-2017) with an annual market value of >$44 million in total product value. Station researchers are conducting research in refining Integrated Pest Management (IPM) recommendations for native pests, recently introduced pest such as spotted winged drosophlia and diseases by enhancing IPM programs with applied research models and regional monitoring systems, studying effects of climate change on pollination and bee health and examining effects of changing temperatures and precipitation on disease occurrence, and providing new knowledge on effects of increased climate variability on crop physiology and yield.

Large- and small-scale potato growers face significant production challenges due to climate change, plant diseases, other pests and high input costs. Potatoes are the leading agricultural commodity in Maine with a total economic value of >$500 million dollars and employing over 6000 people. Station researchers are developing improved potato varieties as part of a regional multi-state effort that will produce high yields, enhance stress tolerance of northern Maine climate conditions, and have improved resistance to diseases. Several new varieties have been released in recent years in an industry partnership with the Maine Potato Board. Other researchers continue to expand our fundamental understanding of common and emerging potato pests and diseases (Colorado potato beetle, PVY virus, pink rot, black rot) and work to develop improved monitoring and control methods.

Station researchers support development of the rapidly growing small-scale conventional and organic agriculture sector in Maine with research on weed ecology and management, new cover cropping systems for northern vegetables, such as broccoli, and cropping systems for new grain varieties for bread and brewing industries, and in other research areas.

Research and Outreach Support for Maine's Livestock Agriculture

Station researchers are presently studying monitoring systems, treatments and pasture management options for controlling a pasture parasite detrimental to the growing sheep industry in Maine; working with colleagues in multiple states in the northeast on collaborative equine disease research; studying alternative forages and forage quality for milking cows; and investigating innovative paper mill by-products than can lower the cost to treat and decrease hay and legume silage spoilage.

Research and Outreach Support for Maine Aquaculture

Station researchers have critical roles in discovery, outreach, and assisting with pilot programs for the growing aquaculture industries in Maine including support of finfish, shellfish, and sea vegetables sectors. Aquaculture is the fastest growing food production industry in the world. A recent economic study found that the aquaculture industry in Maine had >$130 million impact. Most of this revenue is generated from Atlantic salmon farming, and while this industry is profitable, siting and therefore industry expansion is potentially limited because of endangered species interactions, sea lice and superchill. However, eastern oyster and sea vegetable aquaculture has grown considerably in recent years. With 3,500 miles of shoreline, Maine has enormous potential for growth. Station scientists are heavily involved in all aspects of the industry including studies to understand salmon chilling, sea lice ecology, endangered Atlantic salmon ecology, development of disease resistant oysters, sea vegetable ecology and variety development.

Research and Outreach for the Nutritional Well-Being of Maine's People

Station scientist have a long track record of research on promoting healthy eating, the health benefits of nutraceuticals in fruits, food safety monitoring, and environmental chemistry in relation to foods and drinking water. Notable new progress has been made in understanding approaches to increasing fruit and vegetable intake in children and young adults, understanding the impacts of blueberries on vascular health, and the nature of potential nutraceuticals in fruits of greater interest in the marketplace today, such as elderberries.

Advancing Maine's Forest-based Economy

The forest and wood products industries of Maine are in the midst of significant change with important economic ramifications for the state. A federally sponsored Economic Development Assistance Team has issued a plan to revitalize and direct the forest-based industry of Maine and the University of Maine and Experiment Station have significant roles in conjunction with private, federal and state efforts. Station scientists are studying the design of silviculture systems for optimizing yield and alignment with future product streams, monitoring spruce budworm risk and assisting with management options, developing new technologies and modeling approaches (Lidar, unmanned aerial vehicles) to increase management efficiency, creating new composite and structural building materials, analyzing the social aspects and management of family forests, investigating workforce issues of rural communities in northern Maine and many other aspects of forest ecology and management to advance forest management, sustainability and economic growth.

Advancing Aquatic Ecosystem Conservation and Improving Fisheries Management and in Maine

Maine is rich in aquatic resources that encompass the breadth of the state from estuarine areas on the coast to fishless ponds in the western and northern mountains with a myriad of rivers, streams, and lakes in between. The state's extensive and varied waters provide a natural laboratory for understanding the ecology of these ecosystems and their vertebrate and invertebrate organisms and for the conservation of these systems and species. Stations scientists are conducting studies on all aspects of river restoration after dam removal in large river systems in the Kennebec and Penobscot Rivers, these include anadromous and catadromous fish species of special concern, riverine bird populations, marine nutrient transfers to freshwater systems, fish passage and movements around dams. Other examples of important station research include studies of fish movements around experimental tidal power devices, human impacts on stream vertebrate assemblages, water dynamics in watersheds and between ground and surface waters, and long-term impacts of atmospheric nitrogen and climate change on watersheds. These studies are done in close collaboration with natural resources agencies or businesses and have great utility in policy development and permitting processes.

Research and Outreach Support for Maine's Terrestrial and Semi-Aquatic Wildlife

Forestry, agriculture, aquaculture and coastal activities all result in significant interaction with terrestrial and semi-terrestrial wildlife populations in Maine as do other recreational, human development, and industrial activities. Station scientists have active research in these realms with outputs of great value to policy makers, regulators, and natural resource managers. Examples include 1) research on predators (Canada lynx, American marten), grouse species, and bats in northern forests and in relation to forest management, 2) research on coastal and other water birds of special concern that inhabit inland, coastal, and island habitats, 3) the ecology and management of vernal pool habitats and associated amphibian populations, and 4) the human dimensions and policy aspects of wildlife management problems.

Expenditure Summary

In our 2018 Plan of Work, the Maine Agricultural & Forest Experiment Station (MAFES) estimated 38.4 SYs for 2018; the actual number of SYs was 42.03 for FY2018. For FY2018, MAFES expended $2,310,468 (Actual Formula Funds), $4,808,481 (Actual Matching Funds), $887,301 (Actual All Other Funds), for a total of $8,006,250.

Planned Programs--Maine Agricultural & Forest Experiment Station

Maine Food System

In our 2018 Plan of Work, we estimated that there would be 19.0 SYs in this program area; the actual SYs allocated for 2018 were 17.8. During FY2018, MAFES expended $1,115,404 (Hatch), and $2,013,030 (1862 Matching), and $0 (1862 All Other), for a total of $3,128,434 in this program area. MAFES research in this program area has resulted in a number of outputs for FY2018, including savings to growers, completed projects, peer-reviewed and other publications, presentations at professional meetings, workshops, and other venues.

There were several significant outcomes in this program area during FY2018. To highlight a few: Extensive support to the Maine potato industry continued including potato breeding for improved quality, potato pest management, and potato tuber testing. Several varieties developed through the regional potato breeding program are currently in the top 50 U.S. varieties including (acres, rank): Lamoka (2702, 10), Waneta (1025, 19), Lehigh (361, 41), Caribou Russet (347,42), and Pike (271, 45). In support of Maine's expanding aquaculture industry, Experiment Station research has led to the development of two vaccines to protect farm-raised salmon. Two patents were filed in 2018. Upon completion of successful clinical trials one vaccine offers protection against salmon louse (L. salmonis). Given L. salmonis causes the biggest

economic loss to salmon farmers (estimated at over $1billion in 2017) this will be major achievement for the industry.

Climate Change

In our 2018 Plan of Work, we estimated 2.4 SYs in this program area; the actual number of SYs allocated for 2018 was 3.3. During FY2018, MAFES expended $191,489 (Hatch), $436,885 (1862 Matching), and $35,099 (1862 All Other) for a total of $663,474 in this program area. MAFES research in this program area has resulted in a number of outputs for FY2018, including completed projects, publications, and presentations at professional meetings, workshops, and other venues.
Research undertaken by the Experiment Station has resulted in the collection of novel physiological data from four species of wild mammals native to Maine as well as a comprehensive dataset on laboratory mice. Through these studies a technique was developed to assess responses to high ambient temperatures in small mammals using flow-through respirometry at low humidity. This technique will be used in future work on other species and at higher humidities to further address the effects of humidity on the energetics of small mammals. A working version of the Maine Integrated Forest Ecosystem Service (MIFES) model has been developed capable of estimating trends in growing forest stocks, the provision of harvested biomass and industrial roundwood, and forest carbon sequestration in both standing forests and harvested wood products for more than a dozen forest types in the state of Maine. This has supported a framework to model and quantify impacts of land use and environmental policy on the forest sector in Maine and beyond (US and global).

Sustainable Community and Economic Development

In our 2018 Plan of Work, we estimated that there would be 6.2 SYs in this program area; the actual number of SYs allocated for 2018 was 7.4. During FY2018, MAFES expended $322,746 (Hatch), $861,702 (1862 Matching), $200,687 (1862 All Other) for a total of $1,385,136 in this program area. MAFES research in this program area has resulted in a number of outputs for FY2018, including completed projects, publications, and presentations at professional meetings, workshops, and other venues.
Some outcome highlights achieved in this program area. The Experiment Station helped create the Maine Mass Timber Commercialization Center (MMTCC). The purpose of the Center is to advance new forest products technologies and bring innovative mass timber manufacturing to Maine. Two companies (SmartLan and LignaTerra) announced plans in February 2018 to build new plants in Maine. The MMTCC will continue discussions with the two manufacturers to determine how best to support their efforts and make cross-laminated timber (CLT) a success in Maine. In support of the rapidly growing craft beer industry in Maine, an Experiment Station economist worked with the craft breweries in Maine to analyze the economic impact of the sector. Breweries and related activities by their suppliers and employees contributed a total of $260.4 million to the Maine economy in 2017, up from $225 million in 2016. The economic activity generated $1.5 million in excise taxes, $168 million in beer sold and 2,560 jobs with a total of $54.8 million in wages. One out of five tourists equaling 9.8 million people participated in a brewery tour or tasting in 2017. The detail on Maine suppliers has allowed a map of beer inputs to be constructed.

Sustainable Natural Resources

In our 2018 Plan of Work, we estimated 10.8 SYs in this program area; the actual SYs allocated for 2018 were 13.5. During FY2018, MAFES expended $680,829 (Hatch), $1,496,864 (1862 Matching), and $651,515 (1862 All Other) for a total of $2,829,207 in this program area. MAFES research in this program area has resulted in a number of outputs for FY2018, including completed projects, peer-reviewed and other publications, and presentations at professional meetings, workshops, and other venues.

There were several outcomes in this program area during FY2018. Experiment Station scientist Aram Calhoun has become a leading authority on the conservation of vernal pools. Her research informed the creation of a Vernal Pool Special Area Management Plan mitigation tool which was adopted in federal wetland rules for Maine by the US Army Corps of Engineers and the Maine Department of Environmental Protection. She continues to work with Maine towns on implementing the new Vernal Pool Special Area Management Plan and is consulting with 6 new towns, 2 other New England States, and Quebec and New Brunswick to adapt this management plan to their regions. High-profile species such as Atlantic salmon have often driven dam removal projects in the Northeast. Research conducted by the Maine Agricultural and Forest Experiment Station documented the important ecological contributions of a less glamorous anadromous fish species, sea lamprey. Managers have used this research to prioritize recovery of sea lamprey in their dam removal and fish passage plans.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	94.5	{No Data Entered}	38.4	{No Data Entered}
Actual	98.3	0.0	42.0	0.0

II. Merit Review Process

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

- Internal University Panel
- External University Panel
- External Non-University Panel
- Expert Peer Review
- Other (Volunteer advisory boards and county executive committees)

2. Brief Explanation

In an ongoing effort to maintain valuable and relevant programming, faculty and staff engaged in formal and informal review by discipline-specific review panels and advisory groups that help to provide focus. While this results in defined programming intentions for the near- and long-term, the process is dynamic and ongoing throughout the year, and can result in new work to address emerging issues at any time.

Programming merit and success for faculty members is also reviewed by faculty peers and supervisors through reappointment, promotion, and post-tenure processes established by the faculty and administration and codified in employment contracts. A unique process exists for non-faculty programming professionals who undergo annual reviews by supervisors, and peer reviews every 4 years.

We partner with regional Extension programs in the Northeast Region whose active vision is to coordinate translational research, education, outreach, and diversity programming to address problems, opportunities, and workforce development. Our primary mission is to enhance regional cooperation and improve coordination of regional Extension program initiatives for our region. Partners include the following

universities: Connecticut, Cornell, Delaware, Delaware State, District of Columbia, New Hampshire, Maine, Maryland, Maryland Eastern Shore, Massachusetts, Penn State, Rhode Island, Vermont, Rutgers, West Virginia, and West Virginia State.

The station uses its standard external scientific review process for continuing faculty proposing new five-year projects and a fast-track project approval process for new faculty. The fast-track process is intended for new faculty, where an accelerated approval process and a shorter two-year project period better meets the needs of the faculty member and station. A total of 24 projects went through the process in FY2018.

For the standard process, Experiment Station faculty prepare a pre-proposal reviewed by the MAFES Research Council, which is comprised of senior faculty. Following Research Council review to ensure that the proposed work falls within the purview of MAFES, addresses an important need identified by stakeholders, and that the project director possesses the expertise to conduct the research, full proposals are developed. The full research proposals are sent out for external, expert peer review. Upon completion of the external reviews, proposals are returned to the researchers, who make changes based on the comments of the reviewers. Finally, the proposals are reviewed and approved by the Research Council before being submitted to USDA for final approval.

The fast-track process goal is to complete project development and obtain USDA approval in four months. The shorter time line for fast-track projects is achieved by using an abbreviated and internal proposal review, reducing proposal requirements, and expediting processing. Proposals are reviewed by a member of the Research Council and a faculty member to ensure that the proposed work meets all the expectations inherent in the standard process.

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Other (Research using relevant current and first-source data)

Brief explanation.

Cooperative Extension engages stakeholders on an ongoing basis, and also as needs and issues arise. Our programs seek and involve citizen and volunteer group input, and our staff work closely with community and commodity stakeholders to guide their work. Selected examples:

• Our partnership with 16 local county executive committees that meet regularly and provide direction and advice to our programs. These committees also hold countywide meetings inviting public input into programming.
• The UMaine Board of Agriculture, a formed by state statute, advises us on agricultural research and Extension priorities.
• The Maine Wild Blueberry Commission that represents growers and processors, and administers a state tax fund of over $1 million.
• The Maine Potato Board composed principally of Maine potato farmers that offers advice and

support for research. The Board also administers a state tax fund to support Maine's most valuable agricultural commodity.

• The Maine 4-H Foundation Board that works as a close partner to enrich youth experiences through our 4-H Youth Development Program.

• A variety of advisory boards formed with targeted intent to guide the work of our most important programs. Examples: Maine Sea Grant Policy Advisory Board, Tanglewood 4-H Camp Board, Bryant Pond Learning Center Board, the Maine Board of Pesticides Control, and county-based 4-H Leaders Associations.

• We also partner with discipline-specific groups whose mission is to achieve success in a given area. Examples: Maine Organic Farmers and Gardeners Association, Maine Science, Technology, Engineering and Math Collaborative, and the Sportsman's Alliance of Maine.

• We maintain an ongoing open dialogue with Maine Legislators and County Commissioners to communicate our program focus areas and to respond to the needs that have been identified through their constituents.

The Experiment Station encouraged stakeholder input by hosting (along with the college leadership) formal meetings with advisory groups including the Board of Agriculture (two times), the Forest Resources Advisory Committee, and the Coordinating Committee of the Maine Cooperative Fish and Wildlife Research Unit. This year again, as a way to encourage more participation by state legislators, one Board of Agriculture meeting was held in the state capitol building.

Experiment Station leaders and staff regularly attend monthly meetings of the Agricultural Council of Maine (AGCOM) as a way to maintain effective communication with the wide array of agricultural organizations in the state. MAFES faculty, through their interaction with stakeholder groups and individuals in both formal and informal settings, also continued to encourage stakeholder participation. Our research facilities hosted field days for apples, small fruits, and vegetables, potatoes, grains, and wild blueberries and other interests of growers, which allow researchers and administrators to learn more about the needs of the stakeholders in attendance. Overall, the station makes every effort to allow all groups and individuals to express their suggestions and concerns about station-sponsored research through the mechanisms discussed above.

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 Internal Focus Groups
- Use External Focus Groups
- Needs Assessments
- Use Surveys
- Other (Identify and analyze issues)

Brief explanation.

Cooperative Extension - Extension's programming is deeply and broadly grounded in traditional and non-traditional stakeholder individuals, and the general public. In the agriculture and food systems sectors the major stakeholders are identified through coordinating and advisory committees such as the Board of Agriculture, Agricultural Council of Maine, Maine Wild Blueberry Commission, Maine Potato Board, Maine Organic Farmers and Gardeners Association, the Maine Sea Grant Policy Advisory Board, and the Maine Board of Pesticides Control. In the youth development sector the major stakeholders are identified through coordinating and advisory committees such as the Maine

4-H Foundation Board, advisory boards of the 4-H Camp and Learning Centers, and the Maine Science, Technology, Engineering and Math Collaborative. For all of our programming, UMaine Extension maintains a list of all known stakeholder groups, and these groups are contacted on a regular basis, and meets regularly with county-based extension associations and program focused advisory groups.

For all of our programming, UMaine Extension maintains lists of all known stakeholder groups, and these groups are contacted on a regular basis, and meets regularly with staff and county-based extension associations.

Experiment Station - In the agricultural and forestry sectors, the major stakeholder groups are identified through coordinating and advisory committees such as the Board of Agriculture, the Forestry Research Advisory Committee, and the Coordinating Committee of the Maine Cooperative Fish and Wildlife Research Unit. MAFES provides input on potential committee members as do the current member stakeholder groups. For agriculture and forestry, MAFES maintains a list of all known stakeholder groups, and these groups are contacted on a regular basis. Individual stakeholders are identified in a variety of ad hoc ways including through faculty and department/school contacts as well as UMaine Extension.

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 groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Survey of the general public
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Other (Research using relevant current and first-source data)

Brief explanation.

Extension and the Experiment Station collect input through formal organization processes (e.g. Board of Agriculture, Forest Resources Advisory Committee, and Maine Cooperative Fish and Wildlife Research Unit Coordinating Committee) and feedback on research programs of faculty via stakeholder grant review programs (e.g. Maine Wild Blueberry Commission Advisory Committee, Maine Potato Board, Cooperative Forestry Research Unit). Faculty researchers meet with and collect input from both traditional and non-traditional stakeholders at the group and individual level.

In addition, Extension faculty and professionals collect information through direct contact and surveys of traditional and non-traditional during outreach programming, community forums, and monthly volunteer county extension executive committees, as well as regular meetings with community, regional, and state partners (staff and elected officials of county government; state legislators; school teacher and youth groups; and local, county and state commodity organizations.

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.

Cooperative Extension
A new Extension programming direction came through our successful Telstar Freshman Academy, a yearlong, experiential program designed to resilience and high aspiration for high school youth in rural Oxford County. In 2018, the University of Maine System funded the Pathways Early College program at UMaine's Bryant Pond 4-H Center. This is a new initiative that will provide dual enrollment opportunities for high school juniors and seniors in Oxford County, with recruitment targeting first generation college students. The program's goal is to increase the number of students matriculating to UMS campuses, and to increase retention rates, especially among first generation college students.

A very large investment in infrastructure and programming was realized in June 2018, with the opening of the $8 million University of Maine Cooperative Extension Diagnostic and Research Laboratory in Orono. This was the culmination of years of needs assessments, planning, stakeholder input, and funding. In 2014, Maine voters approved an $8 million bond referendum to support Maine agriculture, facilitate economic growth in natural resource based industries, and monitor human health threats related to ticks, mosquitoes, and bedbugs through the creation the new facility. The new lab brings together scientists researching animals, agriculture, insects, and plants under one roof. The unique combination of researchers provides many teaching opportunities for students, as well as premier research and outreach facilities. By allowing for research contributions to agriculture, public health, communities, and wildlife, the lab will benefit Maine in a variety of ways, including protecting the natural resource and food-based economies, adding to food safety and human health, and providing unique diagnostic and testing services to farmers, homeowners and the public.

Maine Agricultural and Forest Experiment Station
The Maine Agricultural and Forest Experiment Station staffs the Board of Agriculture comprised of a wide range of members representing the major agriculture sectors in Maine along with aquaculture interests. The purpose of the Board of Agriculture is to provide input to the University of Maine and the University of Maine System on matters related to agriculture. At the spring and fall 2018 meetings, members identified a need for agricultural engineering support. The result is the University of Maine Cooperative Extension has written a draft job description for an Extension Agricultural Engineer position. Board of Agriculture input has made identifying funding for this new position an Extension priority.

Brief Explanation of what you learned from your Stakeholders

An overarching theme from stakeholders is the recognition that research and extension are a unique resource that regularly produce significant social, environmental, and economic benefit for the people of our state. The ability to provide the full spectrum of help in understanding and identifying issues, researching and addressing issues, and disseminating quality information takes a critical

infrastructure driven by high-level expertise.

A related theme is that funding is key to ensuring the ability for research and extension to create these social, environmental, and economic benefits for the people of Maine. An ongoing commitment to funding repays this investment many times over.

Stakeholders have voiced the need for greater economic capacity research. All segments of the agricultural community express the need to maintain the Experiment Station research farms and greenhouses. They are also concerned about maintaining research capacity for modern science to support the food and agriculture sectors. Stakeholders are strongly supportive of county-based Extension outreach as a mechanism for refining statewide programs to meet unique local needs.

Stakeholders have been impacted through the Maine Food and Agriculture Initiative, that is a partnership among the UMaine College of Natural Sciences, Forestry, and Agriculture and the Maine Agricultural and Forest Experiment Station. This initiative supports stakeholder-driven agricultural research and extension education for Maine. Examples of recent projects include:

- Improving barley quality and yields for emerging high-value markets
- Identifying Profitable Vegetable and Small Fruit Varieties for Maine (Y1-3)
- The use of portable Doppler radar microphone to assess honey bee colony size and health
- Investigation and Education on the Potential Food Allergenic Residues in Composts
- Soil solarization for enhanced weed control in vegetables
- Elderberry Virus Survey
- Evaluation of Onion and Shallot Varieties for Maine Farmers
- Testing Maine's wild and cultivated elderberries for Tomato Ringspot Virus (ToRSV)"

In the area of youth development, Stakeholders are strong advocates for programming in support of STEM; early college and youth aspirations; immigrant, vulnerable, and underserved populations. With this support, UMaine Extension has continued and enhanced our work in such programs headlined as:

- Sparking Student Interest in STEM Careers through 4-H Ambassadors
- Students Follow a Researcher® on Expeditions in the Field
- Tech Wizards Students Helping Solve Real Community Problems
- Supporting Career Awareness in Youth in Aquaculture
- Bolstering Learning Environments of Vulnerable Youth
- Meeting Learning Standards through Open Air Classrooms
- Building Community and Connecting Youth to the Outdoors
- Reducing Summer Learning Loss
- Reducing Obesity in Youth
- 4-H@UMaine Giving Youth a Preview of the College Experience

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	1899440	0	2310468	0
Actual Matching	1899440	0	4808481	0
Actual All Other	9971910	0	887301	0
Total Actual Expended	13770790	0	8006250	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

S. No.	PROGRAM NAME
1	The Maine Food System
2	Positive Youth Development
3	Sustainable Community & Economic Development
4	Climate Change
5	Sustainable Natural Resources

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

The Maine Food System

☑ 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	6%		7%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		7%	
205	Plant Management Systems	3%		8%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		5%	
212	Pathogens and Nematodes Affecting Plants	0%		3%	
213	Weeds Affecting Plants	4%		3%	
215	Biological Control of Pests Affecting Plants	5%		9%	
301	Reproductive Performance of Animals	5%		3%	
302	Nutrient Utilization in Animals	2%		4%	
305	Animal Physiological Processes	5%		1%	
311	Animal Diseases	5%		17%	
501	New and Improved Food Processing Technologies	5%		9%	
502	New and Improved Food Products	5%		4%	
503	Quality Maintenance in Storing and Marketing Food Products	0%		2%	
601	Economics of Agricultural Production and Farm Management	10%		2%	
605	Natural Resource and Environmental Economics	6%		4%	
702	Requirements and Function of Nutrients and Other Food Components	0%		3%	
703	Nutrition Education and Behavior	39%		2%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		7%	
	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	40.9	0.0	19.0	0.0
Actual Paid	41.2	0.0	17.8	0.0
Actual Volunteer	25.0	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
1324065	0	1115404	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1324065	0	2013030	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
5386710	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct scientific research. Publish peer-reviewed journal articles and other publications. Present findings at professional and public meetings and at other venues, and provide training sessions for food producers and processors. Educate undergraduate and graduate students.

- Crop Production Activities - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Crop Production Activities - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- Eat Well (Expanded Food and Nutrition Education Program) - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- Eat Well (Expanded Food and Nutrition Education Program)- Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Farm Energy Activities - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Farm Energy Activities - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- Food Safety - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Food Safety - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- General Activities in Support of the Maine Food System - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- General Activities in Support of the Maine Food System - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- Home Horticulture Activities - Indirect (Applied Research, Media, Internet, Publication, Resulting from

Training)
- Home Hotriculture Activities - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Livestock Activities - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Livestock Activities - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- Nutrition Education - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Nutrition Education - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- Specialty Food Products - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Specialty Food Products - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)

2. Brief description of the target audience

Maine crop and livestock farmers, aquaculture industry, food producers, processors and marketers, Cooperative Extension staff, other scientists, state policymakers, regulators, and legislators, classroom teachers

- 4-H Volunteers (Adult)
- 4-H Youth (Youth)
- Agricultural Producers (Adult)
- Agricultural Service Providers
- Agricultural Workers (Adult)
- Apple Growers (Adult)
- Beef Producers (Adult)
- Blueberry Growers (Adult)
- Business Assist Organization Staff (Adult)
- Community Leaders (Adult)
- Cranberry Growers (Adult)
- Dairy Producers (Adult)
- Elders or Seniors (Adult)
- Families (Adult)
- Families (Youth)
- Farmers (Adult)
- Food Processors (Adult)
- General Public (Adult)
- General Public (Youth)
- Home Gardeners (Adult)
- Home Gardeners (Youth)
- Low-Income Families (Adult)
- Low-Income Families (Youth)
- Master Gardener Volunteers (Adult)
- Ornamental Horticulture Industry (Adult)
- Parents (Adult)
- Pesticide Applicator Training Participants (Adult)
- Pesticide Applicators (Adult)
- Policy Makers (Adult)
- Potato Growers (Adult)
- Sweet Corn Growers (Adults)
- Teachers (Adult)
- Vegetable Growers (Adult)

¨ Volunteers (Adult)

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	38509	3918522	12095	1164507

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

Patent Applications Submitted

Year: 2018
Actual: 2

Patents listed
vaccine against L. salmonis (salmon louse)
physiological solution for sea lice removal

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	28	84	112

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Direct; Club, Conference, Program, Consultation, Scholarship, or Training

Year	Actual
2018	11983

Output #2

Output Measure

- Indirect; Applied Research, Media, Internet, Publication, Resulting from Training

Year	Actual
2018	27138

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Pounds of food donated
2	Monetary value of food produced, gleaned, and donated
3	Number of agencies served
4	Implement practices that improve efficiency, reduce inputs and negative impacts on the environment, increase profitability, or reduce energy consumption
5	Adopt and maintain integrated pest management strategies
6	Demonstrate how to develop integrated farming systems (on farm composting? different enterprises on the same farm?)
7	Improve animal well-being
8	Establish new farm enterprises
9	New crops and markets developed
10	Implement techniques to reduce effects of variable climate
11	Adopt specific food safety plans and/or policies
12	Adopt healthy dietary practices (consume nutrient-rich foods, follow current Dietary Guidelines for Americans or DASH, etc)
13	Increase consumption and preservation of healthful, locally-grown and -produced food (farm to school program, food preservation, etc.)
14	Adopt techniques to improve soil quality
15	Adopt a water saving technique (rain barrels, soaker hoses, etc.)
16	Utilize Cooperative Extension to identify pest problems and determine research-based management strategies
17	Increase consumption of home-grown food

18	Enhance capacity of a sustainable global food system including new/improved plants, animals, technologies, and management systems
19	More sustainable, diverse, and resilient food systems in Maine
20	Improve food safety
21	Adopt dietary plans to prevent and treat illness
22	Providing Expertise to State Programs Supporting Ag Industries
23	Optimizing forage production and quality on livestock farms
24	Research & Outreach Support for Maine Aquaculture
25	Research & Outreach Support for Maine's Crop-Based Agriculture - Potatoes
26	Research & Outreach Support for Maine's Crop-Based Agriculture - General Support to the Agriculture Sector
27	Research & Outreach Support for Maine's Crop-Based Agriculture Fruit Production

Outcome #1

1. Outcome Measures

Pounds of food donated

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	257520

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Successful collaborative gardening initiatives are an important tool for enhancing public health and providing meaningful community engagement opportunities by increasing access to locally grown food, providing a safe space to connect with neighbors, and offering learning opportunities outside the classroom. Supports such as volunteer leaders, educational resources, and manual labor are key contributors to the success of these projects.

What has been done
The Master Gardener Volunteer (MGV) program provides participants with a minimum of 40 hours of in-depth training in the art and science of horticulture. Trainees receive current, research-based information from UMaine Extension educators and industry experts. Trained MGV gardeners, with all levels of experience, are connected with meaningful service projects in their community. Coordinators facilitate relationships between MGV and community partners; assisting with needs assessment, planning, and problem solving.

Results
There are 910 active MGV, 87 of whom were trained in 2018. In total, they donated nearly 28,000 hours to a variety of educational and food security projects throughout the state including supporting 56 community gardens, 54 school gardens, 65 demonstration gardens, and 28 programs involving 796 youth in horticulture. Those involved with food security projects distributed 257,520 pounds of fresh produce from over 100 Maine farms to 187 food alleviation distribution sites and countless neighbors in need as part of the Maine Harvest for Hunger program. Many volunteers enter the MGV program with the goal of improving their gardening skills for personal benefit and then become deeply involved in and passionate about community projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products

Outcome #2

1. Outcome Measures

Monetary value of food produced, gleaned, and donated

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	423271

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Maine has the highest rate of food insecurity in New England and ranks 7th worst in the United States. The USDA estimates that more than 208,000 individuals (16.4%) in Maine are food insecure and that we have the 3rd worst rate of very low food insecurity in the nation. Twenty percent of Maine children and 23% of seniors experience food insecurity. It is especially challenging for food insecure people to afford high quality, fresh, nutritious food, and Maine's emergency food system has seen donations of fresh produce decline significantly in recent years.

What has been done
UMaine Extension's Maine Harvest for Hunger program mobilizes gardeners, farmers, businesses, schools, and civic groups to grow, glean, and donate quality produce to distribution sites (pantries, shelters, community meals), and directly to neighbors in need to mitigate hunger, improve nutrition and health, and help recipients develop positive nutritional habits. In 2018 MHH educational programs focused on engaging food pantry recipients, seniors and community gardeners to grow more of their own produce and teaching practical ways to use fresh produce.

Results
Since 2000, MHH participants have distributed 2.9 million lbs. of food to citizens grappling with hunger. In 2018, donations of 231,752 lbs. of fresh produce from over 100 Maine farms went to 165 hunger alleviation distribution sites. Over 512 volunteers logged 2,664 hours and the value of the produce was over $391,660. Now in its 19th season, MHH is an exemplary statewide collaborative effort between UMaine Extension staff, Master Gardener Volunteers, farms, food pantry staff and volunteers. Every gleaning partnership is unique in how we collaborate with farmers, volunteers and food pantries. Pantry volunteers frequently comment how much the high-quality fresh produce means to recipients, many of whom otherwise would have limited access to them.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
601	Economics of Agricultural Production and Farm Management

Outcome #3

1. Outcome Measures

Number of agencies served

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	17

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

Outcome #4

1. Outcome Measures

Implement practices that improve efficiency, reduce inputs and negative impacts on the environment, increase profitability, or reduce energy consumption

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Adopt and maintain integrated pest management strategies

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	16565

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The $500 million potato industry is Maine's largest agricultural sector, encompassing over 500 businesses generating over $300 million in annual sales, employing over 2600 people, and providing over $112 million in income to Maine citizens. The management of insects, diseases, weeds, and other pests is integral in sustaining a healthy Maine potato crop. Potato growers rely on a multidisciplinary Integrated Pest Management (IPM) approach to ensure that the potato crop is pest and damage free while attempting to minimize the amount of pesticides that are applied.

What has been done
UMaine Extension's Potato IPM Program impacts Maine's 300 commercial potato growers and 48,000 acres of potatoes and is an integral part of the potato industry, and national and international growers who rely on the state's seed crop. We maintain nearly 100 specialized insect traps, coordinate a state network of electronic weather stations, and survey 75 potato fields weekly for weeds, insects and diseases. IPM scientists track potential pest outbreaks to provide growers with information on treatments to minimize pesticide applications and maximize potato yield.

Results
The economic impact from Extension's pest monitoring and educational programs for the 2018 season is estimated at over $8.1 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Measures

Demonstrate how to develop integrated farming systems (on farm composting? different enterprises on the same farm?)

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Improve animal well-being

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	372

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
311	Animal Diseases

Outcome #8

1. Outcome Measures

Establish new farm enterprises

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	800

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Interest in agriculture and starting new farms in Maine has increased dramatically over the past fifteen years. One third of Maine's farmers are beginning farmers with fewer than 10 years of experience. Forty-seven percent of new farm businesses fail within the first five years. Current farmers thinking about changing farm enterprises and new farmers interested in starting a farm often lack skill, knowledge and confidence in areas such as business planning, access to capital, rules and regulations affecting agriculture operations, and marketing.

What has been done
Since 2011, UMaine Extension has provided diverse educational outreach through its "So You Want to Farm in Maine" series to enhance the skills, business management knowledge, confidence of new and established farmers. Extension programs are live, live-streamed and archived, and reached over 800 participants from all Maine counties and out-of-state. Topics included agriculture enterprise selection, business planning, record keeping, market research, regulations, and resource identification.

Results
The series trained people to pursue farming as a viable career option. Since 2014, Extension staff have consulted with 505 new farmers statewide. A survey sample of these farmers (n=158) revealed: 51 new farm businesses have been started where the farm operator has a good understanding of the importance of business planning and how to connect to resources available to them in Maine; 88 new jobs, with estimated wages of $612,000 annually; an estimated total market value of agricultural products sold by these farms of over $2.2 million annually.

In 2017 and 2018, with the training qualified as FSA borrower training, farmers with FSA loans were able to complete their loan requirements and received nearly $1.7 million in farm loans.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

New crops and markets developed

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	107

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent successes in building New England's local organic wheat economy have inspired new markets for a variety of food grains. Our region now boasts scores of businesses (e.g., mills, bakeries, malt houses, and distilleries) with business models centered around locally grown organic grains. Concurrently, the need for local sources of organic and non-GMO feed grains continues to increase. Three critical factors hindering expansion of organic grain production in our region include robust weed and disease management strategies, efficient legume green manure systems, and engaged end-users with strong social networks.

What has been done
We identified the most prevalent disease and insect pests in organic grain production in our region by scouting 53 organically managed fields over two years. We conducted six research station trials and six on-farm projects. We strengthened connections among organic farmers in our region through our Northeast US and Eastern Canada Organic Grain Network (NEEOGRAIN) including a regional listserv, winter webinars, and a cross-border farmer exchange. Finally, we made over 650 contacts with farmers, processors, grain end-users, and crop advisors through nine winter conferences, field days, and tours.

Results
Over 60% of the 70 survey respondents at the 2018 VT Grain Conference indicated that reduced grain quality prevented them from selling their grain at least once in the last 5 years. 100% reported they had adopted practices to help them improve grain quality and sales, and over 60% said they had adopted new varieties, crop rotations, weed control, and post handling practices. Farmers overwhelmingly agree (93%) that our grain outreach events have helped improve their access to markets. In regards to research, farmers felt that they had been able to take the information they had learned and implement better fertility management (18%), identify pests (32%), adopt cover crops (40%), modify weed management (29%), and improve grain drying

(27%). Five farms indicated that the financial grain to their farm from participating in our grain events/projects was between $50,000 and $100,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #10

1. Outcome Measures

Implement techniques to reduce effects of variable climate

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Adopt specific food safety plans and/or policies

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	1225

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The CDC estimates that annually 1 in 6 people (48 million) become sick from contaminated food resulting in 128,000 hospitalizations and 3,000 deaths. The USDA estimates the annual costs of illnesses caused by foodborne pathogens is $15.6 billion. Food pantries and meal service programs staffed by volunteers support 178,000 Maine residents relying on them for hot meals or food donations, and over 1 million people consume food at community events, where food preparation includes risks of cross contamination, improper holding time of food, and poor hygiene.

What has been done

UMaine Extension provides Cooking for Crowds: Food Safety Training for Volunteers, an innovative program that blends food safety education with food security efforts to reduce risk of foodborne illness within vulnerable populations. The program educates volunteers on how to safely plan and purchase foods, transport and store foods, prepare foods, and handle leftover foods to prevent food borne illnesses. Since 2013, 1,225 volunteer quantity cooks from across Maine have attended 42 Cooking for Crowds workshops. On average, these volunteers feed 500 people a week.

Results
Cooking for Crowds participants have increased their knowledge to reduce food borne illness of the 5 million meals they serve annually to Maine's food insecure. Program evaluation show increased knowledge in how to properly handle food in the temperature danger zone, methods to safely cool foods quickly, identifying at least two food safety concepts they would incorporate into their next meal (temperature controls, sanitizing, improving personal hygiene), and planning to share this information with their respective organizations. Assuming that foodborne illness patterns mirror population patterns and that the CFC program reduces foodborne illness in Maine by even just 1 percent, the program would prevent more than $640,000 in economic losses and 1,977 cases of foodborne illness each year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior

Outcome #12

1. Outcome Measures

Adopt healthy dietary practices (consume nutrient-rich foods, follow current Dietary Guidelines for Americans or DASH, etc)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2232

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Maine has the ninth highest rate of food insecurity in the nation and the highest rate of food insecurity in New England. Higher rates of obesity have been found among low-income individuals, especially low-income women and children. The United States annually spends between $147 billion and $210 billion on adult obesity. Rising and sustained adult obesity rates will continue to put a strain on current health promotion programs and continue to raise health care cost for the nation.

What has been done
To improve the food security and diet of Maine's low-income parents and caregivers, UMaine Extension EFNEP implements direct education to improve their knowledge, behaviors, and attitudes related to improving diet quality, increasing daily physical activity, and using food resources management practices to learn how to plan and shop for healthy meals and snacks. Program outcomes are measured for all adults using validated pre/post program surveys.

Results
In 2018, 579 adults participated in Maine EFNEP, and the program reached a total of 2,232 individuals in the program's families. Of the 579 adults, 60% completed pre and post surveys that revealed:

43% eat fruit more often each day,
35% eat vegetables more often each day,
30% drink soda less often,
43% make small changes each day to be more active,
37% thaw frozen food at room temperature less often,
40% plan meal before shopping more often,
32% make a list before shopping more often.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior

Outcome #13

1. Outcome Measures

Increase consumption and preservation of healthful, locally-grown and -produced food (farm to school program, food preservation, etc.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	386

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior

Outcome #14

1. Outcome Measures

Adopt techniques to improve soil quality

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	1640

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Protecting and improving soil health is a key goal for sustainable agriculture, yet many agricultural service providers feel ill-equipped to help farmers make informed decisions about adopting specific soil health (SH) strategies. Extension educators and NRCS staff cite a lack of region-specific information and concrete local examples of successful cover cropping, reduced tillage, and rotational practices.

What has been done
UMaine Extension in 2015 initiated a 3-year SARE Soil Health Professional Development Program to increase participant knowledge, skills, and confidence to provide education and recommendations to farmers about soil health strategies. Ag service providers from Extension, NRCS, Soil and Water Conservation Districts, non-profits, and industry joined cropping systems-based teams led by Extension faculty: potato-grain, dairy cropping, and mixed vegetable. Training included winter workshops, on-farm demonstrations, case studies, and videos.

Results
Trainees reported reaching over 1,640 farmer contacts through: 21 on-farm demonstrations, 35 workshop or field days, 93 presentations, and 740 individual SH consultations. In sum, 185 farmers made a management change or adopted a new practice, affecting over 20,000 acres, as a result of what the farmers learned from the trainees and project activities. These included testing their soil for SH and trying a new cover crop or reduced tillage practice. Trainees also reported the program resulted in 64 new collaborations, and 7 new grant submissions, of which 3 were funded.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
215	Biological Control of Pests Affecting Plants

Outcome #15

1. Outcome Measures

Adopt a water saving technique (rain barrels, soaker hoses, etc.)

Not Reporting on this Outcome Measure

Outcome #16

1. Outcome Measures

Utilize Cooperative Extension to identify pest problems and determine research-based management strategies

Not Reporting on this Outcome Measure

Outcome #17

1. Outcome Measures

Increase consumption of home-grown food

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	628

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One in six Hancock and Washington County residents faces food insecurity. Families experiencing low income often resort to purchasing inexpensive, calorie-rich, less nutritious foods. To make healthy food more accessible, Master Gardener Volunteers grow thousands of pounds of produce for food pantries each year. Food pantry managers have difficulty persuading clients to take the donated produce because recipients don't know how to use it, and pantry volunteers don't have time or expertise to teach them.

What has been done
In 2017, UMaine Extension recruited, trained and supported Eat Well Volunteers who conducted outreach in food pantries in the 2 counties. The Volunteers conducted hands-on cooking demonstrations and nutrition & food safety lessons in food pantries while distributing fresh local produce. Food pantry clients learned new ways to use fruits and vegetables when preparing meals, and ways to preserve fresh produce for future use. In 2018, six months after the intervention, clients were mailed a follow-up survey to assess impacts of the EWV intervention.

Results
Seventy four percent (n = 34) of survey respondents said that as a result of interaction with Eat Well Volunteers, they were able to try a new fresh Maine vegetable or fruit that they had not tried before. Eighty five percent stated the program helped them to have more fresh produce to eat, 77% prepared healthier meals, and 59% felt healthier as a result of the program. Clients indicated an increased likelihood to make healthier food choices when planning meals, and a greater likelihood to choose fresh fruits and vegetables when they are available at the food pantry. All survey respondents indicated that after interacting with Eat Well Volunteers, they were somewhat to very confident in their ability to include fresh fruits and vegetables in their meals and their ability to safely store fresh produce at home.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
702	Requirements and Function of Nutrients and Other Food Components

Outcome #18

1. Outcome Measures

Enhance capacity of a sustainable global food system including new/improved plants, animals, technologies, and management systems

Not Reporting on this Outcome Measure

Outcome #19

1. Outcome Measures

More sustainable, diverse, and resilient food systems in Maine

Not Reporting on this Outcome Measure

Outcome #20

1. Outcome Measures

Improve food safety

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)
Every day, the FDA implements recalls because of possible microbial or chemical contamination in fresh or processed foods. Safety of food products is a major concern to the growers and processers in a time when consumers are more proactive about their health and recalls can result in both financial loss and loss of credibility in their consumer market.

What has been done
Two models, a crustacean and soy, were developed to analyze and detect allergenic proteins in processed foods. The allergenic proteins were processed using various nonthermal and thermal technologies and analyzed for their potential reduction in allergens. In another study conducted

under the same project, elderberry and medicinal plant leaves were analyzed and quantified for phytochemicals using waterless green technologies.

Results
It was clearly shown that processing modifies allergenic proteins in shrimp and soybean, which makes difficult for the existing commercial enzyme-linked immunosorbent assay (ELISA) methods to detect and quantify accurately. The research was highlighted in a USDA multistate flyer in 2017. For the elderberry and medicinal plant leaves study, the results indicated that the total phenolic concentrations of about half of the treated samples were not significantly different from the controls. The results were promising in retaining phytochemcials in the extracts and reuse in value-added products. However, the anthocyanin concentration in elderberries increased generally after microwave blanching. Thus, microwave blanching did not seem to have any detrimental effects on the concentration of the two bioactive compounds.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #21

1. Outcome Measures

Adopt dietary plans to prevent and treat illness

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	289

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Washington County has high rates of diabetes, diabetes-related hospitalizations, diabetes-related lower extremity amputations and diabetes-related deaths. Few Washington County residents participate in self-management education and support programs to develop the skills needed to care for themselves. Barriers to participation include cost, lack of insurance, complexity of education programs and the absence of formal diabetes education programs in the county.

What has been done

Since 2014, UMaine Extension has delivered Dining with Diabetes Down East to 289 citizens in 9 communities. The program includes weekly classes with cooking demonstrations, sampling of dishes, and facilitated discussion. Publications address simplified diabetes meal planning, how to eat to control blood sugar, blood pressure, and blood cholesterol - the main risk factors for diabetes complications. The video series was recorded to DVDs that are used in Native American healthcare facilities, Calais and Houlton hospitals and the Senior Companion Program.

Results
Ninety four percent of participants reported lowered weight, blood sugar, blood pressure, or cholesterol. Participants expressed appreciation for the program's accessibility, and reported positive changes to their diets. All reported that as a result of program they positively influenced diets of spouses, children or grandchildren. Research indicates the program will likely result in decreased disability, death and health care costs. As an example, for an individual on Medicare, approximately $96,000 is saved in Medicare costs for each year hemodialysis is postponed due to improved diabetes control.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior

Outcome #22

1. Outcome Measures

Providing Expertise to State Programs Supporting Ag Industries

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Maine dairy farmers receive payments to support their businesses when milk prices fall below the cost of production. This "Tier program" requires that milk production costs be collected every three years from representative farms in Maine. UMaine Extension received funds from the Maine Milk Commission to conduct the study.

What has been done
Extension staff traveled to 40 Maine farms to collect economic performance data from dairy farms of various sizes throughout the state.

Results
Data from the project is used by the Maine Milk Commission and the Maine legislature to set price support levels for dairy farms when the price of milk falls below the cost of production. Since the program began in 2003, over $97 million has been paid to Maine farmers, and over $43 million in the last 4 years.

4. Associated Knowledge Areas

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

Outcome #23

1. Outcome Measures

Optimizing forage production and quality on livestock farms

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	1034

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Maine farmers manage over 100,000 acres of perennial forages, and another 31,000 acres are rotated with corn silage. Since high quality perennial forages in pastures and hayland are critical to sustaining livestock agriculture in New England, proper identification and management of weed and forage species is important. A 2018 survey showed agriculture service providers lacked the proper knowledge, skills, and confidence to identify weed and forage species, or to develop appopriate strategies to manage them on New England livestock farms.

What has been done
UMaine Extension and the University of Vermont collaborated on a two-year professional development project, funded by Northeast SARE. The project helped agricultural service providers and personnel working in Extension, USDA NRCS, State agricultural agencies, and

non-government organizations in New England to better identify forage/pasture plants and forage weeds, and to study pasture and hay crop management strategies to optimize forage production and quality on livestock farms. Trainings included classroom, field, and webinars, and self-study.

Results
With over 23,564 acres, 1,034 farmers (primarily beef and dairy operations but also small ruminant and equine operations), received new info and skills. Staff participants reported developing 45 presentations that reached 313 producers; the outcomes to farmers of this education and technical assistance included management changes including improved grazing management, soil testing, better weed control, improved harvest schedules, successful field renovation, reduced overgrazing and improved pasture quality, greater use of alternative forages, and increased productivity from raised cutting height for faster re-growth; and estimated financial impacts of the changes farmers made ranged from $1000 to $4000 per farm in money farmers saved and/or generated.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
213	Weeds Affecting Plants
601	Economics of Agricultural Production and Farm Management

Outcome #24

1. Outcome Measures

Research & Outreach Support for Maine 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)
Wild fish likely play an important role as lice reservoirs and sources of initial infection of newly stocked fish and migrating wild smolts. Since the 1990's the success of fish vaccines has been

huge. The recent work of Fast et al (Fast et al., 2007; Jones et al., 2007) has demonstrated that the interaction between sea lice and their host is very dynamic with the parasite secreting a complex of agressins that modulate the local and systemic immune response of the host to improve settlement success. Vaccines targeted against these molecules provide a new route of investigation into the immunological control of sea lice.

What has been done
New knowledge was produced concerning the interaction of aquaculture with the marine environment. Meeting a growing consumer demand for seafood will require increased domestic aquaculture production. This project contributed to this goal in Maine by increasing sustainability, developing methods to control the most damaging parasite in aquaculture worldwide (the Salmon Louse (L. salmonis)) using Maine as a study area.

Results
Two patents were filed in 2018. If the first vaccine clears the clinical trials it is in now, it will be the first effective vaccine against L. salmonis available. Given L. salmonis causes the biggest economic loss to salmon farmers (estimated at over $1billion in 2017) this will be major achievement for the industry. Confirmation of the vaccine's effectiveness will potentially allow the industry to expand in Maine and North America while simultaneously eliminating the environmental impact from sea lice chemical control. The second Patent provides a physiological solution for sea lice removal. It is a natural component of seawater and is considered to be generally regarded as safe (GRAS - a US FDA designation that a chemical or substance added to food is considered safe & exempted from FDA food additive tolerance requirements) compliant. Unlike the vaccine this compound will be effective against all fish crustacean ectoparasites and will have application in freshwater and seawater aquaculture. Understanding the infectious pressure of sea lice in the Gulf of Maine (GoM) is also a key finding. It has helped identify lice hot spots and has suggested the regions from which sea lice are imported into the GoM and how they are distributed within the embayment hydrodynamic. This information is key to policy makers in both allowing aquaculture to expand while eliminating the risks of sea lice interactions between wild and farmed fish.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases

Outcome #25

1. Outcome Measures

Research & Outreach Support for Maine's Crop-Based Agriculture - Potatoes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
MAFES helps Maine potato growers develop new varieties, investigate new pest management strategies, and test potato characteristics. Maine is a major contributor of the regional breeding program whose goal is to develop attractive, productive, disease and insect-resistant potato varieties that can be used by small and large potato producers. New potato varieties are also needed to overcome pest problems while reducing agricultural chemical use and to provide resistance to climactic stress. Pest management research focuses on environmentally friendly and economically viable management approaches for insect pests.

What has been done
Potato breeding for improved quality and pest resistance continued in ME, NY, NC, and USDA-ARS during 2017 and 2018. Advanced clones were introduced to growers through field days, presentations, publications, web sites, and direct contact with stakeholders. The most promising advanced clones enter commercial trials to further explore their potential for important markets, such as chip processing, French fry production, fresh market, and specialty use. In the area of pest management, a series of experiments testing the effects of commercially available mineral oil on mortality, behavior, and development of potato aphids, Macrosiphum euphorbiae (Thomas), green peach aphids, Myzus persicae (Sulzer) (Hemiptera: Aphididae), and Colorado potato beetles, Leptinotarsa decemlineata (Say) (Coleoptera: Chrysomelidae) were conducted. More than one hundred new potato cultivars were tested for glycoalkaloid (natural toxins) content.

Results
Recent Eastern releases were grown on 2,876 ME and NY seed acres during 2017 with a seed value of ca. $8.6M. The resulting seed crop has the potential to plant 28,767 acres in 2018 with a ware value estimated at $86.3M. Nationally, varieties produced by our long-term project were grown on 5,808 seed acres during 2017 with an approximate seed value of $17.4M. The resulting seed crop has the potential to plant 58,808 acres in 2018 with a ware value estimated at $174.3M. Several varieties developed though our collective efforts are currently in the top 50 U.S. varieties including (acres, rank): Lamoka (2702, 10), Waneta (1025, 19), Lehigh (361, 41), Caribou Russet (347,42), and Pike (271, 45). Several additional varieties developed by this program are in the top 100 of US potato varieties: Keuka Gold (161 acres), (Reba (128 acres), NY115 (128 acres), Eva (125 acres), and Andover (94 acres). The pest management research revealed all three species showed negative behavioral responses to oil-treated potato foliage. Oil treatment also increased aphid mortality. Based on these results, mineral oil has potential for expanded use in potato IPM programs. The glyalkaloid testing is a critical part of the development of new, better tasting, better processing potato tuber varieties and supports the Maine potato industry.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #26

1. Outcome Measures

Research & Outreach Support for Maine's Crop-Based Agriculture - General Support to the Agriculture Sector

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)
Weeds continue to be an important production constraint for most organic and low-external-input farmers, especially the increasing numbers of new farmers. Weed management strategies include cultivation, weed seedbank management, and intensive mulching. Organic grain farmers in our region are interested in growing soybeans because they are a good rotation crop for small grains with a relatively high pay price and strong demand, but weed control has proven problematic. Organic farmers are also interested in reducing soil disturbance associated with incorporating leguminous green manures like red clover to supply nitrogen to a following crop.

What has been done
Hoeing with a camera-guidance system was tested. Band-sowing with inter-band hoeing was evaluated as an innovative weed management strategy for organic grains, offering improved crop-weed competition within bands, and improved physical weed control efficacy in between bands. Experiments were conducted evaluating no-till planting soybeans into mulch of winter rye and innovative plowing techniques.

Results
On-farm testing of an inter-row hoe with a camera-guidance system found that extremely heavy weed pressure on some organic farms may prevent successful operation as crop rows were

obscured by weeds. Results with barley were inconclusive due to late cultivation in one year, and highly effective tine harrowing offering exceptional weed control in the second year. However, a related field study including spring wheat, oat, flax, and field pea indicated that band-sowing with inter-band hoeing and tine harrowing offered improved weed control. Evidence of synergy in physical weed control is novel, with important practical applications. In a research-station trial, no-till planting soybeans into mulch of winter rye produced substantially better weed control and higher yields than conventional planting with cultivation. We demonstrated over two years that farmers can implement shallow plowing, plowing to a depth of 3 to 4 inches, and increase over-winter soil cover (from 0 to 12%) without compromising weed control or grain yields in the following crop. An experimental undercutter implement produced even greater over-winter soil cover (84%) but was less effective at killing the green manure.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
213	Weeds Affecting Plants

Outcome #27

1. Outcome Measures

Research & Outreach Support for Maine's Crop-Based Agriculture Fruit Production

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)

To remain competitive, fruit growers diversify their offerings by planting new cultivars and types of fruit that possess superior characteristics that are weaknesses in current varieties. Plums are an additional tree fruit that are adapted to Maine's cold climate and are offered at many farm markets. Standard recommendations for harvest and storage are based on long distance shipping of western cultivars. Research is needed to evaluate the storability of currently grown and new cultivars harvested at different stages of maturity.

What has been done

Research was conducted investigating bioactive compounds and antioxidant capacity in cultivars of five plum species (Hwang, Cole, Myracle, Elwell and Castonguay).

Results
This research identified plum varieties and species with greater antioxidant capacity that also have good consumer appeal. The impact of this research will be an increase in market demand for locally grown plums. The research has been completed, and a publication is in preparation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations in the experiment station are currently conducted at the project and program levels. At the project level, all projects are reviewed by an internal research council and external peer reviewers when initiated and again at completion by the research council. During the research council final evaluation, the focus is on determining if terminating projects met their stated objectives, secured extramural funding, and produced peer-reviewed publications. As for other measures of successful research programs, research faculty in this program area published numerous peer-reviewed articles.

Researchers use a variety of methods to evaluate their own research projects including evaluations retrospectively, before-after, and during the life of the project; case studies; and comparisons between treatment/intervention and nontreatment/nonintervention.

At the program level, external NIFA review teams are asked to review the research programs of schools/departments. These teams provide input on the impact and productivity of research programs supported through the station. The station is working to develop a standard program-level evaluation process, which will be used to evaluate each station program area. Our current plans include an approach based on use of expert panels as

recommended by the federal Government Accounting Office with individual program evaluations occurring every four to five years on a staggered time table.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Positive Youth Development

☑ 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	30%		0%	
802	Human Development and Family Well-Being	20%		0%	
806	Youth Development	50%		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	24.9	0.0	0.0	0.0
Actual Paid	49.5	0.0	0.0	0.0
Actual Volunteer	57.7	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**
373386	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
373386	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
3688561	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

General Activities in Support of Youth

- Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Indirect (Applied Research, Media, Internet, Publication, Resulting from Training

Youth Development Activities

- Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)

2. Brief description of the target audience

- 4-H Volunteers (Adult
- 4-H Youth (Youth)
- Agricultural Workers (Adult)
- Business Assist Organization Staff (Adult)
- Community Leaders (Adult)
- County Executive Committee Members (Adult)
- Eat Well Participants (Youth)
- EFNEP Participants (Youth)
- Extension - staff (Adult)
- Extension Staff (Adult)
- Families (Adult)
- General Public (Adult)
- General Public (Youth)
- Home Gardeners (Adult)
- Parent Educators (Adult)
- Parents (Adult)
- Senior Companion Program Volunteers (Adult)
- Teachers (Adult)
- Volunteers (Adult)

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	6614	329582	40655	460

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	13	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Direct; Club, Conference, Program, Consultation, Scholarship, or Training

Year	Actual
2018	1720

Output #2

Output Measure

- Indirect; Applied Research, Media, Internet, Publication, Resulting from Training

Year	Actual
2018	248

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Youth will demonstrate responsibility, critical thinking and problem solving skills through informed decision making
2	Youth will demonstrate flexibility and adaptability through decision-making
3	Youth will set goals and determine steps to reach them
4	Youth will demonstrate the ability to communicate through multiple methods and media
5	Youth will develop positive and sustained relationships
6	Youth will express interest and be engaged in science related activities
7	Youth will express positive attitudes about science
8	Youth will see science in their futures and recognize the relevance of science
9	Youth will demonstrate a capacity for science process skills (i.e. Designing a scientific procedure to answer a question, Explaining to others why things happen in an experiment, Using data to create a graph for a presentation to others)
10	Youth will participate in service learning/community service
11	Youth will demonstrate leadership
12	Youth have intentions for future civic engagement
13	Youth will demonstrate value and respect for other cultures
14	Youth will consume more healthy foods
15	Youth will consume less unhealthy foods
16	Youth will follow healthy eating patterns
17	Youth will understand the benefits of physical activity

18	Youth will engage in 60 minutes or more of physical activity per day
19	Youth will reduce sedentary activity
20	Youth will engage in safety practices
21	Youth will engage in prevention practices
22	Youth will develop workforce skills in support of the local economy.
23	Youth will explore educational and career aspirations
24	Youth will apply their learning to make contributions to their peers, families and communities

Outcome #1

1. Outcome Measures

Youth will demonstrate responsibility, critical thinking and problem solving skills through informed decision making

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	5700

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area

724	Healthy Lifestyle
802	Human Development and Family Well-Being
806	Youth Development

Outcome #2

1. Outcome Measures

Youth will demonstrate flexibility and adaptability through decision-making

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Youth will set goals and determine steps to reach them

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Relevant, meaningful, and authentic experiences in science, technology, engineering and math (STEM) are important to developing positive attitudes, increasing knowledge, and preparing Maine youth for the 9 million STEM-related occupations projected between 2012 and 2022. Developing Maine youth's STEM literacy is vital to ensuring our state continues to thrive economically and socially. Given the remote and diverse communities where Maine youth live, informal education can help minimize inequities in rural youth STEM education and career pipelines.

What has been done
In coordination with the University of Maine System, the 4-H STEM Ambassador program trained 120 college students in the development and delivery of informal STEM-based educational experiences. Combined, these volunteers worked with over 1,000 youth, and committed 2,400 hours of time including training, preparation and program delivery. Through this program, youth ages 8-14 come to view these Ambassadors as mentors and leaders in their community while also developing skills in STEM through hands-on activities.

Results
In 2018 the 4-H STEM Ambassador program provided experiential programming to over 1,000 youth. Sixty-six community sites, including schools and after school partners, participated with teachers and administrators reporting high levels of satisfaction. Student participants reported that without this program their instructional time with STEM would be reduced. As a result of this program participating youth have demonstrated positive attitudes, increased knowledge, and expanded interest in STEM and STEM careers. This year, all seven UMaine System campuses participated in the 4-H STEM program.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Youth will demonstrate the ability to communicate through multiple methods and media

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Youth will develop positive and sustained relationships

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	7500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Youth will express interest and be engaged in science related activities

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	5560

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Maine needs to graduate more science proficient students to meet the growing demands of our workforce. Studies show youth may have an interest in science, but dislike science class, lowering their intentions to pursue STEM-related career fields. This has been linked to a lack of authentic and engaging learning experiences in STEM. Outreach between university-based STEM researchers and youth is hindered by scheduling, distance from a campus, and dwindling school transportation budgets, all of which negatively impact youth participation.

What has been done
Extension and partners created Follow a Researcher® to help youth to understand the research process by engaging them directly with UMaine researchers in the field. FAR® is a UMaine 4-H program using technology and social media to facilitate real-time conversations between youth and graduate student researchers working in remote locations around the world. The program is now a proven model using technology to engage new audiences with authentic scientific research, humanize the researcher, and make the research process personally relevant.

Results
Since 2015, 4,560 youth ages 7 to 18 and over 150 educators have engaged with researchers during expeditions to Peru, the Falkland Islands, Antarctica, and along the coast of Maine. In 2017, in partnership with the NSF-funded Maine EPSCoR office and SEANET, we highlighted a researcher investigating parasitic relationships with invasive green crabs. The program audience grows annually, and is attracting local and national media attention including being highlighted on the social media accounts of the National Public Broadcasting radio show and podcast "Science Friday", and with an article published in the 2018 Journal of Extension Special Issue on Innovation. In development is the Follow a Researcher® network, which will enable us to manage expeditions from multiple sites from our new website (followaresearcher.org) and engage 4-H programs and researchers from other universities to share expeditions with youth and educators

from around the country and beyond.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Youth will express positive attitudes about science

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	5472

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Under-served students (minority, low income, first generation in college) often lack access to high-quality educational opportunities and career planning. They need early exposure to STEM activities, awareness of college, scholarships, and financial aid options. Nationwide job openings for STEM related careers will increase by 50% compared with non-STEM jobs; in Maine it is projected that one in seven jobs will be STEM-related.

What has been done
Through a partnership with Maine Math and Science Alliance and Axiom Technology, UMaine Extension extended the reach of the Machias STEM hub initiative, reaching 1,231 Washington County youth through including: 4-H Robotics Expo and More, offered by UMaine Machias faculty, 4-H Tech Changemakers, and STEM Guides; Summer of Science, in which youth tried a variety of engineering activities provided by UMaine EPSCoR; Teen Science Cafes; and 4-H STEM Ambassadors, with programming using activities and curriculum from the 4-H Science Toolkits.

Results

In 2018, 1,231 Washington County youth were reached through over 25 activities and events. 4-H's active initiatives and partnerships already in place in the communities have provided access to a ready audience. Evaluations showed increase in number of youth who participated in more than one STEM-related event. With the grant funding now ended the 4-H program is continuing to get requests for programming, youth who participated in STEM hub activities now recognize and sign up for programs and teachers and after school staff are requesting STEM Tool Kits for use with students.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

Youth will see science in their futures and recognize the relevance of science

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	5434

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As a global leader in the aquaculture industry, Maine is uniquely positioned to engage youth in aquaculture education programs that will help grow and strengthen the local business and economy. Hancock County has a thriving aquaculture industry and access to the UMaine Center for Cooperative Aquaculture Research (CCAR). The growing aquaculture industry needs a trained local workforce. Fourteen percent of Maine's working-age population has one or more disabilities.

What has been done
Extension partnered with the UMaine Center for Inclusion and Disability Studies and CCAR to deliver a six-week, paid Aquaponics Internship Program for high school students with disabilities. Located on the CCAR campus, this workforce development project helped youth develop skills

and career awareness relevant to aquaculture. Interns practiced life skills related to the transition into adulthood such as time management, teamwork, communication, and other skills marketable to any industry, and were introduced to local employment opportunities in related fields.

Results
Seven high school students with disabilities successfully completed a six-week, paid Aquaponics Internship Program at CCAR. They learned scientific data collection, teamwork, social skills, and time management. They also made personally meaningful decisions about college and career aspirations. Following a visit to the UMaine's Student Accessibility Services in Orono, one youth Intern reported: "maybe I will actually apply to college after all". Interns were able to identify specific duties in aquaculture job descriptions they felt comfortable doing as a result of the program. They were able to communicate the details of their program to UMaine undergraduate and graduate students, and they created personal resumes which included new, marketable skills they cultivated over the course of the Aquaponics Internship Program.

4. Associated Knowledge Areas

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

Outcome #9

1. Outcome Measures

Youth will demonstrate a capacity for science process skills (i.e. Designing a scientific procedure to answer a question, Explaining to others why things happen in an experiment, Using data to create a graph for a presentation to others)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2734

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The United States needs to improve the proficiency of our students in Science, Technology, Engineering and Math (STEM). Documentation reveals that low-income students have less than average access to science education. The achievement gap is perpetuated during summer

months for low-income students, who lose more grade equivalency due to lack of out-of-school and summer learning opportunities. In addition an increase in STEM education can lead to better employment opportunities and increase the likelihood of youth furthering their education.

What has been done
To prevent summer learning loss, UMaine Extension created and delivered science curricula at 40 unique community sites. Community partners included Boys and Girls Clubs, YMCAs, schools, public housing authorities, and local recreation camps. Summer of Science activities were based on "Innovation Engineering", and included animal adaptation, bioremediation, chromatography, and engineering design. Extension worked with adult volunteers and 34 teens who facilitated activities with over 2,700 youth.

Results
By engaging in summer of science activities, these youth are well poised to return to their academic school year with reduced summer learning loss and an increased interest in science. In addition, it has been documented that youth involved in 4-H are more likely to pursue future courses or a career in science, engineering or computer technology, that can lead to improved employment opportunities. Not only does this program help Maine youth in elementary school during summer months, it also fosters career development, leadership and responsibility for the Maine teens that are trained to deliver educational content in their neighborhoods.

4. Associated Knowledge Areas

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

Outcome #10

1. Outcome Measures

Youth will participate in service learning/community service

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2120

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the National Center for Education Statistics, nationwide, nearly one-third of high school students fail to graduate. In total, approximately 1.3 million students drop out each year-averaging 7,200 every school day. According to research, experts say that dropping out of high school affects not just students and their families, but also the country overall-including businesses, government and communities.

What has been done
Tech Wizards is a youth mentoring program using STEM education and service learning to help youth learn life and workforce skills, improve academic performance, and aspire to post-secondary education, productive careers, and civic engagement. Through Tech Wizards, students joined their science teacher, 4-H mentors and staff, to deliver STEM activities and provide positive mentoring with youth; work with area collaborators to complete citizen science and science learning projects; and were introduced to career opportunities within science, technology, and art.

Results
Statewide in 2018, Maine's Tech Wizards program matched 120 youth along with 10 adult mentors. Youth learned invaluable STEM skills, participated in ongoing fieldwork, citizen science initiatives, service learning, and were empowered to engage with their communities and contribute their time and skills to address important scientific questions, and to recognize that environmental stewardship is both the platform for their learning and an overarching life ethic.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

Youth will demonstrate leadership

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	7500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

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

Outcome #12

1. Outcome Measures

Youth have intentions for future civic engagement

Not Reporting on this Outcome Measure

Outcome #13

1. Outcome Measures

Youth will demonstrate value and respect for other cultures

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2560

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Research shows that physical, social and emotional environments can significantly impact children's learning outcomes. Children in public housing often have increased vulnerability due to

their environment and can benefit from programs that mitigate risk factors, build social capital, and connect them to positive assets.

What has been done
In 2014, UMaine Extension initiated 4-H Community Central at public housing sites in the state?s two largest cities, Portland and Lewiston as a way to build stronger families, reduce school-age youth learning loss, increase science literacy, improve critical life skills, and promote career aspirations. The program places Extension staff in public housing sites, where they engage youth with their parents, elders, school, and community through hands-on 4-H projects in science leadership and citizenship.

Results
In four years, Maine 4-H Community Central in Lewiston and Portland has involved over 7,900 school-age participants. In their local communities, youth in grades 3-8 received over 780 hours of 4-H STEM programming taught by teen mentors and community leaders. Ninety-six teens (82% of color), in grades 9-12 dedicated over 440 hours of mentoring and leadership to young people in their communities. These teens also completed a total of 70 hours of supervision and over 120 hours of training and planning to prepare and implement lessons with younger students. Participating youth have demonstrated knowledge, skills, attitudes, and behaviors necessary for fulfilling, contributing lives.

4. Associated Knowledge Areas

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

Outcome #14

1. Outcome Measures

Youth will consume more healthy foods

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

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

Outcome #15

1. Outcome Measures

Youth will consume less unhealthy foods

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

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

Outcome #16

1. Outcome Measures

Youth will follow healthy eating patterns

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2017, U.S. youth obesity rate was 14.8 percent. It is estimated that more than half of today's children will be obese by the age of 35 if current trends continue. Currently the United States spends $14 billion annually to treat childhood obesity and obese children are almost three times more expensive for the health system than the normal weight child. Rising childhood obesity rates will continue to put a strain on current health promotion programs and continue to raise health care cost for the nation.

What has been done
To help lower childhood obesity rates, UMaine Extension EFNEP provides direct education to Maine's low-income children to improve their knowledge, behaviors, and attitudes related to improving diet quality, increasing daily physical activity, and using food resources management practices to learn how to plan and shop for healthy meals and snacks. Program outcomes are measured for all youth ages 5-18 using validated pre/post program surveys.

Results
In 2018, 2,500 youth participated in Maine EFNEP. Youth participated in an average of 6 classes over a time frame of two months. Ninety-seven percent of participating youth completed a pre and post survey. As a result of participating in EFNEP:

73% of youth improved their abilities to choose foods according to current Dietary Guidelines or improved nutrition knowledge.
26% youth improved their daily physical activity practices.
44% youth used safe food handling practices more often.
64% youth improved their ability to prepare simple, nutritious, affordable food.

4. Associated Knowledge Areas

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

Outcome #17

1. Outcome Measures

Youth will understand the benefits of physical activity

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	5400

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

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

Outcome #18

1. Outcome Measures

Youth will engage in 60 minutes or more of physical activity per day

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	3305

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Educators in Maine K-12 schools are tasked with aligning their lessons in meaningful ways with local and national learning standards. A number of studies have shown that active learning and hands-on lessons create better learning results for students.

What has been done
Teachers are looking beyond the walls of their classrooms to integrate academic content areas and engage students in active learning environments. Gardens, vernal ponds, forested land, and outdoor classrooms have become more popular at schools across Maine, but teachers often lack professional support to know how to best use these spaces to incorporate curricula. UMaine Extension 4-H Camp and Learning Centers staff take students outdoors to deliver STEM based lessons, and mentor teachers to integrate lessons relevant to learning standards.

Results
UMaine Extension's 4-H Camp and Learning Centers? Open Air Classroom at Tanglewood/ Blueberry Cove and Lakeside Classroom at Bryant Pond provide residential, nature and school-based programs that help schools to meet learning standards, and engage students in active learning. In 2018, the 4-H Camp and Learning Centers provided programming for 3305 students from over 60 Maine school groups.

4. Associated Knowledge Areas

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

Outcome #19

1. Outcome Measures

Youth will reduce sedentary activity

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	5400

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research has shown that physical, social and emotional environments can significantly impact youth development and connecting youth to a positive adult role model decreases the risk for making unhealthy choices or engaging in risky behaviors. With youth spending more time connected to social media and other digital platforms resulting in isolation and sedentary indoor time, many youth suffer from obesity and/or ADHD, and some lack opportunities to develop positive interpersonal communication skills.

What has been done
Extension 4-H Camp and Learning Centers provide summer outdoor leadership programs for youth ages 4-17, many from under-served populations, with transforming experiences to develop a sense of place and belonging, and confidence in the outdoors. Youth spend each day in a positive learning environment and live for a week or more alongside trained adult educators, mentors, and caring peers. By choosing from programs focusing on ecology education, the arts, and outdoor skills, youth can create meaningful experiences that fit their needs.

Results
In 2018, the 4-H summer camps served 1888 youth from all 16 counties in Maine, 22 states, and 6 countries. Through living and working together, campers and staff became part of an interconnected community committed to a sustainable future. Youth and program alumni report that the 4-H Camp and Learning Center experience has helped them develop greater self-confidence, civic engagement, and personal and academic success.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle

802 Human Development and Family Well-Being
806 Youth Development

Outcome #20

1. Outcome Measures

Youth will engage in safety practices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	294

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Every 3 days, 100 children are injured and one dies in an ag-related incident in the U.S. For working youth, tractors were the leading source of fatalities. In addition to the devastation brought on by the loss of a life, farm accidents result in negative emotional, community, and economic impacts felt across the entire agricultural community. Access to tractor and farm safety knowledge and interactive trainings increases adoption of safety practices and results in fewer farm accidents.

What has been done
UMaine Extension taught 5 skills-based tractor safety courses for Maine youth. Farm and tractor safety information was shared to the general public, to raise awareness on the importance of farm safety, through trainings, newsletters, social media, and interactive displays at 10 events. To support this programming, Extension collaborated with legislators, Maine Farm Bureau, the New York Center for Agricultural Health and Medicine, tractor dealerships, and local farms.

Results
In 2018, 294 youth and farmers took part in Extension's farm safety trainings. Of these, 167 were trained in tractor safety. Seventy individuals completed the 5-week, 20-hour, National Safe Tractor and Machinery Operation Program curriculum. Each class focused on practical skills learning and the final exam included written and driving tests. Forty-nine people took the abridged Tractor Safety Short Course. Seventy five percent of participants from one tractor safety course responded that completion of this course has allowed them to hold on-farm summer work, and to be safer while performing that work.

4. Associated Knowledge Areas

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

Outcome #21

1. Outcome Measures

Youth will engage in prevention practices

Not Reporting on this Outcome Measure

Outcome #22

1. Outcome Measures

Youth will develop workforce skills in support of the local economy.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	95

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As a global leader in the aquaculture industry, Maine is uniquely positioned to engage youth in aquaculture education programs that will help grow and strengthen the local business and economy. Hancock County has a thriving aquaculture industry and access to the UMaine Center for Cooperative Aquaculture Research (CCAR). The growing aquaculture industry needs a trained local workforce. Fourteen percent of Maine's working-age population has one or more disabilities.

What has been done
Extension partnered with the UMaine Center for Inclusion and Disability Studies and CCAR to deliver a six-week, paid Aquaponics Internship Program for high school students with disabilities.

Located on the CCAR campus, this workforce development project helped youth develop skills and career awareness relevant to aquaculture. Interns practiced life skills related to the transition into adulthood such as time management, teamwork, communication, and other skills marketable to any industry, and were introduced to local employment opportunities in related fields.

Results
Seven high school students with disabilities successfully completed a six-week, paid Aquaponics Internship Program at CCAR. They learned scientific data collection, teamwork, social skills, and time management. They also made personally meaningful decisions about college and career aspirations. Following a visit to the UMaine's Student Accessibility Services in Orono, one youth Intern reported: "Maybe I will actually apply to college after all". Interns were able to identify specific duties in aquaculture job descriptions they felt comfortable doing as a result of the program. They were able to communicate the details of their program to UMaine undergraduate and graduate students, and they created personal resumes which included new, marketable skills they cultivated over the course of the Aquaponics Internship Program.

4. Associated Knowledge Areas

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

Outcome #23

1. Outcome Measures

Youth will explore educational and career aspirations

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2980

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Education after high school is critical to supporting skilled jobs in Maine. Supporting youth to participate in higher education helps to strengthen Maine's businesses and economy. Unfortunately, the number of Maine high school graduates enrolled in higher education lags at 40th in the nation. Although research recommends beginning to address college and career aspirations in elementary and middle grades, coordinating access to a college campus presents

barriers for rural Maine communities.

What has been done
UMaine Extension created 4-H@UMaine to provide a supportive environment for Maine youth grades 6-12 to experience life on a college campus. Participants visit the UMaine campus and imagine the possibility of attending college as they stay in residence halls, eat in the dining commons, get active in the student recreation center, and participate in hands-on workshops by UMaine students, staff, faculty, and 4-H Teen Leaders. They experience healthy relationships in small-group settings led by trained adult leaders and teenage peer mentors.

Results
In 2018, 4-H@UMaine hosted 32 youth, 17 Teen Leaders, and 27 adult staff and volunteers, and college-ready teens who took part in an exclusive experience that included pre-event training in leadership and mentoring.

92% of all participating youth indicated they learned about new career possibilities, helping to raise their career aspirations.
94% plan to go to college.

Youth participants indicated they were most impacted by healthy relationships built during that short time. They also were positively impacted by meeting people from other cultures, and learning more about the college experience and careers.

4. Associated Knowledge Areas

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

Outcome #24

1. Outcome Measures

Youth will apply their learning to make contributions to their peers, families and communities

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2018 3574

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Public Policy changes
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UMaine Extension's youth development programs are evaluated at the project and program level. Projects are reviewed by internal and external peer reviewers at completion. As for other measures of successful programs, Extension faculty and program staff published numerous peer-reviewed articles. Faculty and program staff use a variety of methods to evaluate their own programs including evaluations retrospectively, before-after, and during the life of the project; and case studies.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Sustainable Community & Economic Development

☑ 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%		4%	
123	Management and Sustainability of Forest Resources	0%		15%	
315	Animal Welfare/Well-Being and Protection	0%		2%	
511	New and Improved Non-Food Products and Processes	0%		20%	
602	Business Management, Finance, and Taxation	25%		13%	
603	Market Economics	20%		0%	
605	Natural Resource and Environmental Economics	0%		24%	
607	Consumer Economics	15%		3%	
608	Community Resource Planning and Development	15%		7%	
609	Economic Theory and Methods	0%		10%	
801	Individual and Family Resource Management	20%		2%	
805	Community Institutions, Health, and Social Services	5%		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	6.5	0.0	6.2	0.0
Actual Paid	7.6	0.0	7.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
201989	0	322746	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
201989	0	861702	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
896639	0	200687	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Community Development - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Community Development - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- Economic Development - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Economic Development - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- General Community and Economic Development Activities - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- General Community and Economic Development Activities - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)
- Small and home based business education - Direct (Club, Conference, Program, Consultation, Scholarship, or Training)
- Small and home based business education - Indirect (Applied Research, Media, Internet, Publication, Resulting from Training)

Conduct scientific research. Publish peer-reviewed journal articles and other publications. Present findings at professional and public meetings and at other venues. Educate undergraduate and graduate students.

2. Brief description of the target audience

- Business Assist Organization Staff (Adult)
- Community Leaders (Adult)
- County Executive Committee Members (Adult)
- Elders or Seniors (Adult)
- Extension - staff (Adult)
- Families (Adult)Families (Youth)General Public (Adult)General Public (Youth)
- Small or Home-Based Business Owners - Current (Adult)
- Small or Home-Based Business Owners - Potential (Adult)

Teachers (Adult)Volunteers (Adult)
Scientists, economists, state and local policymakers, extension specialists, green/horticulture industry, tourism planners, land use commissions, and commercial fishermen

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	5309	1416	298	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	5	43	48

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Direct; Club, Conference, Program, Consultation, Scholarship, or Training

Year	Actual
2018	522

Output #2

Output Measure

- Indirect; Applied Research, Media, Internet, Publication, Resulting from Training

Year	Actual
2018	38

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Adopt sound business management practices
2	Increase profitability
3	Jobs created
4	Make more effective business decisions
5	Increase sales
6	Improve efficiency
7	Hire employees
8	Reduce business management risks
9	Start a business
10	Stay in business
11	Expand a business
12	Reconsider business plan
13	Join a business association
14	Join a local chamber of commerce
15	Increase partnerships
16	Increase career aspirations and goal setting
17	Demonstrate applications of life skills

18	Assess community needs and assets
19	Adopt effective community strategies
20	Mobilize community capacities, assets, or resources
21	Demonstrate leadership skills
22	Assess current and projected impacts of climate change and adopt effective strategies to respond to and mitigate such training
23	Identify household priority needs and aspirations
24	Assess alternate choices for managing household resources
25	Adopt sustainable living practices
26	Engage positively in their community
27	Train, support and mentor others in leadership roles
28	Demonstrate application of leadership skills
29	Demonstrate civic engagement
30	Strengthen human capacities, human capital, building partnerships
31	Improve knowledge of, or strategies and tools for, sustaining Maine's rural economies and communities
32	Adoption of strategies/tools for sustaining Maine's rural economies and communities
33	Enhance sustainability, diversity, and resiliency of Maine's rural economies and communities
34	Promote and protect the quality and integrity of natural resource products

Outcome #1

1. Outcome Measures

Adopt sound business management practices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	220

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation

Outcome #2

1. Outcome Measures

Increase profitability

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	103

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small businesses are crucial to Maine's rural economy. One in five jobs in rural Maine are created by entrepreneurs employing five or fewer workers. However, many of these entrepreneurs lack the business skills to successfully start-up and grow their businesses. Research shows that helping rural entrepreneurs improve their business skills will improve their chances for success. One of the most important business management skills is pricing, yet many small business owners lack the knowledge and skills necessary to develop a profitable pricing strategy.

What has been done
Extension conducted pricing workshops statewide, presented a pricing webinar in collaboration with Maine Food Strategy, and taught a pricing seminar at a state conference for Maine entrepreneurs. The goal was to help existing and new entrepreneurs improve their pricing knowledge and skills so they could develop profitable pricing strategies for their businesses. Extension faculty conducted classes on various topics including elements of pricing, pricing models, pricing strategies, price elasticity of demand, markup vs. margin and cost analysis.

Results
Over 80 rural Maine entrepreneurs participated in this successful training. They included specialty food producers, farmers, craft artists, food retailers, environmental consultants, bookkeepers, and other small rural businesses. Eighty-seven percent of participants said they plan to set a new price for their product or service, and all plan to adopt new pricing techniques. Changes they planned to make within six months of the training included: restructure their pricing, conduct a thorough analysis of costs, evaluate their customer base, keep track of their time while producing their products and research their market more thoroughly before setting prices. Several entrepreneurs who had attended the workshops indicated that they subsequently created pricing strategies that led to increased profitability for their businesses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
609	Economic Theory and Methods

Outcome #3

1. Outcome Measures

Jobs created

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	151

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Aspiring and existing entrepreneurs need capital to start, improve and expand their businesses to create good paying jobs for Maine people. Many business owners are challenged to secure adequate funding from traditional lenders to start or expand a business. However, by partnering with a regional economic development organization, traditional lenders like banks are able to increase access to capital for Maine businesses that otherwise would not be eligible for financing.

What has been done
UMaine Extension supports improved access to financing for Maine business through its collaboration with a regional economic development agency that provides SBA loan guarantees for prospective borrowers. As an active member of the Loan Review Committee, Extension provides guidance and oversight on credit and lending strategies, reviews loan applications and along with other business and community leaders arrives at a loan recommendation.

Results
In fiscal year 2018 the Loan review Committee approved 40 loans of over $3.5 million to 27 businesses. Over $7.1 million was leveraged bringing the total investment to over $10.6 million. One hundred-fifty-one jobs were created or retained, and seven of Maine's 16 counties benefited from the program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
607	Consumer Economics

Outcome #4

1. Outcome Measures

Make more effective business decisions

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	130

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
609	Economic Theory and Methods

Outcome #5

1. Outcome Measures

Increase sales

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
607	Consumer Economics
609	Economic Theory and Methods

Outcome #6

1. Outcome Measures

Improve efficiency

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	502

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
607	Consumer Economics
609	Economic Theory and Methods

Outcome #7

1. Outcome Measures

Hire employees

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	151

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation

Outcome #8

1. Outcome Measures

Reduce business management risks

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Start a business

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
609	Economic Theory and Methods

Outcome #10

1. Outcome Measures

Stay in business

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	72

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation

Outcome #11

1. Outcome Measures

Expand a business

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	43

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
607	Consumer Economics
609	Economic Theory and Methods

Outcome #12

1. Outcome Measures

Reconsider business plan

Not Reporting on this Outcome Measure

Outcome #13

1. Outcome Measures

Join a business association

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Join a local chamber of commerce

Not Reporting on this Outcome Measure

Outcome #15

1. Outcome Measures

Increase partnerships

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	13

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation

Outcome #16

1. Outcome Measures

Increase career aspirations and goal setting

Not Reporting on this Outcome Measure

Outcome #17

1. Outcome Measures

Demonstrate applications of life skills

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual

2018 2500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The first three years of a child's life are a critical time for growth and development. Few investments have a rate of return of early childhood programs. Investing in children, starting with the earliest years, produces significant long-term impacts for individuals and communities. Benefits to the children, families and communities can range from reduced child abuse and neglect, lower health care costs to school success and better employment.

What has been done
UMaine Extension Parenting Education Professionals are part of a statewide network of Maine Families Home Visiting Programs. In 2018 ten certified parent educators provided over 2500 home visits to 265 families living in four counties. Using the Parents As Teachers model parent educators met with families in their homes and provided them with current information on child development and parenting; shared activity ideas and ways to engage and nurture their child?s optimal development, and; provided connections and linkages to community resources.

Results
Families from the 4 counties receive services including home visits, group connections, child screening and connections to community resources, knowledge and resources to prepare their children for a stronger start in life and greater success in school. Our results included: 83% of children enrolled had a timely screening for developmental delays. In cases where a delay was discovered 95% of those children were successfully referred and connected with local intervention programs for further developmental evaluation and services. 100% of families who completed the annual parent survey reported the Maine Families Program helped them understand their child?s growth and development.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
805	Community Institutions, Health, and Social Services

Outcome #18

1. Outcome Measures

Assess community needs and assets

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	47

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Local labor markets and perceptions of future opportunities play a large role in determining how young people invest in their personal human capital, which has implications for the survival of communities. Understanding youth decisions about their human capital investments, and the potential impact these choices may have on rural community persistence into the future, in forested areas in economic transition will allow rural communities throughout the U.S. to better understand the challenges facing their social and economic continuity.

What has been done
221 surveys at four schools were completed. Survey results were presented at an academic conference and at community meetings. In addition, two listening sessions for students and parents were held in rural communities that had participated in the survey. These sessions guided local participants through an exercise to list community assets in the seven capitals framework, as well as identifying gaps and potential action points.

Results
Created the Maine Forest Collaborative, a new effort designed to bring project-based and experiential learning to rural forest communities in Maine, focused on the potential forest economy. Two summits with rural high school educators were held, where PIs participated and gave talks about the current state of the forest economy and higher education opportunities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #19

1. Outcome Measures

Adopt effective community strategies

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	42

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Maine is dangerously dependent on the lobster resource for the economic health of its coastal communities and working waterfronts, and aquaculture is one of the few opportunities to diversify from that dependence, but there are many barriers to entering the aquaculture industry.

What has been done
Since 2013, Maine Sea Grant-coordinated Aquaculture in Shared Waters program has provided comprehensive training, networking, technical support and business assistance to fishermen and members of fishing families. Marine Extension Team staff serve the aquaculture start-ups through technology transfer, conducting applied research, and helping potential marine farmers connect with funding opportunities, state regulators, and scientists.

Results
In 2017, two Aquaculture in Shared Waters participants secured a lease to grow oysters at the Bremen Lobster Cooperative, the largest working waterfront space in Maine and home to 24 lobster boats from Stonington to Cape Elizabeth. The training program prepared them with background and network resources to complement their considerable business and fishing skills. Moreover, their enthusiasm and the proximity to the other fishermen in that group made an ideal setting for tech-transfer and discussion between one another. Lobster pounds are changing, and their re-purposing to aquaculture makes a great deal of sense; biologically, logistically and economically.

4. Associated Knowledge Areas

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

Outcome #20

1. Outcome Measures

Mobilize community capacities, assets, or resources

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Informed observers are predicting the coming of a Timber Age, where Northern forests and rural economies supply the growing demand for urban construction and housing. In the Northeast, Maine and its forests sit atop one of the largest urban population centers in the world. With over 90% of its land base covered in trees, Maine is the most heavily forested state in the nation, making it a prime candidate for economic revitalization through the sustainable production of mass timber.

What has been done
Created the Maine Mass Timber Commercialization Center (MMTCC). The purpose of the Center is to advance new forest products technologies and bring innovative mass timber manufacturing to Maine.

Results
MMTCC staff accompanied Governor Paul LePage's staff to SmartLam in Columbia Falls, MT, in an attempt to attract them to Maine. In February 2018, SmartLam announced their intentions to build a factory in Maine. LignaTerra also announced its intention to build a plant in Maine, the second cross-laminated timber (CLT) manufacturer to make such an announcement in the same month. The MMTCC will continue discussions with the two manufacturers with stated intentions of siting a CLT facility in Maine to determine how best to support their efforts and make CLT a success in Maine.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #21

1. Outcome Measures

Demonstrate leadership skills

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	81

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Stakeholder engagement in municipal planning activities, often restricted to public hearings, does not necessarily result in effectively soliciting community input, and conflict resolution can be hindered by a lack of facilitation skills.

What has been done
UMaine Extension collaborated with Maine Sea Grant and UNH Extension to make a 20-hour training "Strengthening Your Facilitation Skills" available in southern Maine. This partnership creating new programming and services opportunities for communities, such as peer learning programs, and creating a network of co-facilitators. In 2017 and 2018 UMaine and UNH Extension collaborated to pilot a 3 session, 21-hour, Community Engagement Academy in the Seacoast Region of Southern Maine and New Hampshire.

Results
"Strengthening Your Facilitation Skills" has graduated over 80 professionals who are now offering their skills within their communities. One participant has initiated a Listen to Learn series of neighborhood meetings on economic development and launched a website to engage the community. Collaboration with New Hampshire Extension made it possible for new programming and services to become available in Maine, such as the Community Engagement Academy, development of new outreach approaches for municipal officials, and understanding the impact of graduates applying their facilitation skills within their communities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #22

1. **Outcome Measures**

Assess current and projected impacts of climate change and adopt effective strategies to respond to and mitigate such training

Not Reporting on this Outcome Measure

Outcome #23

1. **Outcome Measures**

Identify household priority needs and aspirations

Not Reporting on this Outcome Measure

Outcome #24

1. **Outcome Measures**

Assess alternate choices for managing household resources

Not Reporting on this Outcome Measure

Outcome #25

1. **Outcome Measures**

Adopt sustainable living practices

2. **Associated Institution Types**

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	674

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #26

1. Outcome Measures

Engage positively in their community

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2850

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Extension Homemakers is a volunteer group that develops leadership skills, supports community causes, and promotes UMaine Extension's educational programs in 9 Maine counties. These organized programs are part of the statewide network of Extension Homemakers. Local group members meet throughout the year to participate in educational programs, and identify community projects, such as providing assistance to local food pantries or nursing homes or veterans groups, funding educational scholarships or youth camp programs.

What has been done
In 2018, over 550 Extension Homemakers took the opportunity to learn with others, make friends, contribute to their community and county, donating their time, money, and materials to numerous community agencies and projects. Homemakers from over 40 Local Extension Homemaker Groups met and delivered or engaged in Extension programming involving over 2,300 participants and 321 programs including food, personal and community; nutrition and health; gardening and environmental, financial planning and consumer; personal growth; and cultural and creative arts.

Results

In many Maine counties Extension Homemakers remain a traditional and vital part of the community fabric. They also provide direct and indirect benefits in terms of volunteer hours, fundraising, and material donations. In 2018, the total estimated monetary value of the Extension Homemaker program to their communities was over $939,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #27

1. Outcome Measures

Train, support and mentor others in leadership roles

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	226

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Maine beekeeping and maple syrup face production scale management challenges. We need to expand the understanding of scale management for small and medium-sized farms to support the sustainability of such enterprises, using beekeeping and maple syrup as focal points; increase producer awareness of scale management challenges and chances to inform their decision-making; improve social science knowledge of stakeholders; and train the next generation of farmers, resource managers, and scientists in methods to support agricultural sustainability.

What has been done
The Sustainable Food Systems Research Collaborative (SFSRC) fellows program was enhanced at the University of Maine and officially launched at College of the Atlantic. The program is training undergraduate fellows, the next generation of scientists and farmers, in knowledge-to-action models so that they become better at creating, using, and sharing of actionable knowledge that benefits small and medium-sized producers.

Results
One fellow developed a project on the rearing of northern queen honey bees. Another developed a project on social capital among multi- and first-generation farmers, which will be the basis for an

Honors thesis. Four students led the Sweet Spot Module in the Honors Tutorial. They developed an interview instrument that served as a foundation for researchers' interviews with industry stakeholders; students then conducted interviews with beekeeping and maple production industry experts, Jennifer Lund, Maine State Apiarist, and Kathy Hopkins, Extension Professor, to develop and improve the interview instrument for Sweet Spot project stakeholders and research participants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
315	Animal Welfare/Well-Being and Protection
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development

Outcome #28

1. Outcome Measures

Demonstrate application of leadership skills

Not Reporting on this Outcome Measure

Outcome #29

1. Outcome Measures

Demonstrate civic engagement

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	350

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Average New England air temperature increases are among the highest in the continental United States, and sea surface temperatures in the Gulf of Maine have increased faster than 99 percent

of the rest of the world's oceans. Little is known about how marine and upland biota respond to these environmental changes. Climate scientists, resource managers, economists, and others need reliable information about the effects of climate change, and the process of collecting phenology data is a simple, reliable method to ground-truth climate models.

What has been done
Since 2010, UMaine Extension and Maine Sea Grant have worked with partners to develop and coordinate Signs of the Seasons, a monitoring program engaging citizens in observing the timing of seasonal plant and animal life cycle events (phenology). The data are publicly available through the National Phenology Network, and the program offers seminars, webinars, and field-based learning for participants and the public throughout Maine and New Hampshire. Hundreds have been trained to record the phenology of common plants and animals in their own communities.

Results
In 2018, volunteer observers made more than 850 site visits and recorded more than 42,000 observations of the program's 19 indicator species in Maine and New Hampshire, including rockweed and the common loon. Of participants surveyed, 72% reported an increase in their knowledge of climate science, and 95% reported a better understanding of phenology as an indicator for climate-related biological change. SOS continues volunteer engagement with increased K-12 programming, and through opportunities for species-specific research seminars. In 2016, a Maine Maritime Academy researcher using SOS data to re-evaluate a historical model of ocean temperature-mediated reproduction in Ascophyllum nodosum (rockweed) determined that reproduction onset more than 30 days earlier than historically recorded.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #30

1. Outcome Measures

Strengthen human capacities, human capital, building partnerships

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	846

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The average U.S. farmer is 58 years old, and farming is the sixth most dangerous job in America. An estimated 5,700 farmers, farm family members, or farm workers in Maine have a chronic health condition or disability, such as post-traumatic stress disorder, traumatic brain injury, or aging-related issues, such as arthritis or hearing loss. In addition to farmers, fishermen, forest workers, and migrant workers face similar challenges for remaining successful in production agriculture.

What has been done
Maine AgrAbility helps Maine farmers, loggers and fishermen facing physical or cognitive challenges, to enhance their ability to farm and live independently, which improves their quality of life and economic sustainability. AgrAbility specialists assess issues and offer adaptive recommendations. They provide education about safe work methods and connect people with other resources through this nonprofit partnership between the UMaine Cooperative Extension, Goodwill Northern New England, and Alpha One.

Results
Since it began in 2010, AgrAbility has provided technical information to 754 farmers and conducted on-site assessments for 92 agricultural workers. The diverse agricultural operations include dairy and livestock operations, Christmas tree farms, fruit orchards, agritourism, vegetable and maple syrup production, hay sales, managing woodlots and lobstering. Clients reported increased knowledge of their conditions and increased accessibility for their daily work. They reported ways that the assessment and suggested changes helped them decrease physical pain, stress, and strain through modifications to equipment, the work or home environment, and farm operations or chores. One participant shared this success story about the recommendations made by the Maine AgrAbility: "I had challenges I was struggling with, and I was amazed that by the time they left the farm I already had 3 or 4 different things that I knew I could change right then and there. They came up with great ideas."

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
801	Individual and Family Resource Management
805	Community Institutions, Health, and Social Services

Outcome #31

1. Outcome Measures

Improve knowledge of, or strategies and tools for, sustaining Maine's rural economies and communities

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	800

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the USDA "a beginning farmer is someone who has operated a farm for ten years or less." Nearly one third of the farmers in Maine have 10 years or less of experience on their present farm. Forty-seven percent of new farm businesses fail within the first five years. New farmers interested in starting a farm often lack skill, knowledge and confidence in areas such as business planning, access to capital, rules and regulations affecting agriculture operations, and marketing.

What has been done
In 2012, UMaine Extension used a SARE grant to spark the formation of the Beginning Farmer Resource Network of Maine (BFRN). The BFRN is a coalition of Maine agriculture agencies and organizations connecting aspiring and beginning farmers to resources for farm business success. The BFRN?s activities include bi-monthly meetings with member updates, coordination of activities, and professional development trainings; an online beginning farmer resources directory website; and in-depth workshops at the annual Maine Agricultural Trades Show.

Results
The BFRN has become a model for maximizing resources and improving farmer services by increasing statewide communication, coordination and collaboration among ASPs. BFRN's continuing high level of activity is a testament to the sustainability of the network structure and the value BFRN offers to participating organizations, agencies, and institutions. In 2018, an impact survey of BFRN members showed that as a result of BFRN, over 800 farmers have made changes (e.g. business planning and accessing technical assistance), affecting about 40,750 acres and 47,265 animals, and resulting in a total value over 5 years of over $8 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
315	Animal Welfare/Well-Being and Protection
605	Natural Resource and Environmental Economics
607	Consumer Economics
609	Economic Theory and Methods

Outcome #32

1. Outcome Measures

Adoption of strategies/tools for sustaining Maine's rural economies and communities

Not Reporting on this Outcome Measure

Outcome #33

1. Outcome Measures

Enhance sustainability, diversity, and resiliency of Maine's rural economies and communities

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Following the 2007/2008 recession, the US economy underwent significant structural change with manufacturing including agricultural extraction taking a big hit. Like most states, Maine has experienced tough times in agriculture, particularly as a result of ongoing challenges in forestry and logging, meaning the Maine economy needs to exploit areas of niche or potential advantage to support regional and rural economic development. An example of one such pathway are hops and malt crops. The goals of the research are to improve the effectiveness and use of agriculture related to craft brewing, leading to increased regional economic development prospects for rural areas and communities.

What has been done
Worked with the craft breweries in Maine to analyze the economic impact of the sector. Completed in-depth analysis of the agricultural purchases that are involved in craft beer production. This allowed the establishment of the supply chain relationships across the state and across time (2016-2018).

Results
The research revealed Craft breweries in Maine continued to grow in number and in output in 2017. That growth is expected to continue into the foreseeable future. Breweries and related

activities by their suppliers and employees contributed a total of $260.4 million to the Maine economy in 2017, up from $225 million in 2016. The economic activity generated $1.5 million in excise taxes, $168 million in beer sold and 2,560 jobs with a total of $54.8 million in wages. One out of five tourists equaling 9.8 million people participated in a brewery tour or tasting in 2017. The detail on Maine suppliers has allowed a map of beer inputs to be constructed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes
602	Business Management, Finance, and Taxation
605	Natural Resource and Environmental Economics
607	Consumer Economics

Outcome #34

1. Outcome Measures

Promote and protect the quality and integrity of natural resource products

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	520

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Maine has the third largest maple production in the United States, behind Vermont and New York. Maine's maple industry has an annual statewide economic contribution of over $48 million in output, 805 full and part time jobs, and over $25 million in labor income. Maine's maple production industry annually produces over 700,000 gallons of maple syrup.

What has been done
UMaine Extension, UNH Extension and the Vermont Agency of Agriculture, Food and Markets collaborate to create an International Maple Syrup Institute Maple (IMSI) Grading School. To meet ongoing demand, the Grading School has been held annually since 2004, and has been adopted by the IMSI as a signature event aligned with the IMSI mission to protect the quality and integrity of maple products. Participants include producers, bulk buyers and syrup packers, Department of Agriculture inspectors, Extension personnel, and chefs.

Results

For 15 years the school has helped promote the wholesome image of the maple industry and shown that its participants are high quality and careful producers of unique maple products. The continued success of the school and its participants helps promote the exceptional image of the maple industry and its producers who create high quality products. Fifteen years of evaluation results show that 82% of the 520 participants have increased their knowledge about syrup grading techniques. The school provides an excellent platform for industry discussion and education about maple products, grading and quality issues concerning pure maple syrup. The school has received positive media attention in including news articles by the Associated Press and National Public Radio, as well as local television and print media.

4. Associated Knowledge Areas

KA Code	Knowledge Area
603	Market Economics
605	Natural Resource and Environmental Economics
607	Consumer Economics
608	Community Resource Planning and Development
609	Economic Theory and Methods

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations in the experiment station are currently conducted at the project and program levels. At the project level, all projects are reviewed by an internal research council and external peer reviewers when initiated and again at completion by the research council. During the research council final evaluation, the focus is on determining if terminating projects met their stated objectives, secured extramural funding, and produced peer-reviewed publications. As for other measures of successful research programs, research faculty in this program area published numerous peer-reviewed articles.

Researchers use a variety of methods to evaluate their own research projects including evaluations retrospectively, before-after, and during the life of the project; case studies; and comparisons between treatment/intervention and nontreatment/nonintervention.

At the program level, external NIFA review teams are asked to review the research programs of schools/departments. These teams provide input on the impact and productivity of research programs supported through the station. The station is working to develop a standard program-level evaluation process, which will be used to evaluate each station program area. Our current plans include an approach based on use of expert panels as recommended by the federal Government Accounting Office with individual program evaluations occurring every four to five years on a staggered time table.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Climate Change

☑ 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%		9%	
112	Watershed Protection and Management	0%		7%	
123	Management and Sustainability of Forest Resources	0%		7%	
125	Agroforestry	0%		3%	
132	Weather and Climate	0%		8%	
135	Aquatic and Terrestrial Wildlife	0%		17%	
136	Conservation of Biological Diversity	0%		4%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		5%	
205	Plant Management Systems	0%		9%	
215	Biological Control of Pests Affecting Plants	0%		2%	
216	Integrated Pest Management Systems	0%		2%	
301	Reproductive Performance of Animals	0%		1%	
305	Animal Physiological Processes	0%		1%	
306	Environmental Stress in Animals	0%		7%	
307	Animal Management Systems	0%		2%	
311	Animal Diseases	0%		7%	
605	Natural Resource and Environmental Economics	0%		2%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		7%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.4	0.0

Actual Paid	0.0	0.0	3.3	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**
0	0	191489	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	436885	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	35099	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct scientific research. Publish peer-reviewed journal articles and other publications. Present findings at professional and public meetings and at other venues. Educate undergraduate and graduate students.

2. Brief description of the target audience

Maine natural-resource-based industries, Cooperative Extension staff, other scientists, state and federal policymakers, regulators, and legislators, classroom teachers

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	0	0	0	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	52	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- New technique to assess responses to high ambient temperatures in small mammals using flow-through respirometry at low humidity.

Year	Actual
2018	0

Output #2

Output Measure

- Compilation of a comprehensive dataset on the physiology and energetics of the southern flying squirrel (Glaucomys volans) at the northern edge of its distribution range.

Year	Actual
2018	0

Output #3

Output Measure

- A working version of the Maine Integrated Forest Ecosystem Service (MIFES) has been developed. The model is capable of estimating trends in growing forest stocks, the provision of harvested biomass and industrial roundwood, and forest carbon sequestration in both standing forests and harvested wood products for more than a dozen forest types in the state of Maine. Additional work in the last year improved the spatial resolution of the model such that results can be downscaled to the level of a land parcel or better. The model also includes a range of FES metrics, including those related to water quality and habitat provision.

Year	Actual
2018	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Develop new knowledge and technologies to address the effects of climate variability and change
2	Enhance adaptive capacity of production and natural systems to reduce exposure and vulnerability to climate change
3	Understanding Potential Climate Change Impacts on Maine Drinking Water Supplies
4	Understanding potential climate change impacts on small mammals

Outcome #1

1. Outcome Measures

Develop new knowledge and technologies to address the effects of climate variability and 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)
Forests provide critical ecosystem services (ES), including production of fiber resources, carbon sequestration, climate change mitigation, protection of freshwater, and preservation of cultural values. In Maine, the economy accounts for over 6% of the total GDP and has an estimated annual economic impact of $8 billion. In order to better assess Maine's current and future inventory and risks for forest ecosystem services (FES), we need an integrated assessment model to estimate the potential impacts of climate change and land use policy on Maine's FESs.

What has been done
Developed a draft spatial database to quantify the current stock and flow of three FES in Maine (wood, fiber, carbon sequestration). Created a functioning integrated assessment model capable of estimating the potential effect of climate policies on Maine's forest landscape. Explored policy options such as carbon tax and afforestation subsidy to incentivize the adoption of land management activities to enhance Maine's FES.

Results
A working version of the Maine Integrated Forest Ecosystem Service can estimate trends in growing forest stocks, the provision of harvested biomass and industrial roundwood, and forest carbon sequestration in standing forests and harvested wood products in Maine. The model has been improved so that results can be downscaled to the level of a land parcel or better. It also includes FES metrics, including those related to water quality and habitat provision. We have developed a framework to model and quantify impacts of land use and environmental policy on the forest sector in Maine and beyond. Key policies include adjusting timber demand parameters and input prices with the intent to influence harvest levels and forest carbon sequestration rates. The project has had collaboration and input from forestry and industry stakeholders.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #2

1. Outcome Measures

Enhance adaptive capacity of production and natural systems to reduce exposure and vulnerability to climate 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)
Understanding and anticipating the effects of climate change on ecological communities is a regional, national and global research priority. The regional effects of climate change could strongly degrade freshwater ecosystems and the cultural, economic, and social services they provide Maine people. Maine water managers can mitigate negative impacts by prioritizing the maintenance of resilient ecosystems when making decisions on the sustainability of other sources of environmental stressors, but the ability to make these decisions is limited by a lack of understanding of climate change will impact freshwaters.

What has been done
A pond mesocosms experiment was designed in which communities of different ages were subject to a drying disturbance designed to simulate a late season drought. Another experiment used simulated flood disturbances in stream channels to examine the effects of disturbance frequency on stream invertebrate communities.

Results
Researchers found that younger communities contained a higher proportion of mobile organisms such as winged predators, and these were more impacted by drought than less mobile organisms. These results suggesting more frequent drought disturbances may change the trophic structure of pond ecosystems in ways that may in mobility and trophic level on community vulnerability to disturbance in pond mesocosms. The flood disturbance experiment shows that cumulative effects of repeated floods - not just the time communities have had to recover after a flood - affect community structure, suggesting the timing of past floods is important in the response of stream ecosystems to future disturbances.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

Outcome #3

1. Outcome Measures

Understanding Potential Climate Change Impacts on Maine Drinking Water Supplies

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)
Although research has documented earlier ice-off dates and increased concentrations of dissolved organic carbon in many northeastern US lakes the associated changes in the physical and biological structure of these systems remains unclear. These changes could alter lake productivity and community structure, affecting drinking water quality, transfer of toxic substances, and fisheries resources. Understanding the links among DOC, algal communities, and climate-relevant lake thermal structure will aid drinking water utilities in assessing the degree of risk and required treatment strength with DOC fluctuations in their water source.

What has been done
Paleolimnological tools were used to assess how thermal structure has been changing in Maine lakes. A collaboration of 16 other researchers from across the Northeast assessed how surface and deep water temperatures of more than 200 lakes have changed over the past 40 years, assessing dissolved organic carbon levels, extreme weather years, and how precipitation has affected DOC concentrations in lakes based on data from the Long-Term Monitoring Program. Six water districts participated.

Results
The research found that changes in thermal structure have occurred but are variable across lakes. Surface water temperatures and the strength of thermal stratification have increased, while

patterns of change in deep waters have varied. We found that DOC has been increasing in sampled lakes over the past 20 years, with subsequent changes in lake thermal structure. The DOC concentrations in Maine lakes increased during extreme wet years. Storms had variable effects on DOC, and identified three patterns across lakes: large but transient increases, slow but sustained increases, and no change. The researchers involved have been in a continuous communication loop with the water districts to ensure that the research is relevant to their needs, and the results have led to changes in action by the districts.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Understanding potential climate change impacts on small mammals

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)
Global climate change has revealed the need to understand relationships between environmental temperatures, energetics, and performance in animals as species ranges' shift in response to warming temperatures. To identify conservation priorities and predict future trends in species health and distribution, we need to assess the vulnerability of individual species to climate change. The research seeks to address gaps in our fundamental understanding of mammalian energetics at elucidating the effects of activity, humidity and high ambient temperature on the performance (and distribution) of small mammals in Maine.

What has been done
Researchers recorded microclimate temperatures in a variety of forest environments. Investigators collected substantial data from free-ranging small mammals including microclimate selection and body temperature.

Results

This project has collected novel physiological data from four species of wild Maine mammals and a comprehensive data set on laboratory mice. We have refined a technique to assess responses to high ambient temperatures in small mammals using flow-through respirometry at low humidity. This technique will be used in future work on other species and at higher humidities to address the effects of humidity on the energetics of small mammals. Microclimate temperature data are currently being used to refine climate models and make them more applicable for small mammals. Small mammal data collection that included flying squirrels has resulted in a comprehensive dataset on the physiology and energetics of the southern flying squirrel (Glaucomys volans) at the northern edge of its distribution range.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
305	Animal Physiological Processes
306	Environmental Stress in Animals

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations in the experiment station are currently conducted at the project and program levels. At the project level, all projects are reviewed by an internal research council and external peer reviewers when initiated and again at completion by the research council. During the research council final evaluation, the focus is on determining if terminating projects met their stated objectives, secured extramural funding, and produced peer-reviewed publications. As for other measures of successful research programs, research faculty in this program area published 52 peer-reviewed articles.

Researchers use a variety of methods to evaluate their own research projects including evaluations retrospectively, before-after, and during the life of the project; case studies; and comparisons between treatment/intervention and nontreatment/nonintervention.

At the program level, external NIFA review teams are asked to review the research programs

of schools/departments. These teams provide input on the impact and productivity of research programs supported through the station. The station is working to develop a standard program-level evaluation process, which will be used to evaluate each station program area. Our current plans include an approach based on use of expert panels as recommended by the federal Government Accounting Office with individual program evaluations occurring every four to five years on a staggered time table.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Sustainable 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
102	Soil, Plant, Water, Nutrient Relationships	0%		5%	
112	Watershed Protection and Management	0%		7%	
123	Management and Sustainability of Forest Resources	0%		17%	
135	Aquatic and Terrestrial Wildlife	0%		22%	
136	Conservation of Biological Diversity	0%		12%	
202	Plant Genetic Resources	0%		3%	
215	Biological Control of Pests Affecting Plants	0%		3%	
301	Reproductive Performance of Animals	0%		1%	
306	Environmental Stress in Animals	0%		5%	
311	Animal Diseases	0%		8%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	0%		3%	
605	Natural Resource and Environmental Economics	0%		10%	
608	Community Resource Planning and Development	0%		3%	
609	Economic Theory and Methods	0%		1%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	10.8	0.0
Actual Paid	0.0	0.0	13.5	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**
0	0	680829	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1496864	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	651515	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct scientific research. Publish peer-reviewed journal articles and other publications. Present findings at professional and public meetings and at other venues. Educate undergraduate and graduate students.

2. Brief description of the target audience

Other scientists; teachers at all levels; directors of aquariums and museums, exhibit halls, etc.; endangered species biologists/managers; state and local policymakers; state regulatory agencies; environmental consultants; landowners

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	0	0	0	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	54	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Completed analysis of the synchonicity, cyclicity, and periodicity for a 15-year data set of snowshoe hare densities from 2001-2015 on commercial forestlands across northern Mane.

Year	Actual
2018	0

Output #2

Output Measure

- Developed a database from systematic trapping records and evaluated habitat-specific dynamics in hare populations from 1994-1997.

Year	Actual
2018	0

Output #3

Output Measure

- Constructed stage-structured population models to a) quantify spruce grouse population growth rates based on measured demographic rates, b) evaluate potential vital rate contributions to population growth, and c) illustrate the potential contributions of forest management to population growth.

Year	Actual
2018	0

Output #4

Output Measure

- Built a model of harvesting impacts on white sucker life history and population demography, calibrated with data from six Maine populations. Fishery managers at the Maine Department of Inland Fisheries and Wildlife (MDIFW) are using this model to evaluate current regulations on white sucker harvest and identify gaps in information to better survey harvesters. White sucker harvest has been increasing, due to popularity as lobster bait, and managers are concerned about overfishing and potential population declines and ecosystem-level changes.

Year	Actual

2018	0

Output #5

Output Measure

- Created energy-flow models with data from a rural Maine homestead to quantify natural, human labor, and fossil fuel inputs and estimate Energy Return on Investment (EROI) as a metric of profitability for producing fuel, food, and value-added commodities.

Year	Actual
2018	0

Output #6

Output Measure

- Developed an undergraduate/graduate course on Biophysical Economics (EES 351/590: Energy, Wealth, and Power: A Biophysical Systems View of Nature and Civilization). It is now a permanent part of the Department of Wildlife, Fisheries, and Conservation Biology curriculum and also meets university-wide General Education requirements.

Year	Actual
2018	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Improve knowledge of, or strategies and tools for, sustaining Maine's natural resources
2	Enhance sustainability, diversity, and resiliency of Maine's natural resource-based industries
3	Improve health, distribution, and/or abundance of crucial plant and animal species
4	Advancing Aquatic Ecosystem Conservation & Improving Fisheries Management in Maine

Outcome #1

1. Outcome Measures

Improve knowledge of, or strategies and tools for, sustaining Maine's natural resources

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)
Maine's commercially managed forests support the largest spruce grouse population in the eastern U.S. This bird has been identified as a species at considerable risk within the northeast U.S. region by the International Association of Fish and Wildlife Agencies. Ongoing research has documented high rates of occupancy within previously clearcut conifer stands that have been regenerated with the aid of glyphosate application and with precommercial thinning, suggesting that forest management might help to enhance spruce grouse populations.

What has been done
Fieldwork concluded to document demographic rates (adult survival for males and females, nest success, chick survival) of spruce grouse using a combination of radio-telemetry and capture-mark-recapture methods; to compare those rates across stands with different forest management treatments, and to model effects of forest management treatments on demography. Researchers monitored 150 radio-marked spruce grouse during a 6-year study, and located and monitored 26 nests, 60 broods, 43 juvenile and 116 adult spruce grouse. Additionally, over 1000 spruce grouse locations were collected that contributed to our understanding of spruce grouse use of commercial forest stands.

Results
The consequences of spruce grouse use of forest stands with varying management histories (silvicultural treatments and time since stand harvest) on nest success, brood success, juvenile survival, and adult survival were evaluated. Researchers also constructed stage-structured population models to a) quantify spruce grouse population growth rates based on our measured demographic rates, b) evaluate potential vital rate contributions to population growth, and c) illustrate the potential contributions of forest management to population growth.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #2

1. Outcome Measures

Enhance sustainability, diversity, and resiliency of Maine's natural resource-based industries

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Improve health, distribution, and/or abundance of crucial plant and animal species

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
People from a broad spectrum of disciplines grapple with how we can maintain biological diversity in the context of human modification of landscapes. This objective will be pursued primarily as a synthetic, cooperative exercise with colleagues who work on vernal pools, riparian systems, and other examples of "small natural features."

What has been done
Dissemination of research results has included social media. For example, during the period of July 9, 2017 - July 9, 2018, material posted on the project?s Facebook page reached 2,100 people. The Of Pools and People Facebook account currently has 214 subscribers (i.e., "likes") and the Twitter account has 102 subscribers (i.e., "followers").

Results
Creation of a Vernal Pool Special Area Management Plan mitigation tool which was adopted in federal wetland rules for Maine by the US Army Corps of Engineers and the Maine Department of Environmental Protection. Co-project Director Aram Calhoun continues to work with Maine towns

on implementing the new Vernal Pool Special Area Management Plan and is consulting with 6 new towns, 2 other New England States, and Quebec and New Brunswick to adapt this management plan to their regions. Calhoun and colleagues received an NSF NRT grant with vernal pool ecosystems and how transdisciplinary research approaches can lead to conservation success for these wetlands is one of the five research foci. In addition, Calhoun and colleagues are preparing an NSF Smart and Connected Communities proposal to continue the work of advancing the localism paradigm to address natural resource conservation challenges including vernal pools (other resources include tidal power and salmon).

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

Outcome #4

1. Outcome Measures

Advancing Aquatic Ecosystem Conservation & Improving Fisheries Management in Maine

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)
Native fishes of commercial, recreational, or ecological importance in Maine, such as Atlantic salmon, brook trout, alewife, and sea lamprey, have experienced range-wide decline because human activities have degraded freshwater habitats. Recently, humans have sought to mitigate these negative impacts and restore native fisheries, especially for migratory species, by removing dams and restoring access to historic habitat. Both types of human impact can result in rapid changes to in-stream habitat, and it is vital to understand how native species respond and how their functional roles change so we can evaluate and adjust management objectives and actions accordingly.

What has been done
In Sedgeunkedunk Stream, a tributary to the Penobscot River, sites were established along a longitudinal gradient above and below dams, which were removed in 2008 and 2009; in 2010 most of the watershed became accessible to anadromous fish. Research focused on changes in

the distribution and abundance of stream fishes in response to dam removal by conducting population estimates twice yearly. Changes in diversity, abundance, biomass, and community structure over space and time reflect ongoing recovery of the stream following dam removal. Abundance of sea lamprey was estimated by annual mark-recapture surveys of spawning adults and their nests.

Results
Managers have used this research to prioritize recovery of sea lamprey in their dam removal and fish passage plans. Coghlan and Schmitt 2018 disseminated this and other information about Maine's sea lamprey to an international audience in celebration of World Fish Migration year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (new invasive species)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations in the experiment station are currently conducted at the project and program levels. At the project level, all projects are reviewed by an internal research council and external peer reviewers when initiated and again at completion by the research council. During the research council final evaluation, the focus is on determining if terminating projects met their stated objectives, secured extramural funding, and produced peer-reviewed publications. As for other measures of successful research programs, research faculty in this program area published 54 peer-reviewed articles.

Researchers use a variety of methods to evaluate their own research projects including evaluations retrospectively, before-after, and during the life of the project; case studies; and comparisons between treatment/intervention and nontreatment/nonintervention.

Key Items of Evaluation

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)	
0	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)	
0	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.