

V(A). Planned Program (Summary)**Program # 1****1. Name of the Planned Program**

Global Food Security and Hunger

 Reporting on this Program**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			13%	
202	Plant Genetic Resources			7%	
204	Plant Product Quality and Utility (Preharvest)			3%	
205	Plant Management Systems			13%	
211	Insects, Mites, and Other Arthropods Affecting Plants			6%	
212	Pathogens and Nematodes Affecting Plants			9%	
213	Weeds Affecting Plants			7%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants			1%	
216	Integrated Pest Management Systems			2%	
301	Reproductive Performance of Animals			4%	
302	Nutrient Utilization in Animals			3%	
303	Genetic Improvement of Animals			1%	
305	Animal Physiological Processes			2%	
311	Animal Diseases			12%	
501	New and Improved Food Processing Technologies			3%	
502	New and Improved Food Products			2%	
601	Economics of Agricultural Production and Farm Management			3%	
605	Natural Resource and Environmental Economics			3%	
702	Requirements and Function of Nutrients and Other Food Components			3%	
901	Program and Project Design, and Statistics			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	12.5	0.0
Actual Paid Professional	0.0	0.0	14.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	989965	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1700932	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct scientific research. Publish peer-reviewed journal articles and other publications. Present findings at professional meetings, at field days for growers, and at other venues. Educate undergraduate and graduate students.

2. Brief description of the target audience

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

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	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: 2012

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	10	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Mathematical model on sea lice settlement risks for fish-farmed embayments in Maine
Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of crustacean mince-based products commercialized
Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of completed research projects

Year	Actual
2012	11

Output #4

Output Measure

- Number of other publications

Year	Actual
2012	19

Output #5

Output Measure

- Number of public presentations

Year	Actual
2012	60

Output #6

Output Measure

- database management system, Web portal, define data submission procedures, and a set of annual report products including charts, maps and tables for lobster settlement

Year	Actual
2012	1

Output #7

Output Measure

- Blog posts, answering machine messages and email alerts from April 3 to May 18 on mummy berry disease.

Year	Actual
2012	1

Output #8

Output Measure

- Visitor-friendly displays such as a touch tank filled with aquaculture species such as native and European oysters, scallops and Abalones along with large recirculation reef tank, and a new fish hatchery.

Year	Actual
2012	1

Output #9

Output Measure

- Extensive lesson plans on aquaculture for K-12 education

Year	Actual
2012	1

Output #10

Output Measure

- A searchable online resource on weeding tools where growers can find profiles on any of the 34 tools tested (umaine.edu/weedecology).

Year	Actual
2012	1

Output #11

Output Measure

- \$3,516,418 in extramural grant funding

Year	Actual
2012	3516418

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Percentage of Maine lowbush blueberry growers surveyed who are changing their fertilization practices due to information provided by the fertility research program
2	Number of Maine vegetable and/or grain producers increasing their knowledge of biologically based nutrient sources and how to manage them
3	Number of Maine vegetable and/or grain producers adopting soil testing or other practices to improve the efficiency of their soil fertility programs as indicated by reduced nutrient inputs, improved yields, or both
4	Development of a basic vaccine against the emerging fish pathogen <i>Francisella philomiragia</i> subsp. <i>Noatunensis</i>
5	Development of best husbandry practices for polyculture fish farms
6	Number of dairy producers modifying their forage management procedures by including the use of a silage additive
7	Increase in number of organic potato growers using biocontrol and mutualistic microorganisms to improve disease management, enhance crop yields, and increase soil fertility
8	More potato breeders will start using transgenic lines carrying novel R-genes from <i>S. bulbocastanum</i> as donors in their variety development programs
9	Release of at least one new eastern oyster broodstock to the oyster culture industry
10	Increase production efficiency and market share for Maine's oyster growers
11	Increase in number of crustacean processors in Maine producing/selling mince
12	Increased production of wild blueberries through proper management of weeds, diseases, and insect pests
13	Number of organic and sustainable Maine growers adopting the use of the most ecologically and economically efficient nutrient amendments to supplement or improve their current nutrient management systems
14	Percentage decline in use of nutrient amendments that pose a net-negative impact on soil or water systems in Maine
15	Number of Maine vegetable growers practicing crop rotation in hoop houses by growing alternative crops
16	Percentage of Maine potato producers adding organic amendments to improve soil quality
17	# of commercial-scale tests of new high-yielding, high-quality, and/or pest-resistant potato clones tested in Maine

18	# of new high-yielding, high-quality, and/or pest-resistant potato clones named and released by the Maine Potato Breeding Program
19	Reduced pesticide use and/or improved marketable yields on acres planted to new pest-resistant potato cultivars in Maine
20	Number of Maine potato farmers adjusting their aphid management practices to take maximum advantage of natural population regulation
21	Percentage decrease on Maine potato farms in the use of broad-spectrum insecticides for aphid control, annually
22	Percentage of potato producers receiving information on programs which can lead to more efficient use of N, P and K fertilizers
23	Percentage of potato producers conducting small-scale adoption trials using lower rates of N, P and K fertilizers
24	Percentage of potato producers conducting small-scale adoption trials of late blight resistant varieties and associated reduced chemical fungicide programs
25	Percentage of potato producers adopting fertilization programs with reduced rates of N, P and K fertilizers
26	Percentage of potato producers adopting late blight resistant varieties and associated reduced chemical fungicide programs
27	Number of new or improved innovations developed for food enterprises
28	Number of new or improved value-added products that can be sold by producers (and other members of the food supply chain)
29	Number of innovations adopted in food processing enterprises
30	Number of new innovations developed for Maine's shellfish growers
31	Number of new innovations developed to aid Maine's lobster industry
32	Adoption of best practices and technologies resulting in increased yields, reduced inputs, increased efficiency, increased economic return, and conservation of resources--a. Number of producers indicating adoption of recommended practices:
33	Enhance capacity of a sustainable global food system including new/improved plants, animals, technologies, and management systems--New potato varieties
34	More sustainable, diverse, and resilient food systems in Maine
35	Maine blueberry farmers increase their knowledge of best practices for managing their crops
36	Number of new diagnostic systems analyzing plant and animal pests and diseases

Outcome #1

1. Outcome Measures

Percentage of Maine lowbush blueberry growers surveyed who are changing their fertilization practices due to information provided by the fertility research program

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of Maine vegetable and/or grain producers increasing their knowledge of biologically based nutrient sources and how to manage them

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	700

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Interest in using biologically based sources of nitrogen to meet crop needs is increasing in New England. Continuing expansion of certified organic crop production, which must rely on organic sources for the bulk of nutrient inputs, over the last decade has contributed to this increase. Concurrently, the recent volatility in prices for synthetic fertilizers has led many conventional farmers in New England to look toward alternative nutrient sources. Yet farmers find that managing nutrients from biologically based sources has inherent challenges, not least of which is a relative scarcity of practical information and tools to guide their nutrient management decisions.

What has been done

University of Maine researchers evaluated biologically based fertility strategies for wild blueberries, for which poor soil quality is recognized as a key yield-limiting factor. They also evaluated biologically based fertility strategies for organic bread wheat, an emerging crop in New England.

Results

The three experiments conducted in this project increased researcher and participant knowledge in how to manage nutrients in biologically based fertility systems. Results were shared with approximately 700 Maine farmers at conferences, hands-on workshops, and grower field days.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Number of Maine vegetable and/or grain producers adopting soil testing or other practices to improve the efficiency of their soil fertility programs as indicated by reduced nutrient inputs, improved yields, or both

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Development of a basic vaccine against the emerging fish pathogen *Francisella philomiragia* subsp. *Noatunensis*

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The prevention of infectious disease in fish by vaccination is well established especially for the established farmed species such as Atlantic salmon and Atlantic halibut. However, the commercialization of other species such as Atlantic cod presents new problems. Atlantic cod have brought a new cohort of pathogens with them into culture such as *Francisella philomiragia* subsp. *noatunensis* (FPN), but Atlantic cod do not respond well, at least immunologically, to the current

vaccine technology developed for Atlantic salmon.

What has been done

University of Maine scientists are investigating the control of aquatic animal diseases by immunotherapeutics, such as vaccines and immunostimulants. The researchers continue to work with stakeholders in fish health in Maine and the legislature, especially Department of Marine Resources, and they continue to keep the community well informed of their research through open days and a free annual seminar on the relevance of this research to Maine and its economy.

Results

As a result of their work with the biotechnology industry in Maine on developing and testing vaccines for emerging diseases, the scientists are currently carrying out a series of trials to confirm the efficacy of two new vaccines with a view to commercialization with a Maine company.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases

Outcome #5

1. Outcome Measures

Development of best husbandry practices for polyculture fish farms

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of dairy producers modifying their forage management procedures by including the use of a silage additive

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Increase in number of organic potato growers using biocontrol and mutualistic microorganisms to improve disease management, enhance crop yields, and increase soil fertility

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

More potato breeders will start using transgenic lines carrying novel R-genes from *S. bulbocastanum* as donors in their variety development programs

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Release of at least one new eastern oyster broodstock to the oyster culture industry

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Increase production efficiency and market share for Maine's oyster growers

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Oyster culture comprises a growing portion of the aquaculture production in Maine waters. In 2006, the harvest of eastern oysters was worth more than \$1.4 million with >3 million oysters harvested, representing a 67% increase over the 2005 harvest. Outbreaks of disease, however, still cause considerable damage to the industry and limit its expansion.

What has been done

University of Maine marine scientists deployed a series of oyster lines with demonstrated resistance to the oyster diseases MSX, Dermo, and ROD along with hybrid lines generated by

crossing these disease-resistant lines at six sites from New Jersey to Maine in late July and August of 2011. They then monitored the growth and survival of oysters for two full seasons.

Results

Oyster hatcheries have adopted the approach of hybridizing genetic lines of oysters to achieve additional gains in growth and survival. The researchers plan to make the actual lines used in their current project available to commercial hatcheries at the conclusion of our project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals

Outcome #11

1. Outcome Measures

Increase in number of crustacean processors in Maine producing/selling mince

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Increased production of wild blueberries through proper management of weeds, diseases, and insect pests

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Fine leaf sheep fescue (*Festuca filiformis*) is an introduced perennial grass in Maine wild blueberry fields, and growers in the Jonesport, ME, area recently reported an herbicide-resistant population that has begun taking over local fields.

What has been done

University of Maine scientists evaluated both herbicides registered for use on wild blueberry and unregistered herbicides for control of fine leaf sheep fescue and other weeds and injury to blueberry. Kerb 50W (2 lb/a) was applied in fall 2011 and pre-emergence in spring 2012. Sinbar WDG (2 lb/a)/Direx 4L (2 lb/a)/Velpar L (1 lb/a) or Trimix, Matrix SG (4 oz/a) and Lorox DF(2 lb/a) were also applied pre-emergence, and Arrow (8 oz/a) and Option (1.5 oz/a) were applied twice post-emergence.

Results

They found that fall-applied Kerb resulted in the highest blueberry cover. Lorox and Option had significantly higher initial phytotoxicity, but overall levels were not unacceptably high, and the plants grew out of it with the exception of minor phytotoxicity in August in the Lorox treatment. Fall Kerb was also significantly and consistently most effective in controlling fine leaf sheep fescue over time, followed closely by Matrix, while Arrow and Lorox were consistently ineffective. In conclusion, fall application of Kerb and pre-emergence application of Matrix controlled fine leaf sheep fescue, and Trimix could be effective with low fine leaf sheep fescue pressure. Arrow, Lorox, and spring application of Kerb and Option were not effective if there is sheep fescue and/or broadleaf weed pressure. This research will be important to Maine’s 575 wild blueberry growers who produce an average of 80 million pounds per year. Maine produces 15 percent of the North American blueberry crop and 40 percent of the wild blueberry crop. Successful adoption of these practices will ensure that wild blueberry growers in Maine can produce a crop efficiently and remain competitive in the world marketplace in future years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #13

1. Outcome Measures

Number of organic and sustainable Maine growers adopting the use of the most ecologically and economically efficient nutrient amendments to supplement or improve their current nutrient management systems

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

The dissemination of information from this research project has led to at least 10 organic farmers in Maine changing their fertility regime to use organic fertilizers of a different type or sources to increase ecological and economic benefits. Target audiences were primarily organic vegetable and grain growers who were members of the Maine Organic Farmers and Growers Association. However, the researcher fielded questions from farmers from at least six different East Coast states who were looking for advice on alternative N fertilizers and from three extension educators from outside Maine who wanted data and summaries from the trials related to this work.

4. Associated Knowledge Areas

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

Outcome #14

1. Outcome Measures

Percentage decline in use of nutrient amendments that pose a net-negative impact on soil or water systems in Maine

Not Reporting on this Outcome Measure

Outcome #15

1. Outcome Measures

Number of Maine vegetable growers practicing crop rotation in hoop houses by growing alternative crops

Not Reporting on this Outcome Measure

Outcome #16

1. Outcome Measures

Percentage of Maine potato producers adding organic amendments to improve soil quality

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Conventional potato production in cool, humid regions such as Maine is often characterized by soil degradation, high pressure from soilborne plant pathogens, and high inputs of fertilizers and pesticides. Soil degradation can be counteracted by adding organic amendments to soil. Compost is widely recognized to be a beneficial soil conditioner. However, how well compost is able to increase soil aggregation and to supply nitrogen is uncertain.

What has been done

University of Maine soil scientists studied a range of compost types, all produced in Maine, under laboratory and field conditions. Poultry manure is another organic amendment, produced in Maine, which may be beneficially applied to soils to build organic matter and supply plant nutrients, particularly phosphorus. However amending soils with poultry manure to meet plant need for nitrogen, or disposing of excess manure on soils, may lead to over application of phosphorus and accumulation of phosphorus in solid phases. The reactions of poultry manure phosphorus with soils were examined in laboratory and greenhouse studies.

Results

Although several composts appeared to help maintain small aggregate stability, none appeared to increase it. Immature composts had the greatest effects on soil properties, but generally are not suitable soil amendments due to possible introduction of phytotoxic compounds. One mature compost, produced using a unique process, both stimulated soil microbial activity and maintained levels of soluble nitrogen in soils. Amending soils with poultry manure increased levels of soluble phosphorus and promoted transformation of mineral-bound phosphorus to soluble phosphorus, which was then available for plant uptake. It is hoped that research-based information on the effects of soil amendments such as compost and manure will help accelerate the use of these amendments on-farm to improve soil quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
204	Plant Product Quality and Utility (Preharvest)
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

213 Weeds Affecting Plants

Outcome #17

1. Outcome Measures

of commercial-scale tests of new high-yielding, high-quality, and/or pest-resistant potato clones tested in Maine

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	16

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

To facilitate the process of growers adopting new potato varieties, University of Maine researchers coordinated 16 commercial-scale trials representing 11 new potato varieties (4 chippers, 3 russets, 2 reds, and 2 specialty market yellow fleshed) and 156 acres during 2012. Additional commercial trials were conducted in the other participating states. AF0338-17, AF3001-6, and AF3362-1 were among the clones in these commercial trials. If these varieties perform well their production will expand over time. Depending on the characteristics of the specific potato variety, the potential benefits of adoption include new marketing opportunities, more efficient processing, higher yields, better nutritional value, reduced pesticide costs, and less risk of losses to stress, diseases, and pests.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #18

1. Outcome Measures

of new high-yielding, high-quality, and/or pest-resistant potato clones named and released by the Maine Potato Breeding Program

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Eastern potato production represents hundreds of farms and more than \$460 million cash farm receipts; therefore, the impact of a successful new potato variety can mean many millions of dollars to the industry. Consumers also benefit from the high-quality, local food production resulting from new potato variety adoption. Disease-resistant varieties generated by this project have the potential to greatly reduce growers' losses to devastating diseases such as pink rot and/or late blight.

What has been done

During 2012, the project distributed seed potatoes for 20 regional potato variety trials conducted in eight states and two Canadian provinces. Eleven standard varieties and 26 numbered clones were tested for yield, tuber quality, and pest resistance. NE1031 Regional potato variety trials were conducted at three Maine locations during 2012. The regional trial sites (numbers of clones tested) were Presque Isle (41), St Agatha (32), and Exeter (20). Each regional trial site reports results to their local stakeholders and submits their data to the project website coordinator located in NC. The data are entered into a searchable database so that results are accessible to stakeholders and researchers anywhere in the world.

Results

Elkton (B1992-106) was released in 2012, while AF0338-17, AF3001-6, and AF3362-1 are slated for 2013 release. Based on 2011-12 results, AF0338-17, AF4157-6, and NY148 were the most outstanding chipping prospects, AF4013-3 was a promising yellow-fleshed, specialty clone, while Modoc was the best performing red-skinned clone. Classic Russet, AF3362-1, and AF3001-6 were the top performing russeted clones. Lamoka (NY139), Waneta (NY138), and Red Maria (NY129) are three 2010-2011 releases that are attracting commercial interest.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #19

1. Outcome Measures

Reduced pesticide use and/or improved marketable yields on acres planted to new pest-resistant potato cultivars in Maine

Not Reporting on this Outcome Measure

Outcome #20

1. Outcome Measures

Number of Maine potato farmers adjusting their aphid management practices to take maximum advantage of natural population regulation

Not Reporting on this Outcome Measure

Outcome #21

1. Outcome Measures

Percentage decrease on Maine potato farms in the use of broad-spectrum insecticides for aphid control, annually

Not Reporting on this Outcome Measure

Outcome #22

1. Outcome Measures

Percentage of potato producers receiving information on programs which can lead to more efficient use of N, P and K fertilizers

Not Reporting on this Outcome Measure

Outcome #23

1. Outcome Measures

Percentage of potato producers conducting small-scale adoption trials using lower rates of N, P and K fertilizers

Not Reporting on this Outcome Measure

Outcome #24

1. Outcome Measures

Percentage of potato producers conducting small-scale adoption trials of late blight resistant varieties and associated reduced chemical fungicide programs

Not Reporting on this Outcome Measure

Outcome #25

1. Outcome Measures

Percentage of potato producers adopting fertilization programs with reduced rates of N, P 24 and K fertilizers

Not Reporting on this Outcome Measure

Outcome #26

1. Outcome Measures

Percentage of potato producers adopting late blight resistant varieties and associated reduced chemical fungicide programs

Not Reporting on this Outcome Measure

Outcome #27

1. Outcome Measures

Number of new or improved innovations developed for food enterprises

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The survival of the seafood and aquaculture industries, in Maine and throughout the U.S., is tied to their long-term economic and environmental sustainability. One aspect of this sustainability involves developing new value-added products using underutilized species or byproducts of seafood/fish processing.

What has been done

To this end, University of Maine food scientists continued their fish-oil fortification studies, with a focus on shelf-stable, intermediate-moisture foods. A grain-based nutrition bar was selected since it fits the criteria and because nutrition bars have become a popular, portable snack food. The scientists fortified whole-grain-based nutrition bars with four levels of a nonemulsified, nonpurified commercially available fish oil. Then they evaluated the baked nutrition bars for proximate composition, water activity, omega-3 fatty acids, oxidative stability, and consumer acceptance.

Results

The results of the study on fortifying nutrition bars with fish oil suggest that nonemulsified, nonencapsulated fish oil can successfully replace canola oil in intermediate-moisture nutrition bars to provide EPA and DHA levels as high as 178 mg/serving without affecting consumer acceptability or oxidative stability. Most commercially available omega-3-enriched products are enriched with flaxseed or algal oils, at very low levels (32 mg EPA/DHA). There is abundant evidence supporting the health benefits of long-chain omega-3 fatty acids for cardiovascular, neurological, and fetal health, but far too few people consume the recommended intake of these important oils. The fortification of commonly consumed products such as shelf-stable nutrition bars with omega-3-rich fish oil may increase consumption of omega-3 fatty acids among U.S. consumers who do not meet the recommended intake of two servings of fatty fish per week and contribute to improved health status.

4. Associated Knowledge Areas

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

Outcome #28

1. Outcome Measures

Number of new or improved value-added products that can be sold by producers (and other members of the food supply chain)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The survival of the seafood and aquaculture industries, in Maine and throughout the U.S., is tied to their long-term economic and environmental sustainability. One aspect of this sustainability involves developing new value-added products using underutilized species or byproducts of seafood/fish processing.

What has been done

To this end, University of Maine food scientists continued their fish-oil fortification studies, with a focus on shelf-stable, intermediate-moisture foods. When an opportunity arose to partner with a local Maine artisanal cheese producer, the scientists began developing a fish-oil-fortified goat cheese in a project funded by the Maine Technology Institute.

Results

The scientists were able to fortify goat cheese with fish oil to successfully make an FDA "Excellent Source" claim, both in the University of Maine's pilot plant facility and in a scale-up process on location at Seal Cove Farm. They used encapsulated, odorless and flavorless, omega-3-rich fish oil to produce a heart-healthy soft goat cheese without adversely affecting sensory quality or oxidative stability of the cheese. The goat cheese may be fortified to deliver up to 1.1 g long-chain omega-3 fatty acids per 30 g serving without affecting consumer purchase intent and up to 1.5 g without affecting oxidative stability. Of the 30 participants who rated the fortified cheese at the Seal Cove retail facility, all liked the cheese "very much," and indicated they would be willing to pay \$0.50-\$0.75 more per round of goat cheese for the fortified samples. The UMaine scientists also partnered with the Agricultural Research Service in Fairbanks, AK, to produce a cream cheese fortified with smoked salmon oil. They evaluated the effect of antioxidants on stability of the fortified cream cheese and determined the optimal level of fortification based on consumer acceptability. In contrast to the goat cheese where the scientists minimized the fish flavor, for the cream cheese, they wanted to deliver a distinctive smoked

salmon taste. Results indicate that cream cheese may be fortified with smoked salmon oil to deliver 800 mg EPA+DHA per serving without affecting consumer acceptability or oxidative stability. Low levels (200 ppm) of mixed tocopherols and green tea were equally effective at preventing oxidation of the fortified cheese.

4. Associated Knowledge Areas

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

Outcome #29

1. Outcome Measures

Number of innovations adopted in food processing enterprises

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Enzymatic browning is a well-documented issue that negatively affects the fruit and vegetable industry. An estimated 50% of fruit is ruined from enzymatic browning losses.

What has been done

University of Maine food scientists have developed a new technique to improve the quality of fresh-cut and processed Maine potatoes to reduce enzymatic browning and acrylamide content upon frying, and to reduce after-cooking darkening. They compared sodium acid sulfate (SAS) and citric acid to a control to determine the effectiveness of each treatment as an anti-browning inhibitor.

Results

Prior to this research, sodium acid sulfate was only used as an acidulant in beverages in the food industry. Now, however, companies, in the U.S. and worldwide, are using SAS to reduce potential enzymatic browning in fresh-cut fruits and vegetables. Jones-Hamilton Company, the company that produces SAS, uses the findings from this research when recommending to other companies

on how to incorporate SAS dips in their processing as an anti-browning aid. Although citric acid was commonly used to reduce enzymatic browning by the fruit and vegetable industry, SAS is a less expensive alternative given the price of citric has been rising for the past five years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies

Outcome #30

1. Outcome Measures

Number of new innovations developed for Maine's shellfish growers

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Due to inadequate external funding for part of their oyster project, University of Maine marine scientists initiated a new project intended to overcome the bottlenecks associated with the production of razor clam seed in the hatchery and provide the means for Maine's shellfish hatcheries to begin supplying razor clam seed to the industry.

What has been done

During the spring and summer of 2012, the scientists conducted several razor clams spawning, reared the larvae to settlement, and successfully induced the larvae to settle using a variety of substrates. They found that the survival of recently settled spat can be quite high when the spat are reared in fine to coarse sand sediment trays.

Results

The scientists shared their findings on razor clams at two Razor Clam Roundtable Workshops. At these workshops, they provided interested industry participants with information on the culture of razor clams and solicited ideas on how to implement improvements in hatchery and grow-out culture of this species. These workshops generated substantial enthusiasm for adopting the culture of razor clams. Now that they have identified approaches to increase the production of razor clam seed, the scientists hope to capitalize on this enthusiasm in a follow-up project testing

field culture methodologies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes

Outcome #31

1. Outcome Measures

Number of new innovations developed to aid Maine's lobster industry

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The American lobster is the most valuable single-species fishery in New England and Atlantic Canada, valued at approximately US\$1 billion (FAO 2009). The collapse of this fishery would be catastrophic to Maine's coastal economy and change the face of its unique working waterfront.

What has been done

University of Maine researchers, working with the American Lobster Settlement Index (ALSI), have constructed a database management system, Web portal, defined data submission procedures, and a set of annual report products including charts, maps and tables to be posted on the Website and disseminated to stakeholders in annual reports.

Results

The most important impact of completing this objective is to have the first standardized US-Canada time-series database on lobster early life stages. The "change in action" that this provides is that the Web portal puts the entire 24-year data set at the finger tips of the collaborative. This, in turn, should facilitate retrospective analyses of the data that will result in a "change in knowledge." All ALSI participants will be able to mine the data set to address questions of their own.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #32

1. Outcome Measures

Adoption of best practices and technologies resulting in increased yields, reduced inputs, increased efficiency, increased economic return, and conservation of resources--a. Number of producers indicating adoption of recommended practices:

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	23

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Demand for local organic food has inspired new interest in growing bread-quality wheat in New England. Our region's farmers have long produced small grains for animal feed on dairy and crop farms, but lack local knowledge and research information regarding production for the organic bread market. University of Maine researchers are part of a project that aims to build farmers' capacity to produce high-quality organic bread wheat.

What has been done

Researchers conducted five research projects in both Maine and Vermont to investigate key production issues with organic bread wheat. Variety trials of 18 winter and 22 spring bread wheat varieties were repeated for the third year at four sites to identify regionally adapted varieties suited to organic production. A team of four artisan bakers developed a bake test protocol and tested varieties that had shown promising agronomic and quality characteristics. In a separate set of trials, promising winter wheat varieties were evaluated for their tolerance to late planting. One fertility trial compared different organic preplant nitrogen sources for their effects on spring wheat grain yield and protein concentration. Another trial evaluated the use of in-season diagnostic tests to determine if and how much topdress N is cost effective. Lastly, a systems trial compared rotations for organic bread wheat on dairy farms with particular attention to nitrogen and weed dynamics and grain yield and quality.

Results

This project is helping create local, organic food grain economies in our region. Field research projects provided new information that was implemented directly by farmers in our region. Three years of variety trials have identified four to five new varieties each of spring and winter wheat that show promise in our region for organic production. Bakers identified certain varieties (e.g., Redeemer) that have superior baking quality. As a result, at least eight farmers in Maine, seven in Vermont, three in Quebec, one in New Hampshire, and four in New York have chosen new varieties based on this information. Since this project began, farmers in our region have increased production of organic wheat from 300 acres in 2008 to just under 1,700 acres in 2012, and they are well-positioned to meet further increases in demand. Farmers in Maine reported in a 2012 survey that as a result of this project they have made new contacts (80%) and changed at least one production or marketing practice (70%), which has helped them expand markets, improve crop/product quality, increase sales, increase yields, or reduce production costs. They estimated the economic value of these changes to be over \$10,000 each for those growing 10 or more acres of grain per year and over \$1,800 each for those growing less than 5 acres per year. Additionally, farmers and millers who participated in a 2010 "peer learning across borders" trip to Denmark estimated they will gain in sum more than \$400,000 in economic value from what they learned. The relationships made with Danish farmers, millers and bakers on that trip continue to develop.

4. Associated Knowledge Areas

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

Outcome #33

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Eastern potato production represents hundreds of farms and more than \$460 million cash farm receipts; therefore, the impact of a successful new potato variety can mean many millions of dollars to the industry. Consumers also benefit from the high-quality, local food production resulting from new potato variety adoption. Disease-resistant varieties generated by this project have the potential to greatly reduce growers' losses to devastating diseases such as pink rot and/or late blight.

What has been done

As part of a multistate effort (NE1031), University of Maine scientists have taken part in a project to breed, select, and develop new potato varieties that will benefit potato producers in the eastern U.S. Crosses between parents with desirable traits take place at ME, NY, NC, and USDA Beltsville, MD. Field sites in ME, NY, NJ, PA, OH, VA, NC, and FL are used to test the breeding materials for yield and quality traits over a wide range of growing conditions.

Results

The eastern potato breeding and selection effort produces new varieties and evaluates their potential to serve fresh, processing, and specialty markets in the East. Red Maria was released in 2010 and two new chipping varieties, Lamoka and Waneta were released in 2011 and demand for their seed has exceeded supply. Elkton was released in 2012, while AF0338-17, AF3001-6, and AF3362-1 are likely to be released during 2013. These varieties and other promising clones from the project continue to be evaluated and adopted by the potato industry. Recent eastern releases since 2002 (e.g. Beacon Chipper, Marcy, Monticello, Harley Blackwell, Red Maria, Lehigh, and Peter Wilcox) were grown on 708 seed acres during 2011 with a seed value of \$1,880,000. The resulting seed crop had the potential to plant 7000 acres in 2012 with a ware value conservatively estimated at \$14M. Over a longer time frame, 26 of the 105 varieties listed in the ME certified potato directory were released by the Eastern programs since 1990. These releases represent 1909 seed acres with a seed value of \$5.1M. This seed crop had the potential to plant 19,000 acres in 2012 with a conservatively projected value of \$38,000,000. This excellent rate of adoption will certainly grow over time as the industry builds seed supplies. There is particularly strong grower interest in improved new chipping varieties to meet quality requirements of eastern processing plants. Harley Blackwell fits this need in NC and other eastern states where internal defects reduce the quality of the current standard chipping variety, Atlantic. Elkton and AF0338-17 are also expected to fit this market. Lamoka and Waneta are new chipping varieties that are being rapidly adopted by the industry. Marcy adoption has been strong because it chips, has scab resistance, and has 20% higher yield than standard varieties. Specialty varieties, Adirondack Blue, Adirondack Red, Lehigh and Peter Wilcox, are being adopted by small-scale fresh market growers because of their yellow, blue, or red flesh color and excellent culinary quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #34

1. Outcome Measures

More sustainable, diverse, and resilient food systems in Maine

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Biological control of pests has a rich history in the USA with key successes dating back more than 125 years. University of Maine entomologists are participating in a northeast regional project that builds upon our national expertise in biological control and specifically addresses pest complexes and research opportunities that are unique to this region. Their work in Maine focuses on lowbush blueberry, a native perennial crop.

What has been done

UMaine entomologists have been studying the natural enemies of blueberry insect pest species to develop strategies for managing these pests that do not rely on insecticides as the predominant tactic. They have been studying the effectiveness of these natural enemies at suppressing pest insects and developing methods to ensure their conservation and integration into modern integrated pest management.

Results

Investigations into the native natural enemies of insect pests in the lowbush blueberry agroecosystem revealed that ants, spiders, opiliones, and ground beetles are the primary fauna represented. Of these groups, ants and spiders have the most impact on the abundance of pest insects. The researchers found that applications of organophosphate insecticides affect the diversity and abundances of the natural enemy species. By selecting reduced-risk insecticides, growers can limit deleterious effects on these valuable predators. They also found that ants appear to be negatively affected by herbicides, through a positive relationship between ant abundance and diversity and floral density within blueberry fields. The researchers recommend less intensive management and selection of less harsh insecticides as a tactic for enhancing natural biological control of insect pests in blueberry fields. The documented outcomes from this study include species establishment, natural enemy spread, reduced pest problems and associated effects on other components of the ecosystem as a result of natural enemy releases,

potential non-target effects, and increased knowledge about the science biological control. They shared these findings with blueberry growers at the annual University of Maine summer blueberry field day and during three grower twilight meetings held in the three major blueberry-growing regions in Maine.

4. Associated Knowledge Areas

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

Outcome #35

1. Outcome Measures

Maine blueberry farmers increase their knowledge of best practices for managing their crops

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Mummy berry disease affects all species of blueberry and can decrease yield up to 50% in highbush and 100% in lowbush blueberries. Currently, the majority of growers in Maine, New Hampshire, and Massachusetts are applying up to three fungicide applications using a calendar schedule which often results in incomplete control and unnecessary fungicide applications.

What has been done

University of Maine scientists are continuing to study the biology and control of mummy berry disease. They have conducted lab experiments to determine the range of sensitivity of *Monilinia vaccinii-corymbosi* to the most commonly used fungicides to control this fungus, propiconazole and fenbuconazole, and have conducted a fungicide field trial to test new fungicides for control of mummy berry disease. They have also set up field to determine if there are inherent differences in when the apothecia develop and the weather factors that affect apothecia development and longevity. In addition to their experiments, the researchers have spent made a concerted effort to educate growers on mummy berry disease. In 2012, they provided reports on mummy berry infection as blog posts, answering machine messages and email alerts from April 3 to May 18,

and then subsequent posts on other diseases.

Results

Their research on *M. vaccinii-corymbosi* collected from three fields with multiple, bi-yearly applications of propiconazole found that these isolates were significantly less sensitive to propiconazole than isolates collected from a wild stand of lowbush blueberries that had never been treated with fungicides. These experiments suggest that there is the possibility of resistance to propiconazole developing in *M. vaccinii-corymbosi*. In fungicide trials in two fields, they found fungicides with different chemistries, different azole ingredients, and mixtures of fungicides were significantly effective at controlling mummy berry disease compared to an untreated control. In response to their educational efforts, the researchers have found that growers at field meetings answered questions about mummy berry disease correctly more than 75% of the time.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #36

1. Outcome Measures

Number of new diagnostic systems analyzing plant and animal pests and diseases

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Lobster mortality in shipment and live storage is becoming more of an economic problem. Shrinkage of more than 20% has been reported.

What has been done

To address issues related to lobster health and environmental interrelationships, University of Maine scientists formed the Lobster Shell Disease Coalition, a region-wide organization of scientists involved with lobster research.

Results

As part of the Lobster Health Coalition's efforts, a small number of lobsters were originally sampled from Maine with the help of funding from Maine Sea Grant. Then through the help of the NOAA funding, lobsters from Maine, Rhode Island, Massachusetts, and Long Island Sound were sampled. Shell lesions were recorded and measurements of other health parameters were taken. A total of 932 lobsters were examined. Lobsters were examined for vigor, parasites were noted, hemolymph was cultured and tissues were archived frozen in the University of Maine's Marine Environmental Samples Repository for future use. Histology was done on eye stalk, antennal gland, hepatopancreas, muscle, gonad, nerve, and shell. During the course of this Lobster Health Coalition project, the researchers also raised funds from a variety of sources to develop a Web site dedicated to communication among members of the LHC and between the LHC and industry, as well as the general public.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases

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

Some projects terminated early or PIs changed focus of their research, which affected our ability to report on all previously submitted state-defined outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations 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. For FY12, 11 projects went through the review process in this program area. As for other measures of successful research programs, faculty in this program area published 42 peer-reviewed articles and secured more than \$2,700,000 in extramural funding. Also during this time period, research results published by faculty in this program area were cited by peers more than 900 times in other peer-reviewed journals.

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

Based on evaluations conducted during the project, researchers often revise or refocus their research efforts. For example in a study on wild blueberry production, investigators expanded project sites from two to four per management system for a total of 16 sites, but blocks per site were reduced from four to two, so total number of sample blocks remained the same at 32. This change enables the scientists to capture more variability to improve the application of the results. Researchers also respond to emerging concerns from industries to which their connected and change the focus of their research to address such concerns. For example, when contacted by an oyster grower facing an infestation of blister worm on his oyster farm, University of Maine marine scientists began to investigate the physiological tolerances of the worm in order to devise better treatments for the problem.