

2010 University of New Hampshire Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

This report represents the primary research component from the New Hampshire Agricultural Experiment Station (NHAES). It addresses the use of federal Hatch and corresponding New Hampshire matching and non-match funds. Our partners in Cooperative Extension comprise a separate administrative unit at UNH, and the two entities report individually to USDA. The NHAES provides split funding for some CE faculty, we provide direct research project support, and we cover all costs for the multiple UNH agricultural farms, dairies and greenhouse facilities that are used in common. Consequently some portion of the reported FY2010 UNH Extension achievements may credibly be associated with the NHAES, and conversely for aspects of this report.

As recommended by USDA we have streamlined our report to focus on significant outcomes rather than providing a comprehensive accounting.

The mission of the NHAES is to undertake research toward generating knowledge and technology to support a highly diversified agricultural and natural resource system that produces, processes and delivers food, fiber, forest products, and myriad environmental services for our citizens. We do this in the context of protecting environmental quality, and helping to maintain the viability of rural communities. Both basic and applied efforts are supported to ensure that we address shorter and longer-term needs. We strongly believe that each is required to achieve excellence in advancing our stakeholder's goals and supporting the information needs of a thriving agricultural economy.

We function as an incubator and test bed of new ideas and technologies, diverting economic risk from our stakeholder operations. We attract and engage students in the research enterprise, creating better learners and well qualified employees, and in many cases new converts to agriculture. Much of our science addresses specific local concerns and examples within national priority areas, bringing strong relevance to leading research conducted in New England. We continue to work closely with colleagues in the other New England land grants to find ways to pool expertise and resources for benefit of the region. Importantly, we leverage our excellent field and laboratory research facilities to integrate and invigorate our undergraduate and graduate teaching programs, and our funded scientists help train the next generation of agricultural practitioners and scientists.

The funding that supports the research activities of our NHAES-engaged faculty comes from a diverse mix of sources. During 2010, 17% of funding was from federal capacity funds, 45% from state appropriations, and 38% from other sources outside the university (the latter number is conservative as it includes only new grants that began in 2010 but not ongoing projects). The combined federal and state capacity funds are foundational to the UNH ability to continue to have positive impact on agriculture and related natural resources.

A crucial role for NHAES is to undertake research that addresses priority local, state and regional needs. For example, regionally applicable agricultural research is needed to identify crops, crop varieties, and production practices that are best suited to the unique climatic and soil conditions of NH and Northern New England. Although vegetable and fruit production is economically significant for NH and the region, NH production constitutes a very small percentage of U.S. production for almost all horticultural crops. As a result, most research on production methods is applicable to terrain and climates that are very different from those faced by NH and New England growers. Crop varieties that are developed elsewhere may or may not be adapted to the short growing season, cold winter temperatures, specific soil types or prevalent pests of our area. Such varieties must be carefully evaluated for performance in this region. Results of

NHAES research directly impact the practices and varieties that farmers try on their farms. Outcomes might directly favor adoption of specific practices, but they are equally useful if they prevent farmers from trying practices that are shown to be unsuccessful or not profitable. The same relationship is valid for any of the topics that we address in agriculture, natural resources, and rural community vitality. We partner with Extension to provide information that specialists disseminate across the state.

We have implemented a strong focus on ensuring relevance and productivity of funded projects through review and screening criteria that emphasize accountability of outputs, outcomes, and impacts. Another focus to which we have successfully targeted funds is to attract some of UNH's very best scientists who have not previously been interested in agricultural issues. This year we were again able to engage several of these outstanding scientists through participation in new, multidisciplinary Hatch projects.

A few highlights of our accomplishments this year include the first to our knowledge PhD graduate in the nation with thesis on organic dairy nutrition; production of squash varieties having high levels of nutritionally-beneficial carotenoids and lutein along with improved eating quality and powdery mildew resistance; new varieties of osteospermum along with new recommendations on reduced greenhouse energy use; having identified and clarified two fundamental misconceptions about NH demographics that are critical to state policy makers; identified interest in and availability among the private sector for part time hiring of retirees to help improve the economic status of rural communities; more efficient ways to measure above- and below-ground carbon sequestration in forests and a working strategy for optimizing soil sampling based on variance of soil carbon and bulk density.

Our research is on par with the best in the nation. Results of research conducted by NHAES funded scientists was published in Proceedings of the National Academy of Science (2 papers), Science, Nature Genetics, and other premier science journals, and was invited for presentation to national and international audiences at Gordon Research Conferences and multiple other venues. The same is true for top economics and management journals based on our social sciences work with rural communities. As importantly, results and recommendations were concurrently provided to regional producers through presentations, field tours and newsletters. Roughly one-half of total UNH royalty income is from licenses on seeds derived entirely through NHAES plant breeding.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	23.1	0.0
Actual	0.0	0.0	9.3	0.0

II. Merit Review Process

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

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

2. Brief Explanation

The New Hampshire Agricultural Experiment Station conducts a formal peer review process for proposed research projects. An announcement is sent to eligible faculty announcing the availability of support. Faculty are encouraged to submit a one page description of their proposed project and meet with the NHAES Associate Director to discuss the work. If the resulting proposed project is considered to fit within the guidelines for support, the faculty member is encouraged to develop a full proposal. Submitted proposals are critically and competitively reviewed by an internal panel of faculty members plus the Associate Director. The committee develops a categorized list of projects recommended for approval of funding. The Director and Associate Director use this recommendation along with their own evaluations related to Station priorities and available resources to make the final decisions as to which projects to fund. Approved proposals are forwarded to NIFA for ultimate approval of funding. Criteria used for proposal evaluation are: 1) relationship to the Hatch or Hatch-Multistate programs and to the NHAES mission and research priorities; 2) scientific and technical merit; 3) soundness of approach, procedures and methodology; 4) likelihood of significant contributions and/or innovative advances; 5) demonstrated previous and current research productivity and accomplishments and likelihood to leverage NHAES resources; and 6) likelihood of significant enhancement in research capability and competitiveness. Merit review for NHAES research outputs and outside funding typically comes through the scholarly peer review process, providing consistent strong feedback to our internal merit decisions based on quality and productivity.

III. Stakeholder Input

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to 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
- Survey specifically with non-traditional individuals
- Survey of selected individuals from the general public
- Other (Comments from proposal and manuscript reviewers)

Brief explanation.

Input to inform NHAES activities and priorities was encouraged by multiple means, including presentations and meetings with traditional and non-traditional stakeholder individuals and groups. We also interacted with less traditional but highly engaged stakeholders via local farmers markets where we engaged CSA and CFA operations (meat, produce, seafood, and agricultural products), and other venues. We are increasing efforts to identify and engage non-traditional stakeholders, many of whom are marginally or unfamiliar with the support available through NHAES. Stakeholder participation at NHAES research field days, and our relationship with cooperative extension administrators and employees both served as valuable means of feedback. Input by stakeholders within individual NHAES projects was encouraged in a wide variety of ways including surveys (telephone, in person, and web-based), through presentations at scientific and non-scientific conferences, through educational workshops, through multistate project meetings, via mass media,

through publications, through the university classroom and via educational programs aimed at K-12 students and teachers. We are genuinely interested in stakeholder participation in our activities, and strive to relay this attitude, as well as how their input is incorporated, to encourage continued broad involvement.

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
- Open Listening Sessions
- Needs Assessments
- Other (UNH Cooperative Extension)

Brief explanation.

Our partners at UNH Cooperative Extension, the NH Department of Agriculture, Markets & Food, the college and NHAES advisory groups, and individual faculty and staff have been extremely useful in identifying stakeholder individuals and groups. Administrative presence on multiple initiatives (state and regional committees, boards, etc.), and consistent participation in appropriate gatherings such as the annual NH Farm & Forest Exposition, facilitate direct identification and communications with a very diverse group of stakeholders. Listening to and speaking with participants during field days, open houses, and extension conferences and workshops provides insights from grower groups, professionals, government agencies, home gardeners and many others. The UNH Diversity and Affirmative Action & Equity Offices aid in identifying potentially underrepresented and under served constituents.

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

Brief explanation.

For strategic planning and development of NHAES programs and priorities, input was collected primarily through meetings with stakeholder groups and individuals including growers, farmers, citizens, agricultural organizations and councils, natural resources professionals and managers, state and federal agency representatives, regional AES and Extension administrators, research project directors, graduate and undergraduate students, extension specialists, and so forth. The directors and scientists also attended many cooperative extension workshops and took

advantage of these opportunities to participate in discussion with groups and individuals.

The College of Life Science and Agriculture and NHAES completely overhauled the Agriculture and Research sections of our website to make the Experiment Station and agriculture much more prominent, visible and accessible to those who explore or interact through that venue. The updated NHAES website welcomes stakeholder input, and clearly states our commitment to equal opportunity access.

NHAES research project participants obtained direct and indirect stakeholder input through varied avenues. Projects with social science components frequently used questionnaires and surveys. Stakeholder input to many basic science and some applied projects occurred in the form of reviewer inputs to proposals and manuscripts, and from questions, comments and discussions at regional, national and international conferences. Stakeholder input for other projects was collected through comments and questions at workshops and training sessions for end users.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Research Programs
- In the Staff Hiring Process
- To Set Priorities
- Other (Strategic Initiatives Development)

Brief explanation.

Stakeholder input was used in reviewing our existing and proposed strategic and operational activities, including expenditures. All input is objectively considered for prioritization within our finite budget, personnel, faculty expertise and other resources. Among activities suggested by stakeholders, we are investigating the feasibility of integrated research, teaching and outreach programs related to dairy and meat processing, and we have initiated targeted field days at our research facilities (farms and greenhouses) to more directly engage and communicate our activities.

Brief Explanation of what you learned from your Stakeholders

We continued to receive broad and strongly supportive input concerning our move towards a focus on sustainable agriculture and food systems, agro-ecosystems, local food and agriculture opportunities, and nutrition and health aspects of agricultural products. There was strong support for our brand new undergraduate major in Sustainable Agriculture and Food Systems, and for our investing NHAES dollars into 4 new faculty hires.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	1653684	0

2. Totaled Actual dollars from Planned Programs Inputs				
Extension			Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	1396771	0
Actual Matching	0	0	1555485	0
Actual All Other	0	0	0	0
Total Actual Expended	0	0	2952256	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	2569130	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Agricultural Systems
2	Animals & Animal Products
3	Biotechnology & Genomics
4	Communities, Economics & Commerce
5	Food, Nutrition & Health
6	Natural Resources & Environment
7	Pest Management
8	Plants & Plant Products
9	Sustainable Horticulture
10	Sustainable Marine Aquaculture & Fisheries

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Agricultural Systems

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			10%	
121	Management of Range Resources			10%	
403	Waste Disposal, Recycling, and Reuse			35%	
608	Community Resource Planning and Development			45%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.4	0.0
Actual	0.0	0.0	0.4	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	70427	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	31969	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

Organic dairy producers across New England were recently polled about their most expensive operational inputs, and overwhelmingly responded that these were organically-certified feed and utilities costs. Both these areas are currently being addressed through NHAES research, with the latter topic within this program area. This work is strongly leveraged by a USDA-SARE funded project, and provides information on the energy budget of the NHAES Burley-Demeritt farm agroecosystem including the production of biomass for use as bedding and in a compost-to-energy system. The research overall is intended to reduce on-farm energy demands by using available plant biomass resources. The facility provides a research and outreach model for the small-scale, diversified farms characteristic of New Hampshire and New England. This year's results related primarily to grazing grass productivity and how to measure that production and grazing intensity accurately. Providing reliable and inexpensive methods for measuring these two flows is important to pasture management, which is re-emerging as an important part of the agricultural economy in the northeast. Four methods were evaluated for measuring standing biomass of pasture herbage, with clipping as the standard against which the other three were compared. The plate method was determined to provide the best combination of rapid sampling and repeatability to provide the best pasture biomass estimates, and is inexpensive and time-efficient for use by producers. The Burley-Demeritt farm is part of our active outreach program, and visitors were regularly exposed to the processes and results of this study. It was used for school groups and by extension for educational programs.

Additional work in this program area focused on food sufficiency and farm sustainability in New England. This research is nearing conclusion, with priority increasingly focused on disseminating the results so that it will be widely available. Numerous local and regional presentations were made to public library and community meetings, garden clubs, church groups, farm and agricultural organizations, environmental conservation and natural resources organizations, Cooperative Extension, master gardeners, and Colby and Sterling Colleges. One popular press book was published and is being widely disseminated around the region.

2. Brief description of the target audience

The target audiences for work conducted in this area include northeastern farmers and farm managers, dairy industry workers and companies, town governments, town, state and national agricultural commissions and agencies, food producers and processors, citizens and consumers, researchers working in related areas, students, and others generally interested in sustainable agricultural practices.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	1000	2000	50	100
Actual	450	700	40	60

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

Patent Applications Submitted

Year: 2010

Plan: 0

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	2	
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of participants in the project (not including audience counts)

Year	Target	Actual
2010	8	8

Output #2

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
2010	3	4

Output #3

Output Measure

- Number of graduate student directly involved in the projects

Year	Target	Actual
2010	2	1

Output #4

Output Measure

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

Year	Target	Actual
2010	3	4

Output #5

Output Measure

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

Year	Target	Actual
2010	4	1

Output #6

Output Measure

- Number of reviewed publications including theses, abstracts, etc

Year	Target	Actual
2010	3	1

Output #7

Output Measure

- Number of peer-reviewed publications

Year	Target	Actual
2010	1	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Increased knowledge through publications and other measures
3	Number of undergraduate students involved and trained
4	Increased knowledge about agricultural systems in support of management efforts

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Increased knowledge through publications and other measures

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increased knowledge about agricultural systems in support of management efforts

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Measurement of available forage resources accurately and efficiently is important to pasture-based dairy management, which is re-emerging as an important part of the agricultural economy in the northeast.

What has been done

Field investigations were completed to evaluate producer-accessible methods to measure pasture grass production, productivity and grazing intensity. Four methods were evaluated for measuring standing biomass of pasture herbage, with clipping as the standard against which the other three were compared. The plate method was determined to provide the best combination of rapid sampling and repeatability to provide the best pasture biomass estimates, and is inexpensive and time-efficient for use by producers.

Results

This result will improve producer abilities to effectively manage their pastures while saving labor and operations dollars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (none for this program area.)

Brief Explanation

None for this program area.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)

Evaluation Results

Evaluation of results based on discussions with peers and stakeholders is strong for this planned program area.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Animals & Animal Products

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals			26%	
302	Nutrient Utilization in Animals			14%	
303	Genetic Improvement of Animals			5%	
305	Animal Physiological Processes			17%	
307	Animal Management Systems			8%	
311	Animal Diseases			22%	
723	Hazards to Human Health and Safety			8%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.4	0.0
Actual	0.0	0.0	1.8	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	314336	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	563025	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

Five supported scientists participated in three multistate research projects including NE-1027 Ovarian influences on embryonic survival in ruminants, NE-1034 Genetic bases for resistance and immunity to avian diseases and NC-1042 Management systems to improve the economic and environmental sustainability of dairy enterprises.

As model for potential application to management of livestock reproduction, analyzed results of an experiment designed to quantify the rate of replenishment of the extragonadal sperm reserves of rats, and to compare that rate of replenishment to estimated rates of daily sperm production. Prepared a manuscript based on these results, and disseminates results through stakeholder contacts.

Completed laboratory studies to examine the molecular basis of visual signaling and determined how the biochemical pathways that regulated rod photoreceptor vision (night vision) differed from those that control the light response in cone photoreceptors (daytime and color vision). This research emphasized analysis of the structural and functional differences in key enzymes in the signaling pathway, and has importance to domestic and commercial animals as well as humans.

Evaluated the correct dose of sodium bicarbonate to add to colostrum replacer to increase immunity in newborn dairy calves. Results continue to be disseminated through peer reviewed journal articles, the NC-1042 annual report, and the UNH Dairy Report to producers and other stakeholders.

Collected blood, feed and milk samples from Jersey cows at both the NHAES organic (pasture-fed) and conventional (total mixed ration-fed) dairies. Extracted and prepared milk samples for analysis of somatic cell counts, protein, fat, lactose, and fatty acid composition. Prepared and extracted feeds for analysis of fatty acids. Measured interleukins, chemokines and fibrinogen as markers of health status.

Initiated cell culture studies to improve our understanding of endothelial cell diversity, cytoskeletal architecture, the expression of immune-response molecules and the diversity of cell death signaling within bovine ovarian tissue. Used cell culture techniques to separate endothelial cells from the steroidogenic cells of the bovine corpus luteum. The endothelial cells were cultured under different conditions, including different types of media. Cellular techniques were used to determine products of these endothelial cells, such as proteolytic enzymes. This research is investigating the structural and functional mechanisms by which ovarian cells influence fertility in cows. Results were presented to members of the Multistate Project at our annual meeting.

Modeled host range expansion of bacteria to a novel host and allowed the identification through whole genome re-sequencing of specific mutations and mechanisms of the adaptive evolutionary process by *Vibrio fischeri*. The same innovation that allowed colonization of a new host arose in 4 experimental populations, and resulted from a mutation in an uncharacterized histidine kinase gene.

2. Brief description of the target audience

The target audience for this program area includes dairy producers and the dairy foods industry, feed sales representatives, nutritionists, large animal veterinarians, agricultural educators, industry representatives, regulatory agencies, the pharmaceutical industry, reproductive toxicologists, healthcare professionals and veterinarians interested in human and animal vision and visual diseases; educated laypeople interested in vision, visual disorders, and blindness; companies seeking therapeutic treatments using drugs that target enzymes in the retina or the vascular system; breeders seeking to avoid inherited visual disorders and blindness that are common in certain animals; research scientists, cooperative

extension personnel, and graduate and undergraduate students.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	350	1150	50	25
Actual	410	1140	10	1015

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

Patent Applications Submitted

Year: 2010
 Plan: 0
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	7	
Actual	0	10	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of participants in the project (not including audience counts)

Year	Target	Actual
2010	15	31

Output #2

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
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2010 5 20

Output #3

Output Measure

- Number of graduate student directly involved in the projects

Year	Target	Actual
2010	3	8

Output #4

Output Measure

- Number of reviewed publications including theses and abstracts)
Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of peer-reviewed publications
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Number of undergraduate students involved and trained
3	Increased knowledge through publications and other measures
4	Increased knowledge about animal management, nutrition, reproduction, and health
5	Increase understanding of physiological bases for reproductive effectiveness.
6	Advanced knowledge of mechanisms of pathogen infection in food animals.

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increased knowledge through publications and other measures

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increased knowledge about animal management, nutrition, reproduction, and health

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Increase understanding of physiological bases for reproductive effectiveness.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Impaired reproductive performance is a major factor contributing to profitability of dairy and meat animal producers. In the U.S. cattle industry alone it is estimated that the cost of infertility exceeds \$1 billion/year. Animal breeders/producers, veterinarians, reproductive physiologists, and extension staff are interested in fundamental information concerning animal infertility and improving reproductive efficiency.

What has been done

NHAES research as part of an integrated multistate effort has resulted in optimized methods for the isolation, growth and cryopreservation of endothelial cells of the bovine ovary. Information of this nature is of critical importance for understanding basic ovarian function and for developing strategies to improve animal fertility, including humans.

Results

Results of this activity will provide unique opportunities to conduct future biochemical and molecular characterization studies leading to increased income to individual farms and the livestock industry.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals

Outcome #6

1. Outcome Measures

Advanced knowledge of mechanisms of pathogen infection in food animals.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Infections from emergent pathogens especially in the genus *Vibrio* are on the rise worldwide. Many of the human pathogenic *Vibrios* are vectored through the consumption of shellfish, and these infections are a concern to the public, regulatory agencies, and shellfisheries. Additionally, *Vibrios* are common pathogens of fish in aquaculture, and in recent years new variants of fish pathogens have emerged as problematic. An understanding of the mechanisms of emergence of pathogens and their niche expansion is requisite for developing preventative strategies.

What has been done

We developed a model for studying the mechanisms by which a benign species of *vibrio* expands its host range. We characterized the rapid host expansion of this species and identified several specific mutations that facilitated adaptation. These are likely similar to mechanisms used by pathogenic *Vibrio* strains.

Results

The basic knowledge generated through this research will contribute to increased food safety of shellfish consumption, thereby reducing incidence of sickness and associated health care costs while providing enhanced opportunities for shellfish growers and harvesters.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

Government regulations concerning conduct of research using animals added a layer of time commitment beyond completing the underlying research goals. Competing programmatic challenges within the USDA-NIFA competitive grants program reduced potential for extramural funding to support the work.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Biotechnology & Genomics

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			33%	
301	Reproductive Performance of Animals			10%	
304	Animal Genome			17%	
305	Animal Physiological Processes			20%	
307	Animal Management Systems			3%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			17%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.0	0.0
Actual	0.0	0.0	1.2	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	137965	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	181469	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

Supported faculty members along with their students and collaborators completed a diversity of activities this year. As evidence of the high quality of our supported research efforts, two papers from projects this program area were published in Proceedings of the National Academy of Sciences, one of the top-ranked scientific journals in the world. Several of the projects represent investments in more fundamental aspects than for most other program areas, and are expected to provide significant payoffs through improved technologies and management tools in 5 to 15 or 20 years. Many of these projects are strongly leveraged by extramural funding from NIH, NSF, USDA and other sources, and several include excellent international collaborators.

Expression patterns of five genes involved in signal transduction pathways in plants were determined. The disappearance of amyloplasts during salt stress of plant roots, and the gravitropic response of roots under salt stress were documented. These are important issues in irrigated agriculture using marginal quality water, in arid landscapes, and certain other situations.

The Jagged1 gene is involved in adipogenesis and therefore obesity and diabetes. The regions of the murine Jagged1 gene promoter that are responsive to adipogenic signals generated by the hormones insulin and glucocorticoid were mapped using molecular biology and biochemistry techniques. This work also used bioinformatics approaches to identify promoter elements of the Jagged1 gene that are conserved among placental mammals.

Controlling reproduction either by improving efficiency or preventing population increases in commercially important and non-indigenous species, is of critical importance to farmers and fish and wildlife biologists. To control reproduction, it is critical to understand the underlying mechanisms of neuroendocrine control. The structure and function of brain and pituitary hormones in controlling reproduction was investigated using a multidisciplinary approach and a myriad of molecular, endocrinology and biochemical techniques. In addition to its fundamental importance, one application of this work is in situations where production of sterile organisms can lead to improved food animal production and management.

The structure, character, and regulation of translational initiation complexes was investigated using the model eukaryotic organism *Saccharomyces cerevisiae*. This research involved the novel use of analytical ultracentrifugation with fluorescent detection system (AUD-FDS).

The *Frankia* actinorhizal symbiosis represents an important ecological and economic role in agriculture and the environment. An increased understanding how the actinorhizal symbiosis influences the global distribution of these plants and their wide range of habitats could be extended to other plants systems. Several novel natural products biosynthetic gene clusters in three *Frankia* genomes that may have potential biotechnological uses were identified, and some of these pathways were documented. Bioinformatics data mining of new *Frankia* genomes was initiated. A semi-high throughput assay system for filamentous bacteria to reliably test multiple variables was developed, and a genome-guided approach was used to identify plant hormone biosynthetic capacity in *Frankia* genomes. It was demonstrated that *Frankia* auxin production helps guide plant organ/structural development (nodule formation). Gene expression studies were initiated via a genome-guided approach and will help to correlate gene expression to potential function. Studies on non-*Frankia* actinobacteria associated with actinorhizal plants were initiated to elucidate plant-microbe aspects of the symbiosis, as were comparative bioinformatics studies on *Frankia* genomes from different host ranges to identify potential host recognition genes. Finally, studies on the effects of host plant root exudates on *Frankia* physiology were also initiated. The

overall impact of this study is a greater understanding of plant-microbe beneficial interactions. The use of these actinorhizal plants in bioremediation, soil stabilization, nurse cropping, biomass production, and land reclamation applications could potentially impact the 230 million people in the United States.

2. Brief description of the target audience

The target audience for this program area includes stakeholders interested in safe measures for production of food products from "farm to plate"; lay and professional audiences interested in adipose tissue, obesity, diabetes and stem cell differentiation; agricultural and biotechnology industries, land restoration groups, environmental restoration and protection groups, farmers, health care professionals, food industry specialists, veterinarians, molecular biologists, infectious disease professionals, biomedical researchers, federal and state agencies and managers, students at the nearby 2 year college, university graduate and undergraduate students, postdoctoral scientists, faculty, and university, government and industry scientists.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	600	150	25	50
Actual	850	480	25	55

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

Patent Applications Submitted

Year: 2010

Plan: 1

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	9	
Actual	0	10	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of participants in the project (not including audience counts)

Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
2010	3	32

Output #3

Output Measure

- Number of graduate student directly involved in the projects

Year	Target	Actual
2010	4	14

Output #4

Output Measure

- Number of non-peer-reviewed publications including theses, abstracts, etc

Year	Target	Actual
2010	9	33

Output #5

Output Measure

- Number of peer-reviewed publications

Year	Target	Actual
2010	3	10

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Number of undergraduate students involved and trained
3	Increased knowledge through publications and other means
4	Increased knowledge of potential intervention strategies for obesity and insulin resistance.
5	Increase fundamental understanding of gene expression to support future agricultural applications.

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increased knowledge through publications and other means

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increased knowledge of potential intervention strategies for obesity and insulin resistance.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Obesity is a health care crisis in the United States and is paralleled by dramatic increase in the number of persons afflicted with some form of insulin resistance. Therapeutic agents that target pathways important for regulating adipose tissue or improve insulin sensitivity have potential to reduce the obese state, and to ameliorate or prevent development of insulin resistance and other obesity-induced conditions. One potential therapeutic intervention is Jagged1, a signaling molecule that regulates cell fate determination including the process of adipogenesis. The mechanisms that govern transcriptional regulation of the jagged1 gene in adipogenic or most other cell types are largely unknown.

What has been done

We found that Jagged1 mRNA expression levels are dramatically (over 1000 fold) downregulated by insulin in adipogenic cell lines - a finding that is, to our knowledge completely novel. Using transcriptional inhibitors, we found that insulin treatment is likely to affect Jagged1 transcription, not degradation. Furthermore, we found that insulin also causes an increase in the transport of the Jagged1 intracellular domain into the nucleus, although its role in this organelle is still unknown but may be related to regulation of cellular proliferation and survival.

Results

Results of these studies will aid in the development of treatments designed to treat obesity and its related pathologies. The training received by students performing research under this project has led to employment opportunities for undergraduates and a Thesis for one of the graduate students involved in the project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes

Outcome #5

1. Outcome Measures

Increase fundamental understanding of gene expression to support future agricultural applications.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

From a number of biochemical and genetic studies it has become clear that viral infection processes, aberrations in metabolic states, and the progression to diseases ultimately involve alterations in the rate and timing of gene and protein expression. It has, therefore, become of paramount importance to understand the basic mechanisms that eukaryotic organisms employ for the control of gene expression.

What has been done

We used affinity AUC-FDS to identify translational complexes from the yeast *Saccharomyces cerevisiae*. Our results established that affinity AUC-FDS provides a simple methodology to purify protein complexes and to identify the components within the complexes. Our studies resulted in the first identification of the novel 77S translational complex. The regulation of this complex indicates that environmental stresses act directly upon it to control mRNA translation and stress granule formation.

Results

These results indicate that the use of other Flag-tagged protein in combination with specific GFP-tagged proteins will allow the expansion of this technique to identify other biologically important complexes. This information will not only have an impact on the health and quality of life of humans but will be especially important for preserving and strengthening the vitality of agriculturally important plants and animals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None.)

Brief Explanation

A few of these external factors had minor impacts on the conduct of research, but none has materially affected the outcomes nor resulted in unmet goals.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Communities, Economics & Commerce

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
131	Alternative Uses of Land			7%	
133	Pollution Prevention and Mitigation			3%	
403	Waste Disposal, Recycling, and Reuse			8%	
603	Market Economics			4%	
605	Natural Resource and Environmental Economics			9%	
608	Community Resource Planning and Development			27%	
610	Domestic Policy Analysis			8%	
801	Individual and Family Resource Management			7%	
802	Human Development and Family Well-Being			7%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			17%	
805	Community Institutions, Health, and Social Services			3%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.3	0.0
Actual	0.0	0.0	1.0	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	146484	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	124684	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

Four supported scientists participated in multistate research projects including W-2133 Benefits and Costs of Natural Resources Policies Affecting Public and Private Lands, NE1029 Rural Change: Markets, Governance and Quality of Life, NC1171 Interactions of individual, family, community, and policy contexts on the mental and physical health of diverse rural low-income families, and W-2004 Population Dynamics and Change: Aging, Ethnicity and Land Use Change in Rural Communities.

Analyzed the economic impacts of alternative methods of waste management with particular attention to the own price elasticity estimates of unit pricing programs and application of newer econometric methods to new data sets and to data sets used in previous studies. Analyzed the economic issues surrounding privatization versus public provision of public services such as waste management.

Examined the aging of New Hampshire's population and compared it to that elsewhere in the US. Described the changing racial and ethnic composition of rural and urban areas of the state. Investigated how changes in the size and composition of the rural population affect changes in land use and analyzed the linkages between demographic change and emerging land use change.

Conducted two surveys using 930 businesses and 500 retirees in the New England region to ascertain the efficacy of various incentives to offer specialized job opportunities for rural retirees. One of the emphases focused on wages willing to be offered by job category defined using the BLS delineations and the expected (or minimum) wages that would be acceptable to the returning workers on a part-time or full-time basis. A website was developed where both firms and individuals could register for common employment needs.

2. Brief description of the target audience

The target audience for this program area includes businesses in the Northeast United States seeking to employ retired individuals on a part-time or full-time basis and retirees seeking additional employment opportunities, state and local governments, recycling agencies, non profits, pollution prevention groups, infrastructure investment concerns, constituencies interested in demographic trends in rural and urban areas including state and national policy-makers and planners, non-profit organizations, media and the general public; and policy makers at the state and federal levels.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	3000	2000000	1000	3000
Actual	625	1930	0	0

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

Patent Applications Submitted

Year: 2010

Plan: 1

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	6	
Actual	0	4	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
2010	6	1

Output #2

Output Measure

- Number of graduate student directly involved in the projects

Year	Target	Actual
2010	5	6

Output #3

Output Measure

- Number of workshops and training sessions

Year	Target	Actual
2010	6	7

Output #4

Output Measure

- Number of non-peer-reviewed publications (theses, abstracts, newsletters, fact sheets, articles, etc)

Year	Target	Actual
2010	15	17

Output #5

Output Measure

- Number of peer-reviewed publications
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Number of undergraduate students involved and trained
3	Increased knowledge through publications and other means
4	Accurate information about state demographic trends to facilitate public planning and expenditures.
5	Evaluate potential for full or part time employment of retirees in rural areas.

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increased knowledge through publications and other means

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Accurate information about state demographic trends to facilitate public planning and expenditures.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Accurate and timely information about state demographic trends is critical to governmental and commercial efforts to plan and undertake myriad social programs and to maintain viability of rural communities.

What has been done

Findings from the project have provided important new information on state demographic trends that have identified two key misconceptions. Specifically, we demonstrated that the population of New Hampshire does not include a disproportionate share of older adults, and that young adults are not leaving New Hampshire in disproportionate numbers. These findings have been widely disseminated to state policy makers, non-profits and the business community via presentations, media interviews and publications.

Results

Results of this project have received extensive media coverage including more than 1,000 media mentions in the past year. It has been also been disseminated through invited presentations to leadership of federal, state and civic government entities, public volunteer organizations, and the NH university system.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Evaluate potential for full or part time employment of retirees in rural areas.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Some retirees must seek additional income, in part because of the recent economic downturn. At the same time some rural firms seek a viable and qualified labor pool available in their area, while local economies seek to identify potential influx of dollars.

What has been done

Surveys were conducted of rural businesses and retirees across New England. A total of 56% of the businesses indicated moderate to strong interest in hiring retirees on a part- or full-time basis. One key reason was that this group already had medical care benefits in place. When asked if government tax incentives would motivate the business to offer employment opportunities, 44% indicated affirmatively. Nearly 50% of the firms stated they would be willing to pay a premium over the existing category median wage for a qualified retiree, with 15% willing to pay a 50% premium.

Results

These results are encouraging with respect to potential rural development outcomes in NH and the region. Further, if a number of retirees drawing full social security benefits were able to return to the workforce, the ramifications for the nation's social security pool would be substantial, particularly given the impending onslaught of baby-boomers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
610	Domestic Policy Analysis

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (none)

Brief Explanation

Not applicable this year.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food, Nutrition & Health

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources			6%	
204	Plant Product Quality and Utility (Preharvest)			26%	
304	Animal Genome			5%	
305	Animal Physiological Processes			5%	
503	Quality Maintenance in Storing and Marketing Food Products			8%	
702	Requirements and Function of Nutrients and Other Food Components			10%	
703	Nutrition Education and Behavior			2%	
723	Hazards to Human Health and Safety			18%	
724	Healthy Lifestyle			20%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.4	0.0
Actual	0.0	0.0	1.0	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	144490	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	91840	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

Two of the supported scientists participated in multistate research projects NC1028 Promoting healthful eating to prevent excessive weight gain in young adults, and NE1023 Improving plant food (fruit, vegetable and whole grain) availability and intake in older adults

Blood samples were drawn from female athletes before and after an arduous exercise to evaluate the zinc transport and metabolism of endothelial cells to explore micronutrient metabolism in the blood.

Several experiments were completed to evaluate the potential effects of polybrominated diphenyl ether (PBDE) on obesogenecity.

Breeding combined with laboratory analyses continued toward developing squash cultivars with greater concentration and availability of beneficial carotenoids and xanthophylls such as lutein, which are important for vision and other aspects of human health.

An in vitro model of porcine lung alveolar macrophage was developed to complement in vivo studies in pigs and small laboratory animals, and research continued into impacts of different fatty acid profiles on alveolar macrophages associated with development of airway allergies humans.

2. Brief description of the target audience

The target audience for this program area includes scientists, animal and human nutritionists, professionals interested in micronutrient metabolism, vegetable growers interested in nutritional benefits for use as a marketing tool, consumers concerned with nutritional benefits of the produce they purchase, dairy and other farmers involved in farm animal products, nutritionists, and the scientific community at both the national and regional levels.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	600	4300	120	0
Actual	75	5000	0	0

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

Patent Applications Submitted

Year: 2010
 Plan: 0
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	6	
Actual	0	7	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
2010	6	8

Output #2

Output Measure

- Number of graduate student directly involved in the projects

Year	Target	Actual
2010	6	6

Output #3

Output Measure

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

Year	Target	Actual
2010	9	8

Output #4

Output Measure

- Number of non-peer-reviewed publications (theses, abstracts, newsletters, fact sheets, articles, etc)
Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of peer-reviewed publications
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Number of undergraduate students involved and trained
3	Increased knowledge through publications and other means
4	Develop vegetable cultigens having high concentration and availability of beta-carotene and related nutrients.
5	Evaluate impacts of environmental chemicals on obesogenecity.

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increased knowledge through publications and other means

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Develop vegetable cultigens having high concentration and availability of beta-carotene and related nutrients.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Carotenoids are a class of fat soluble, orange-pigmented, complex molecules, some of which are important human nutrients. Beta-carotene is important in development and eye function, and a broader role in health has been attributed to carotenoids in reducing the risk of several degenerative health problems and certain cancers, in photoprotection of skin, and photoprotection of the eye provided by the carotenoids lutein and zeaxanthin. Squash are unique in that many varieties are a good source of lutein, typically provided only by green leafy vegetables. A major proportion of the carotenoids in many varieties of squash, including lutein, are molecularly linked to fatty acids by ester bonds, and these bonds have to be broken prior to absorption of carotenoids into the blood stream.

What has been done

During the past four years we completed studies of carotenoid content and profiles in breeding lines and selected varieties of squash. Results show highly diverse carotenoid profiles among different squash cultigens, and many cultigens contain abundant carotenoids not known to provide nutritional benefits.

We developed squash breeding lines in which most of the lutein is non-esterified, and also squash lines in which non-esterified beta-carotene is the major carotenoid. These breeding lines are being utilized to develop new hybrid varieties with improved nutritional benefits in terms of carotenoid composition.

Results

Our research on eating quality and total carotenoid levels in squash in relation to harvest period and storage time provides base-line information on proper harvest period and storage time for maximizing eating quality and nutrition in squash. This information provides guidelines for growers and consumers of squash that are being disseminated through Cooperative Extension and presentations at grower meetings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #5

1. Outcome Measures

Evaluate impacts of environmental chemicals on obesogenicity.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Polybrominated diphenyl ether (PBDE) is commonly used as a flame retardant on children's pajamas and other products. Recent evidence has suggested that these and other environmental chemicals might be implicated in contributing to development of obesity.

What has been done

Using growing rats we learned that PBDEs disrupt macronutrient metabolism and energy balance, and that the obesogenicity of PBDEs can be modulated by diet. PBDE exposure during pregnancy and lactation affected body weight of dams, and developmental exposure of rats to flame retardants interacted with the diet of the offspring to influence weight gain.

Results

Findings suggest that PBDEs impact not only adipose tissue but also liver metabolism and could contribute to weight gain in experimental animals and humans. This knowledge can be used by health professionals and policy makers toward reducing potential exposure to environmental chemicals that may contribute to the national obesity epidemic.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
723	Hazards to Human Health and Safety

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None)

Brief Explanation

Not applicable this year.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

- Time series (multiple points before and after program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Natural Resources & Environment

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	5.8	0.0
Actual	0.0	0.0	0.2	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	25656	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	32856	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

The NHAES supports multiple research efforts related to natural resources and the environment, with many of these funded through the McIntire-Stennis program that is not covered in this report. Others are included in this report but in different Program Areas based on appropriate grouping of related projects.

Microcystins are a hepatotoxin produced by cyanobacteria that are common in freshwater lakes and reservoirs. They present a significant danger to humans who live near these bodies of water, and who swim in or drink from them. In an integrated research and extension project, cyanobacteria testing was carried out on six New Hampshire lakes as part of a class project in the UNH course entitled Field Studies in Lake Ecology. Eleven undergraduate students in the class were trained in the collection of lake water samples and ELISA testing of microcystins. Microcystins were tested for in over 250 water quality and drinking water samples sent to our laboratory from the ME Department of Environmental Protection, Lake Associations in NH and MA, and public water suppliers in NH, ME, MA and CT. In sum, samples for microcystins cyanobacteria counts and identification were processed from 5 northeast states. The project worked with public water suppliers and Lake Associations to develop cyanobacteria monitoring programs. A very large number of oral presentations and workshops were provided across the state and region by the supported scientist, Extension collaborator, and the multiple graduate and undergraduate students involved in the research. Audiences included individual and groups of stakeholders, lakes management and advisory groups, state and federal agency staff including USEPA and departments of Public Health, town officials, and scientific peers.

The citizen-based Cyanobacteria Monitoring Program or CCMP was created and is designed to assist lakes in developing cyanobacteria monitoring protocols and to provide microcystin analysis for lakes and drinking water supplies. The CCMP also trained four undergraduates in field and lab methods in lake monitoring and microcystins analysis. A webpage (<http://cfb.unh.edu/programs/CCMP/CCMP.html>) was developed describing the CCMP and providing sampling protocols to the public. Research on cyanobacteria at Lake Attitash, MA and Shoals Marine Lab, ME was incorporated into the UNH Project SMART, a summer program for high school science students throughout the northeast.

Multiple undergraduate students were trained in the laboratory, and five of these presented the results of their research at the UNH Undergraduate Research Conference. Two graduate students were actively involved in the work.

2. Brief description of the target audience

The target audiences for this work included University of New Hampshire (UNH) students in multiple classes, high school students in Project SMART, UNH undergraduate students trained in cyanobacteria toxin research in the laboratory, faculty collaborators and patients at the ALS (Lou Gehrig's Disease) Clinic at Dartmouth-Hitchcock Medical Center, UNH Veterinary Diagnostic Laboratory, Tufts School Veterinary Medicine, MA Nature Conservancy Cape Cod, Loon Preservation Committee, Squam Lakes Natural Science Center, Town planners, decision-makers and Conservation Commissions from the NH towns of Guilford, Laconia, Dover, Milton, Holderness, Meredith, Barrington, and the MA towns of Amesbury, Merrimac and Nantucket), Meredith, Lakes Region Planning Commission, North Country Resource Conservation and Development Agency, the Belknap County Conservation District and the State and Federal Agencies (eg NH Dept Environmental Services, NH Office of Energy and Planning, MA Dept Public Health, Maine Dept Environmental Protection, US EPA Laboratory Chelmsford MA, US EPA Atlantic Ecology Division RI), lake association members, lake shore residents, New England Interstate Water Pollution Control Commission, Maine Rural Water Association, public water suppliers (CT MA ME NH RI).

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	900	1500	50	80
Actual	250	200	20	800

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

Patent Applications Submitted

Year: 2010
 Plan: 0
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	12	
Actual	0	14	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
2010	15	0

Output #2

Output Measure

- Number of graduate students directly involved in the projects

Year	Target	Actual
2010	15	2

Output #3

Output Measure

- Number of non-peer-reviewed publications (theses, abstracts, newsletters, fact sheets, articles,

etc)

Year	Target	Actual
2010	18	3

Output #4

Output Measure

- Number of websites in which project results have been incorporated

Year	Target	Actual
2010	12	3

Output #5

Output Measure

- Number of peer-reviewed publications

Year	Target	Actual
2010	4	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Number of undergraduate students involved and trained
3	Increased knowledge through publications and other means

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	6	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Graduate student involvement in experiment station research projects is fundamental to our mission to train the next generation of agricultural scientists.

What has been done

Two graduate students were integrally involved in an integrated research and extension effort to evaluate the risks and potential solutions to the problem of hepatotoxic mycrosistins produced by freshwater aquatic cyanobacteria blooms in northeastern lakes and reservoirs, and therefore potentially drinking water supplies. The students carried out laboratory and field work targeted at this important natural resources-related public health problem.

Results

Graduate students met with stakeholder groups, state and federal agency staff, university and high school students, faculty members and scientists to relay their findings. They simultaneously gained firsthand knowledge and experience about real world management and statutory implications and procedures.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	6	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Engaging undergraduate students in research, particularly as related to agriculture and associated natural resources, is crucial to achieving a stream of highly qualified future scientists and managers, as well as an educated and discerning populace.

What has been done

184 students in multiple classes at the University of New Hampshire, 23 high school students from the northeast region through the summer Project SMART program, and 14 UNH undergraduate students trained in cyanobacteria toxin research in the laboratory, were involved in or exposed to research on toxic microcystins in northeastern lakes and open waters.

Results

A substantial number of young citizens have been educated about this important issue, and the scientific and management approaches targeted toward potential solutions. This change of knowledge and condition will propagate to others via peer-to-peer discussions.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Increased knowledge through publications and other means

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (No external factors interfered substantially with the outcomes.)

Brief Explanation

Many of these external factors may impact public management approaches and outcomes in response to the issue, but none have interfered with our integrated research and extension efforts.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)
- Case Study

Evaluation Results

Results of ongoing evaluations are still pending. Some may have been provided in the UNH Extension annual report by our Extension cooperator on the project.

Key Items of Evaluation

V(A). Planned Program (Summary)**Program # 7****1. Name of the Planned Program**

Pest Management

V(B). Program Knowledge Area(s)**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
211	Insects, Mites, and Other Arthropods Affecting Plants			90%	
215	Biological Control of Pests Affecting Plants			10%	
	Total			100%	

V(C). Planned Program (Inputs)**1. Actual amount of professional FTE/SYs expended this Program**

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.5	0.0
Actual	0.0	0.0	0.2	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	19756	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	25179	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**

The breeding juvenile hormone (JH) profiles of several species of burying beetles and a carrion beetle, males and females, paired and single, were compared to understand the evolution of the role of JH in orchestrating the changes in physiology and behavior that occur during a breeding bout. The ultimate goal was to better understand the proximate causes of behavioral changes in these beetles. How

hormones control reproductive physiology and behavior of beetles that are opportunistic breeders was evaluated. Used standard breeding techniques for getting samples of breeding male and female burying beetles. Took hemolymph from each at designated times after the initiation of breeding and used radioimmunoassay to determine titers of JH.

2. Brief description of the target audience

Target audience include students in university classrooms, scientists in behavioral ecology or behavioral endocrinology and agricultural pest research, and the general public through articles for popular science magazines and talks to lay audiences.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010
 Plan: 0
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	1	
Actual	0	1	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
2010	1	1

Output #2

Output Measure

- Number of graduate student directly involved in the projects

Year	Target	Actual
2010	1	2

Output #3

Output Measure

- Number of non-peer-reviewed publications (theses, abstracts, newsletters, fact sheets, articles, etc)
Not reporting on this Output for this Annual Report

Output #4

Output Measure

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

Output #5

Output Measure

- Number of peer-reviewed publications
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase in knowledge about hormonal control of reproduction and parental care in beetles (qualitative outcome statement)
2	Number of graduate students involved and trained
3	Number of undergraduate students involved and trained

Outcome #1

1. Outcome Measures

Increase in knowledge about hormonal control of reproduction and parental care in beetles
(qualitative outcome statement)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many beetles are agricultural pests but in spite of the number of beetles species, the hormonal control of their reproduction and reproductive behavior is relatively little studied. Burying beetles, although not pests, are a good model system to better understand the roles of juvenile hormone (JH).

What has been done

The breeding JH profiles of five carrion and burying beetles were characterized to understand the evolution of hormonal regulation. JH titers of the burying beetles with the most elaborate parental care showed dramatic changes during a reproductive bout. These hormones, among other effects, facilitate mate recognition so individuals can recognize intruders vs. mates, and aggressive responses to intruders. These beetles use a breeding resource (carcass) that must be defended. The strength of the response (increase in JH) correlated with the expected degree of competition for the breeding resource and its defensibility.

Results

Resulting knowledge of the role of juvenile hormone in reproductive behavior of these beetles can be used to develop potential management strategies for beetles which are agricultural pests.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Plants & Plant Products

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management			15%	
133	Pollution Prevention and Mitigation			25%	
136	Conservation of Biological Diversity			10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			50%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.3	0.0
Actual	0.0	0.0	0.4	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	50699	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	62337	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

Light and temperature treatments were imposed on mature sunflower leaves, and cell and anatomical structural changes were compared to control plants.

Historical comparisons of seaweed populations from the late 1800s-early 1900s to the present day were made to assess the impacts of introduced and altered floras at specific locations. Rapid assessment studies of fouling populations were made between Downeast Maine and New York in order to document floristic changes, numbers of introduced taxa, and the results of anthropogenic impacts. Molecular studies clarifying "cryptic" introduced species were conducted to document patterns of introductions within this geography. Dissemination of results occurred via scientific publications, presentation of significant findings to coastal resource managers, and interactions with diverse conservation units.

2. Brief description of the target audience

The target audience for this program area includes scientists studying or interested in stress responses in plants, plant breeders interested in extending temperature tolerance ranges through breeding or molecular biological manipulation, and coastal zone managers (e.g. Fish and Game and Environmental Protection units) charged with protection of coastal resources.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	400	1500	10	0
Actual	35	150	0	0

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

Patent Applications Submitted

Year: 2010
 Plan: 0
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	5	

Actual	0	4	0
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V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of participants directly involved in the project (not including audience counts, workshop participants, survey respondents, etc)
Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
2010	5	13

Output #3

Output Measure

- Number of graduate student directly involved in the projects

Year	Target	Actual
2010	5	6

Output #4

Output Measure

- Number of non-peer-reviewed publications (theses, abstracts, newsletters, fact sheets, articles, etc)
Not reporting on this Output for this Annual Report

Output #5

Output Measure

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

Output #6

Output Measure

- Number of peer-reviewed publications
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Number of undergraduate students involved and trained
3	Increase in knowledge to publications and other means
4	Increased knowledge about changes in marine seaweed presence along the northeast coast, including those introduced by humans.

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increase in knowledge to publications and other means

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increased knowledge about changes in marine seaweed presence along the northeast coast, including those introduced by humans.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The documentation of historical and recent floristic changes and species composition is of critical importance in characterizing long term changes such as global warming and more recent anthropogenic impacts to our critically important coastal and estuarine habitats, with the latter in particular providing important habitat for many commercially important fish, shellfish and crustaceans.

What has been done

Rapid assessment surveys between New York and Downeast Maine showed seven introduced taxa, with four originating from Asia, two from Europe and one from the Pacific Northwest. Many of these taxa were introduced via human-mediated vectors, including shellfish aquaculture and vessels (i.e. on hulls and ballast waters). The abundance of these introduced species was enhanced by eutrophication or increased nutrients. Molecular studies documented the occurrence of several ?cryptic? or inconspicuous introduced seaweeds, including the Asiatic green alga *Ulva pertusa* and the red seaweed *Gracilaria vermiculophylla*. Historical comparison across 100-years in Casco Bay, Maine evaluated seaweed similarity.

Results

The information is available to scientists, aquaculture and fisheries producers, local and federal governmental units and conservation organizations to help mitigate impacts to our important coastal and estuarine habitats. The initial sites of an introduced seaweed often suggest a possible vector such as shellfish transfer, major conduits of transport including boats hulls and propellers, canals, etc. Genetic determination of introduced species helps characterize the source and number of introduction events. Enumeration of species composition of ?green tide? nuisance algae will be used to characterize ?stressed? or eutrophic habitats.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None)

Brief Explanation

Not applicable.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)

- During (during program)
- Time series (multiple points before and after program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Sustainable Horticulture

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			5%	
201	Plant Genome, Genetics, and Genetic Mechanisms			5%	
202	Plant Genetic Resources			17%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			10%	
204	Plant Product Quality and Utility (Preharvest)			32%	
205	Plant Management Systems			27%	
212	Pathogens and Nematodes Affecting Plants			4%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.4	0.0
Actual	0.0	0.0	1.3	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	196583	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	142531	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

The production and improvement of horticultural crops is disproportionately fundamental to the agricultural economy of NH and the region, compared to the remainder of the United States. This represents one of several areas where our strong support of state and regional foci would not otherwise be accommodated through national funding initiatives. Of the six included projects in this program area, four are integrated research and extension efforts and one is also tied to multistate research project NE-9, Conservation and Utilization of Plant Genetic Resources. All these projects critically rely on the NHAES greenhouses and research farms.

Field variety trials were conducted for several vegetable crops to evaluate yield, quality, and susceptibility to insects and diseases. Field experiments were carried out to evaluate the feasibility and expense of using various season extension techniques for fall establishment and spring harvest of selected crops. Multiple workshops were held for growers, and research project reports were developed for dissemination. Variety trials and cultural experiments have enabled agricultural experiment station and cooperative extension educators from NH and neighboring states to provide commercial farmers and gardeners with regionally accurate information about specialty vegetable crop production.

Multi-year field experiments were concluded testing woody plant responses to nursery container types and overwintering techniques over a representative range of environmental conditions. Results were presented to producer groups and at scientific conferences.

Greenhouse experiments were conducted to improve quality of *osteospermum* floriculture crops.

116 experimental hybrids of ornamental pumpkin, seed pumpkin winter squash, summer squash and melon were evaluated at the University of New Hampshire Horticulture Research Farms. These included *Cucurbita pepo*, (acorn squash, gourds, ornamental pumpkins, summer squash, and hull-less seeded pumpkins); *Cucurbita maxima* (semi-bush kabocha, Hubbard, and processing squash); *Cucurbita moschata* (classic butternut and round-fruited cultigens), and *Cucumis melo* (cantaloupe, honeydew and Galia melons). Criteria include fruit quality, disease resistance and other traits of importance to growers and consumers.

Strawberry breeding assisted by molecular tools and techniques continued, with targets including the fungal pathogen verticillium wilt, improved potentially healthful antioxidant content, developing new molecular markers based on gene candidate functional relationships to traits of interest, and establishment of a field plot suitable for organic strawberry production to help support this component of our agricultural

stakeholders.

2. Brief description of the target audience

The target audience for this program area includes vegetable and fruit growers in New England and the Northeast, parts of Canada, South Africa, Europe and the Middle-East; home gardeners in New England and locations having similar climates, vegetable crop researchers worldwide, owners and operators of greenhouses that produce floriculture crops, nursery producers and landscape contractors in NH and throughout the northeast, extension educators who work in horticulture, plant breeders and crop producers, strawberry growers, and consumers who want nutritious local fruit and vegetable products.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	300	500	0	200
Actual	715	29000	250	50

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

Patent Applications Submitted

Year: 2010

Plan: 0

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	5	
Actual	0	3	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops and training sessions

Year	Target	Actual
2010	4	3

Output #2

Output Measure

- Number of participants in the project (not including audience counts)

Year	Target	Actual
2010	10	13

Output #3

Output Measure

- Number of undergraduate students involved in the research projects

Year	Target	Actual
2010	5	15

Output #4

Output Measure

- Number of graduate students involved in the research project2

Year	Target	Actual
2010	2	11

Output #5

Output Measure

- Number of non-peer reviewed publications (theses, abstracts, newsletters, fact sheets, articles, etc)

Year	Target	Actual
2010	2	11

Output #6

Output Measure

- Number of websites in which the project results are incorporated.

Year	Target	Actual
2010	2	4

Output #7

Output Measure

- Number of peer-reviewed publications

Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Number of undergraduate students involved and trained
3	Incureased knowledge through publications and other means
4	Develop new and improved horticultural products that are available to producers and consumers
5	Increase the rate of development for new horticultural products through molecular breeding tools.
6	Demonstrate viable means to extend the effective growing season for northwest agricultural crops.
7	Help provide new alternative crops for regional growers and consumers.
8	Help improve efficiency and effectiveness of woody landscape plants production.

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Incureased knowledge through publications and other means

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Develop new and improved horticultural products that are available to producers and consumers

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	2	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Locally-grown vegetables are highly touted in the Northeast. Production costs are high throughout much of the region, so growers must receive premium prices for locally grown produce to be profitable and sustainable. Part of the justification for paying higher prices is the consumer expectation that locally grown vegetables will have better eating quality and/or nutritional value than vegetables transported over large distances.

What has been done

Over 40 new cucurbit varieties have been developed and commercialized over the past 10 years, and several have had a significant impact on agriculture in New England and the Northeast. Two recent examples are ?Honey Bear?and ?Sugar Dumpling? acorn squash with exceptional eating quality and powdery mildew resistance. Another promising introduction is Slick Pik (trademark) YS26, a unique yellow straightneck summer squash with glossy fruit and stems that are largely devoid of the prickly spines which irritate pickers and damage neighboring fruit, resulting in greatly improved appearance and shelf life. Several companies within and outside the U.S. are interested in utilizing pumpkin germplasm which provides hull-less pumpkin seeds for preferred eating.

Results

These and other new varieties with better disease resistance, improved nutrition, greater adaptability and which provide a greater diversity of food and ornamental products for growers to market and consumers to buy will help to sustain local agricultural production, and will enhance the ability of regional seed companies to remain competitive and profitable.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

Outcome #5

1. Outcome Measures

Increase the rate of development for new horticultural products through molecular breeding tools.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
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2010 {No Data Entered} 2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The need for new crop varieties that satisfy the expanding consumer demands for high quality, locally grown produce and value-added horticultural products challenges plant breeders to respond quickly to changing environmental conditions, evolving production landscapes, and emerging markets. Yet the elapsed time between a breeder's initial cross-pollination and the release of a superior variety may be five to ten years, if not more.

What has been done

Laboratory and field work was carried out to accelerate the pace of variety development by translating knowledge about plant genomes into "molecular breeding" tools of demonstrable value to plant breeding practitioners. A contribution to the research and publication of the first strawberry genome sequence is one major result.

Results

The national and international impact in the strawberry genomics and molecular breeding communities is immense. Already, this sequence is accelerating efforts to develop the molecular markers needed to initiate marker assisted breeding in strawberry by providing the basis for design of the first strawberry SNP (single nucleotide polymorphism) chip by the RosBREED Consortium.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #6

1. Outcome Measures

Demonstrate viable means to extend the effective growing season for northwest agricultural crops.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The short growing season constrains outdoor agricultural production in the northeast region. Economically viable methods to extend the growing season are important to our agricultural economy and to meeting consumer demand for locally produced foods.

What has been done

We demonstrated in studies done on NHAES and collaborating grower farms that it is feasible to produce an overwintering sprouting broccoli crop in New England without supplemental heat for early spring harvest.

Results

Based on preliminary results, nine cooperating growers have learned about and planted trial crops of winter sprouting broccoli. Of these, two have found that it fits their market well. Other growers are currently evaluating the crop, and two regional seed companies now market this new crop, as a direct result of our outreach efforts. We estimate that a gross income of \$1000 or more during the winter months could be produced in a typical high tunnel of 1500-1800 square feet with relatively little labor. The dollar impact of our work to growers and gardeners is estimated at \$5,000, but we are still in the very early phases of adoption of this crop.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Help provide new alternative crops for regional growers and consumers.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Development and evaluation of potential alternative crops is critical to economic opportunities for state and regional growers. Sweetpotato is a staple crop in some other areas, but has been considered as not viable in the northeastern United States due to climatic restrictions.

What has been done

The fifth and final year of a project evaluating varieties and cultural practices of sweetpotato was completed. We were the northernmost site participating in the National Sweetpotato Trial Network, which evaluated cultivars and breeding lines and provided feedback to breeding programs. Varieties and production practices that are suitable for our climate were identified, and grower awareness of sweetpotato as a feasible crop for the Northeast was increased. The results were presented to several hundred growers and gardeners in New England.

Results

At least fifty growers in the region have begun to grow this crop as a direct result of our work. Feedback and advice to growers has been provided to help refine their production and storage practices. The annual economic impact of this work to state and regional farmers and gardeners is conservatively estimated as at least \$20,000.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

Help improve efficiency and effectiveness of woody landscape plants production.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Woody landscape plants are an important and highly used component in yard and landscape improvement, land rehabilitation and other applications. Root zone temperatures limit survival of plants in above ground containers in many areas, and traditional over-wintering techniques for nursery stock are labor intensive and expensive.

What has been done

Based on cumulative research results, common woody species were been grouped into risk categories to help growers prioritize labor and space resources for winter protection. Leaving low-risk container plants in situ over the winter is supported by these results, reducing production costs in northern and high elevation settings. In some species root cold tolerance is enhanced by fabric containers, but the primary benefit of fabric containers is a more fibrous and well-distributed root structure which will enhance landscape performance.

Results

This research information will result in more effective and economical production practices for woody landscape plants, and provide better-performing stock to consumers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy

Brief Explanation

Climatic conditions inherently impact the conduct and results of field research, while the economy affects grower and consumer abilities to take advantage of the resulting knowledge and products.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- During (during program)
- Other (see below)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Sustainable Marine Aquaculture & Fisheries

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
135	Aquatic and Terrestrial Wildlife			10%	
136	Conservation of Biological Diversity			9%	
201	Plant Genome, Genetics, and Genetic Mechanisms			9%	
204	Plant Product Quality and Utility (Preharvest)			8%	
301	Reproductive Performance of Animals			10%	
302	Nutrient Utilization in Animals			4%	
303	Genetic Improvement of Animals			5%	
305	Animal Physiological Processes			6%	
306	Environmental Stress in Animals			18%	
307	Animal Management Systems			6%	
308	Improved Animal Products (Before Harvest)			6%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			9%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.6	0.0
Actual	0.0	0.0	1.8	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	290375	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	299595	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

Antifreeze protein induction was quantified and compared in different stocks of cod for application in site-specific stocks in netpen aquaculture enterprises having different water temperatures.

Continued long term sea urchin recruitment studies from New Hampshire to Eastport, Maine. Brought hatchery up to full operational level, including production of two cohorts of over 1 million juvenile urchins. These were used in out planting studies at lease sites and laboratory growth studies.

Conducted pilot-scale commercial and field studies on strategies to eliminate or reduce concentrations of *Vibrio parahaemolyticus* and *Vibrio vulnificus* from freshly harvested oysters in Maine and New Hampshire. Determined that natural relaying was the most effective method to reduce the concentrations of the vibrios. Detected *V. parahaemolyticus* genes associated with pathogenesis in temperature-abused oysters prior to treatment.

Documented extant populations and introduction events of the green alga *Codium fragile* (Oyster thief; deadman's fingers) and the red alga *Neosiphonia harveyi*, which are recognized as among the most serious invasive algae in marine habitats.

Collected and identified marine intertidal invertebrates. Sequenced cytochrome oxidase I genes of all specimens. Determined intra- and inter-specific variation. Identified potential barcode gap.

Collected "seed" stocks of the green seaweed *Ulva* and the red seaweeds *Gracilaria* and *Porphyra*. Species identities of collected and cultured specimens were confirmed by DNA sequencing of the *rbcl* gene and/or the ITS-1 spacer region. Grew cultures under a series of temperature and daylength regimes to determine conditions that promote progression through different life history stages. Examined nutrient kinetics of the *Ulva* and *Porphyra* species and its effect on protein, chlorophyll, carotenoid, and phycobilin (*Porphyra* only).

Began a controlled study to transplant clams without cancer to areas identified with high incidence of cancer. Assessed sediments for grain size, toxin load and continuous temperature readings to evaluate whether transfer of the cancer can occur from affected clams to those that are normal as we have demonstrated in the laboratory via injection of hemolymph alone, suggesting that a virus is involved.

Tracked lobsters of various types using ultrasonic telemetry, and monitored the activity of lobsters using a novel method involving accelerometers, with goal to learn more about factors that influence lobster

2010 16 36

Output #2

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Target	Actual
2010	5	32

Output #3

Output Measure

- Number of graduate student directly involved in the projects

Year	Target	Actual
2010	4	20

Output #4

Output Measure

- Number of non-peer-reviewed publications (theses, abstracts, newsletters, fact sheets, articles, etc)

Year	Target	Actual
2010	8	15

Output #5

Output Measure

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

Output #6

Output Measure

- Number of peer-reviewed publications
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students involved and trained
2	Number of undergraduate students involved and trained
3	Increased knowledge through publications and other means
4	Identify mechanisms to reduce incidence of pathogenic disease outbreaks in oysters.

Outcome #1

1. Outcome Measures

Number of graduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of undergraduate students involved and trained

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increased knowledge through publications and other means

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Identify mechanisms to reduce incidence of pathogenic disease outbreaks in oysters.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2010

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Oysters naturally contaminated with pathogenic vibrios are causing increasingly more common disease outbreaks for consumers of raw or undercooked shellfish.

What has been done

Pilot-scale commercial and fiend experiments were tested to determine what post-harvest conditions for live oysters are most conducive to reducing concentrations of pathogenic vibrio species.

Results

The most effective strategy for reducing vibrio concentrations is natural relaying, or transferring freshly harvested oysters from a harvest area with vibrios to a relay site where they do not exist or are present at low concentrations. Finding new ways to safely harvest shellfish opens up more local commercial opportunities and provides a safer product to consumers.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Government Regulations
- Other (None)

Brief Explanation

Not applicable

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Other (see below)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}