

**Annual Report of Accomplishments and Results  
October 1, 2005 to September 30, 2006**

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

**COLLEGE OF LIFE SCIENCES AND AGRICULTURE**

**UNIVERSITY OF NEW HAMPSHIRE  
DURHAM, NEW HAMPSHIRE**

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March 16, 2007

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**NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION**  
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**2005-2006**

**INTRODUCTION**

The New Hampshire Agricultural Experiment Station (NH-AES) resides within the University of New Hampshire College of Life Sciences and Agriculture. It has the responsibility for the Hatch, McIntire-Stennis, Animal Health, and Multi-State Research Programs. This report of accomplishments does not include New Hampshire Cooperative Extension, which is a separate administrative unit in New Hampshire. However, there is effective coordination of appropriate programs among both units. Through the NH-AES Advisory Committee representing key stakeholder groups, we are working to facilitate constituent input and to improve our delivery of research findings to end users.

**A. Planned Programs**

**Goal 1: An Agricultural System that is Highly Competitive in the Global Economy**

**Issue**

Provide both basic and applied research to support increased knowledge to improve production, marketing and processing of American agricultural products.

**Overview:**

The New Hampshire AES has established as an outcome indicator increasing the effectiveness of basic and applied projects related to New Hampshire agricultural needs. Additionally, we use the increase in agricultural production in New Hampshire and income growth to New Hampshire farm operations as indicators. Based on the most recent data available from the USDA's New England Agricultural Statistics Service\*, the number of NH farms remained stable at 3400 between 2003 and 2004 compared to 2800 farms in 1995. In 2005, total land in acres was 450,000 with the average size farm of 132 acres compared to the average size farm in 1996 of 145 acres. Between 2003 and 2004, the agricultural sector contribution to the State's Economy increased from \$195.4 to \$ 213.3 million-note (*2005 data have not been reported to date*). Total farm assets increased from \$1,098.0 to \$1148.3 million between 2003 and 2004, while total farm debt increased from \$119.5 to \$123 million dollars.

We continue our philosophy that the mission of the Agricultural Experiment Station is greater than solely enhancing production agriculture and thus support basic and applied sciences that help position NH to 1) develop new agricultural products and jobs, 2) augment farm-based and farm-related industry, 3) provide opportunities for non-traditional and sustaining farming endeavors such as the Organic Dairy, and 4) create opportunities for farm and rural community development. Each of these areas contributes to the development of a highly competitive and sustainable agricultural system for the global market. The research findings, developments and technologies are and will be transferred through various mechanisms and working directly with our Intellectual Property Office in such forms as publications, patents, genomic data banks, technology transfer, policy recommendations and formation of spin-off companies.

(\* ) Sources: New England Agricultural Statistics, 2005

The NH Agricultural Experiment Station supports the following basic and applied projects within Goal 1 to create technology and research for the benefit of the state, region and nation. We believe these projects provided valuable results, excellent return on the investment of AES funds, and a strategic position for the NH AES to successfully achieve the five year POW goals.

### **Key Theme - Animal Production Efficiency**

#### **1. Improve supply of nutrients to dairy cows (2 Projects)**

##### **a. Brief description of the activity**

Two projects are devoted to improving the efficiency of conversion of feed protein to milk protein that is fundamental to both environmental and economic sustainability of the US dairy industry. In the first project, two lines of research are ongoing. One is testing the use of essential oils as a way to decrease protein degradation in the rumen and the other is attempting to identify laboratory methods to obtain accurate estimates of intestinal digestibility of rumen-undegraded feed protein—amino acids (RUP-AA). Forty-two Holstein cows were used to determine if the addition of VERTAN (IDENA, France; a specific blend of essential oils) to a corn silage based diet would alter protein metabolism in the rumen and increase the conversion of feed N to milk protein. Dietary treatments were given from 21 to 105 days postpartum. There was no effect of Vertran on DM intake, milk yield, milk composition, blood urea N, or rumen pH. Testing an immobilized digestive enzyme assay (IDEA) seemed to indicate that this method is a good approach for predicting the digestibility of RUP-AA in soybean meal products and distiller's grains but not in fishmeal. In the second project, the Ruminant Feed Analysis Consortium which was started in 2003 as an industrial consortium at the University of New Hampshire was incorporated this past year (2006) as a non-profit organization called the Feed Analysis Consortium, Inc. The second activity of this project is a continuation of research directed at determining the metabolizable Met values for commercially available Met supplements. Obtaining these values is difficult because of product differences with regard to solubility, particle size and density, site of degradation and absorption. An ongoing experiment is testing the lactational performance of cows fed a Met deficient diet supplemented with either Smartamine M or MetaSmart.

##### **b. Short Impact/Accomplishment Statement**

The protein research provides information that is needed for more precise formulation of dairy cattle diets for protein. More precise feeding of protein increases the conversion of feed nitrogen to meat and milk protein, decreases feed costs, and reduces the potential for nitrogen pollution. Feeding essential oils is a way to reduce protein degradation in the rumen and stabilize ammonia concentrations, thereby reducing protein wastage. In the second project, the formation of the Feed Analysis Consortium is considered a landmark accomplishment. As a membership based organization, the extent of its success is expected to parallel the needs of the animal and feed industries for advances in feed analysis and nutritional modeling and the need for a North American Feed Information System.

##### **c. Source of funding/total expenditures/full time equivalents**

Source of funding: Hatch

Total expenditures: Federal - \$ 74,918

State- 173,195

Total – 248,113

Full-time equivalents: Sci. 0.6; Prof 1.2; Total 1.8

d. Scope of impact: Multistate; Integrated Research and Extension Project 1 - (AL, AZ, CA-Davis, ID, IL, IN, IA, J.D.. Heiskell & Co., KS, KY, MD, MI, MN, MO, NH, ND, OH, PA, SD, USDA-ARS/WI, UT, VA Tech, VT, WA, WI.).

Project 2: Multistate; Integrated Research and Extension (AZ, CA-Davis, FL, GA, IN, IA, KS, LA, MD, MI, MN, NE, NH, NM, NY-Cornell, OH, PA, SD, TX, UT, VT, VA Tech, WI).

## 2. Predicting bovine fertility (2 Projects)

### a. Brief description of the activity

Pregnancy losses in cattle during the late embryonic and early fetal period are an economic concern to the cattle industry. Two independent NH projects contribute to a multistate effort to understand ovarian function relative to late embryonic/early fetal mortality in cattle and to determine if environmental/metabolic stressors affect fertility as well as embryonic/fetal survival. Specifically, one study is examining the effects of the environment on the corpus luteum function by examining the relationship between heat stress and the expression of heat shock proteins (HSP). This past year, the mechanism of HSP was investigated in vivo and in vitro. It was shown that a variety of environmental and biochemical stimuli induces HSP expression, and this induction is mediated by the transcription factors, HSP 1 and 2. Another study is examining the diversity of the microvasculature within the corpus luteum by examining the role of prostaglandin. Recent studies examined structural and functional attributes of endothelial cell population of estrous cows compared with those of pregnant cows. Results indicate that several attributes of endothelial cell population are retained throughout early pregnancy. These attributes may be important to the adaptable nature of the luteal microvasculature during angiogenesis and angiostasis, which in turn affect luteal function during the estrous cycle and early pregnancy.

### b. Short Impact/Accomplishment Statement

Luteal cells respond to heat treatment by increasing expression of heat shock proteins, a defense mechanism of cells that is evolutionarily conserved. With the recent knowledge that heat shock proteins are not found exclusively inside cells, the potential impact of the present study is that future studies can be conducted to determine whether detection of heat shock proteins in blood or milk is prognostic of cows experiencing heat stress. Knowledge of the diversity of the microvasculature within the corpus luteum could provide new insight about the relative sensitivity of this tissue to immune-mediated and prostaglandin F2-alpha-induced aspects of luteolysis. Considering that PGF remains the most widely used hormone in the livestock industry to induce luteal regression, further understanding of the cellular actions of PGF within the corpus luteum could lead to new methods of regulating ovarian function and fertility.

### c. Source of funding/total expenditures/full time equivalents (for 2 projects)

Source of funding: Hatch  
Total expenditures: Federal - \$57,885  
State- 86,405

Total – 144,290

Full-time equivalents: Sci. 0.6; Prof 0.6; Total 1.2

d. Scope of impact: Multistate Research (CTS, MA, NH, NYC, OH, WVA)

### 3. Improving nutrition for dairy calves

#### a. Brief description of the activity

Lactoferrin, a milk protein, has antibacterial, antiviral, and growth promoting activity. Ongoing research continues to examine supplementation of milk replacer with 0, 1 or 2-g/d lactoferrin. Analysis conducted included plasma IgG and blood xylose after a xylose challenge. The presence of xylose in the blood is an indicator of intestinal development. To date the results of one study indicated there is no benefit to supplementing calves with lactoferrin. The data are currently being analyzed. The second study is ongoing and is investigating if wet brewer grains could be slowed by the addition of an enzyme containing inoculants. Characteristics measured over time include proximate nutrient analyses, mold, clostridia and yeast counts. Reducing deterioration of wet brewers grains will provide more farmers with the opportunity to feed this material to their dairy cattle.

#### b. Short Impact/Accomplishment Statement

Lactoferrin may enhance IgG uptake in the neonatal calf and thus increase intestinal development resulting in more efficient nutrient use and healthier calves. Enhancing the uptake of IgG should improve the health of the calf and reduce medical costs for the dairy producer. The use of wet brewers grains as a feed is limited to farmers who can feed the material at a fast rate so as not to incur spoilage. Reducing spoilage should provide farmers with the opportunity to feed this material.

#### c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$23,683

State- 35,743

Total – 59,426

Full-time equivalents: Sci. 0.3; Prof. 0.3; Total 0.6

d. Scope of impact: Multistate; Integrated Research and Extension (AZ, CA-Davis, FL, GA, IN, IA, KS, LA, MD, MI, MN, NE, NH, NM, NYC, OH, PA, SD, TX, UT, VT, VA Tech, WI)

### 4. Enhancing Efficiency with Equine Semen

#### a. Brief description of the activity

The impact of prepackaging extended equine semen in straws at room temperature prior to cooling to 5C is being evaluated. Two approaches have been identified that result in cooling rates for pre-packaged semen that are sealed and placed on a freezing rack prior to transfer to the vapor above liquid nitrogen for freezing. One method involves placing straws in a 500 ml Fleaker that is then placed in a refrigerator for cooling. After 2 hrs, the straws are removed, dried and placed on freezing racks for transfer to liquid nitrogen vapor for freezing. A second method tested was to put the diluted semen into the straws and place directly on the freezing

rack for cooling to 5C. To date, semen from several stallions has been diluted in the three different freezing externs using the two different cooling methods. The quality of semen processed by each of these different methods will be assessed via post-thaw motility and flow cytometry.

b. Short Impact/Accomplishment Statement

Procedures that allow semen to be packaged in plastic straws for freezing prior to rather than after cooling will be more convenient for breeders who do not have on-farm access to a walk-in refrigerator. The ability to package extended stallion semen in straws prior to cooling will also enhance the ability to control semen temperature prior to freezing.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$21,749  
State- 62,674  
Total – 84,423  
Full-time equivalents: Sci. 0.3; Total 0.3

d. Scope of impact: State Specific

5. Lobster habitats and survival

a. Brief description of the activity

The primary goal of this project is to use a combination of telemetry techniques to track individual American lobsters moving freely in their natural habitat. In particular, this project aims to determine if the home range of a lobster is related to its size or sex, and whether the size of a lobster home range varies depending on the habitat. In 2006, a total of 25 lobsters were equipped with both ultrasonic transmitters and HOBO tidbit dataloggers to also measure water temperature in the vicinity of each lobster. Compared to the previous years of study, the lobsters showed strong affinities for shelters, will eave and return to the same shelter on a daily basis, and when disturbed they move offshore. As the water temperature decreased in the fall, the majority of lobsters moved more than 4 km offshore and those that remained inshore tended to stay in the same shelter and occupy small home ranges. The data to date demonstrate that when lobsters are disturbed they tend to move toward deep water using wave surge as their primary cue.

b. Short Impact/Accomplishment Statement

This study will provide valuable data that can assist biologists, managers and members of the fish industry in a better understanding of the ecology and behavior of lobsters in New England waters. These studies on homing and orientation may shed light on how other aquatic species, in addition to lobsters, navigate underwater. In addition, many of the tools and techniques developed in this study are being tested and/or used by other marine scientists.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$42,076

State- 102,513

Total – 144,589

Full-time equivalents: Sci. 0.6; Prof. 0.2; Total 0.8

d. Scope of impact: State Specific

6. Oyster and Mussel habitats

a. Brief description of the activity

Populations of molluscan shellfish such as the eastern lobster have been in long-term decline for decades in many areas, and restoration programs are underway in most coast states. This project assessed experimental reefs to increase the production and restoration of oysters and mussels and by determining the best kinds of materials to use for construction of new reefs. From these studies, it was shown that alternative substrates such as crushed concrete can be effectively used for settlement of oyster larvae and construction of reefs. Sampling of previously constructed reefs showed that reef development can potentially be enhanced by placement of multiple small reefs in an area instead of a single larger structure.

b. Short Impact/Accomplishment Statement

This project is designed to provide information useful to the State of New Hampshire in meeting its goal of restoring 8 hectares of oyster reef bottom by the year 2010. In addition to impacts at the state level, the results of this research have been and will be reported at national and international conferences. Full-scale reef restoration projects totaling about 1.4 hectares that occurred in 2005 and 2006 were based in part on information gained from these experimental scale reef studies.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$9,894

State-

Total – 9,894

Full-time equivalents: Prof. 0.0; Total 0.0

d. Scope of impact: State Specific

**Key Theme - Animal Health**

1. Genetic bases for resistance to avian diseases

a. Brief description of the activity

Ongoing research focuses on the immunogenetics of retroviral and oncogene tumor regression. Major histocompatibility *B* complex (MHC) genes, which govern immune responses, control tumor outcome, either regression or progression. A new MHC recombinant designated R13 was found in the tenth backcross generation for R1 and tested for antibody production this past year. B17B16 represents the genetic base that contains a single unique MHC recombinant. A single R13B17 male mated to five R13B17 females to produce an experimental progeny segregated into three different groups based on three distinctive genotypes. Each progeny were injected with RBC to induce a primary antibody



response. The same birds received another injection at 11 weeks of age to stimulate a secondary antibody response. The results from these studies indicate a complementary effect between R13 and B17 in the secondary antibody response.

b. Short Impact/Accomplishment Statement

Poultry health will be improved by greater understanding of the genes that affect avian immunity. Improved health of poultry represents a substantial economic benefit to poultry breeders and producers.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$39,448  
State- 113,655  
Program Income - 272  
Total – 153,375

Full-time equivalents: Sci. 0.3; Prof. 1.1; Total 1.4

d. Scope of impact: Multistate Research (AL, AR, CA-Davis, DE, IA, MS, NH, NY-Ithaca, NC, SC, TX).

2. Causes of soft shell clam decline

a. Brief description of the activity

Normal and leukemic hemocytes from the soft-shell clam, *Mya arenaria*, were used to investigate wild type clam p53 and clam mortalin proteins before and after treatment with MKT-077 (cationic inhibitor of mortalin) using immunocytochemistry, co-immunoprecipitation and sub-cellular localization. Using co-immunoprecipitation, clam p53 and clam mortalin were bound together in the cytoplasm of leukemic but not in normal hemocytes—these results were published in 2006 (Walker et al., 2006). During this past year, experiments were designed to examine the two versions of mortalin that are overexpressed in leukemic clam hemocytes. These studies are addressing the hypothesis that one of the variants that leads to overexpression is involved in tethering p53 in the cytoplasm and immortalizing leukemic clam hemocytes, since ATP binding and hydrolysis are essential for releasing p53 from the mortalin/p53 complex in mammals.

b. Short Impact/Accomplishment Statement

The EPA has come under increased scrutiny for the use of vertebrates, particularly mammalian, models in bioassessment of environmental hazards. There is increased pressure from the EPA to develop models and protocols for evaluating potential hazardous compounds found or released into the aquatic environment and from NOAA for better indicators of environmental conditions. If these studies are successful in demonstrating a link between the environment and clam leukemia, the potential of using *Mya arenaria* leukemia model as a sentinel species for ecotoxicological studies and as an environmental indicator is high.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$26,274  
State- 56,333  
Total – 82,607  
Full-time equivalents: Sci. 0.3; Total 0.3

d. Scope of impact: State Specific

### 3. Role of Normal Microbiota to Animal Health

#### a. Brief description of the activity

In the first year of this project, significant progress has been made towards the goals of understanding how the GacA global regulator of the symbiont *Vibrio fischeri* coordinates colonization of its animal host. The overall picture from DNA microarray analysis indicate that GacA plays an important role in central metabolism. These data indicate that the ancient role of GacA is in redox balance and cell energy. Investigations are also underway in determining the role of Fur and iron acquisition in symbiosis and resistance to oxidative stress, as oxidation is an important host defense that is triggered by both pathogens and symbionts. In additional studies, it has been determined that GacA is necessary for normal host tissue responses including apoptosis and appendage regression. The mechanism for these effects is under investigation. Most importantly, this work demonstrates that these host-tissue changes limit subsequent bacterial colonization.

#### b. Short Impact/Accomplishment Statement

A limitation of optimizing animal health and combating disease is the lack of information about the role of normal microbiota to animal health. These studies are instrumental in demonstrating how beneficial microbes overcome host barriers to establish mutualistic infections. They also serve as useful models for infection, as this symbiosis is completely natural. The future use from the data from these studies may assist in developing strategies not only for combating infections, but also for enhancing beneficial microbes or applying probiotics to agriculture.

#### c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal – \$14,302  
State- 7,871  
Total – 22,173  
Full-time equivalents: Sci. 0; Prof. 0.4.; Total 0.4

d. Scope of impact: State Specific

## **Key Theme - Plant Production Efficiency**

### 1. Development of Components for Greenhouse Production System

#### a. Brief description of the activity

Multiple experiments were run at UNH and at commercial greenhouse sites in NH, NJ, CO and MI. A protocol was developed to measure leaching, and leaching and fertilizer use were

subsequently measured during commercial propagation. Greenhouses varied considerably in leaching rate and therefore in nutrient and water use efficiency. Post-harvest experiments investigated botrytis, ethylene, and temperature effects on storage of unrooted and rooted cuttings. 1-MCP was found to be highly effective at desensitizing lantana, begonia, and portulaca cuttings to ethylene exposure. The Ornamental Breeding Program at UNH released five new cultivars in 2006; Nolana Loma Blanca, and the Browallia Endless series, with cultivars Illumination, Celebration, Flirtation and Celebration. These will all be marketed as Proven Selections by Proven Winners. Trials comparing fungicide efficacy for control of Botrytis during shipping determined Decree and Spectro to be most effective.

b. Short Impact/Accomplishment Statement

Eight large commercial greenhouses received in-depth training in reduced leaching. Grower education workshops were presented to approximately 400 individuals in several states. Five new cultivars were provided to the horticulture industry. Research results were published in both scientific and industry publications.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$113,780  
State – 42,538  
Program Income – 12,831  
Total – 169,149  
Full-time equivalents: Sci. 0.5; Prof. 0.8, Total 1.3

d. Scope of impact: Multistate; Integrated Research and Extension (AK, AZ, CTH, GA, KY, ME, NE, NH, NJ, NY-Ithaca, OH, PA, TX)

2. Genetics and breeding of Cucurbita

a. Brief description of the activity

High dry matter, mostly in the form of starch and sugars, largely defines acceptable eating quality in squash. Whereas, peak biomass in mesocarp tissue is reached by 30 to 35 days in the three major species of squash, the time-course for conversion of starch to sugar varies considerably. We have demonstrated in Cucurbita pepo that soluble solids levels (a reliable estimate of sugar content) of mesocarp tissue increases during fruit maturation from 5 to 7% at 25 days after pollination (DAP) to 11 to 15% at fruit maturity (50 to 60 DAP). Soluble solids levels equal or greater than 11% are considered acceptable for good eating quality. In the fall of 2006, dry matter and soluble solids levels were compared in three major cultivated species of squash: C. pepo, C. maxima, and C. moschata. In C. pepo, all breeding lines and hybrids exhibited sufficient soluble solids contents at harvest; whereas, most breeding lines and cultivars at C. maxima and C. moschata had less than 11% soluble solids at harvest. Cultigens of C. maxima and C. moschata have been identified in which acceptable soluble solids are reached within two weeks after harvest. Utilizing this germplasm, it should be possible to breed new cultivars having fruit that reach acceptable eating quality by or shortly.

b. Short Impact/Accomplishment Statement

Most fresh market squash is usually no longer stored for long periods of time prior to being distributed to supermarkets. Squash is either direct retail-marketed or is stored only for a short period following harvest and transit before it is purchased by the consumer at supermarkets. Research aimed at defining when fruits from different species and varieties of squash reach an acceptable degree of maturation for good eating quality, can assist growers and distributors of squash in making proper decisions regarding the harvesting and post-harvest handling of squash.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$19,446  
State- 44,475  
Total – 63,921  
Full-time equivalents: Sci. 0.3; Total 0.3

d. Scope of impact: Integrated Research and Extension; State Specific

3. Conservation of plant genetic resources

a. Breeding work continues with the three major species of squash and pumpkin with the genus *Cucurbita*-pepo, maxima and moschata—with the objectives of developing new germplasm with better disease resistance, better eating quality and adaptation to northern latitudes. Earlier and more compact cultivars of spoon and egg gourd, Koshare and Goblin, were released last year and are now carried by several seed companies. Progress continues to be made in expanding the variation in colors and patterns in these two types of gourds and attaining better early crown set in spoon gourds. In *C. pepo*, two new compact cultivars with powdery mildew tolerance (PMT) have been released and seed of one of the two F1 hybrids, Sugar Dumpling, is currently being sold commercially. Three of the new F1 hybrids carry tolerance to powdery mildew, and three of the hybrids have a semi-bush growth habit adapted to high density planting and rapid leaf canopy development. In melon, seven new F1 hybrids released last year are now being carried in several seed catalogs, and in cooperative breeding efforts with two seed companies, two new cultivars adapted to the northeast, Rockstar and Wrangler, are being sold commercially.

b. Short Impact/Accomplishment Statement

New cultivars of acorn and Sweet-Dumpling-type squash developed at UNH provide growers in northern latitudes with varieties having good tolerance to powdery mildew, the most prevalent disease on cucurbits in the northeast, and with better eating quality than that of most commercial cultivars. Adoption of these varieties by growers will reduce pesticide inputs, and because of improved eating quality, should increase consumer demand and expand the market for acorn and related types of squash.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$19,862  
State- 39,894  
Total – 59,756

Full-time equivalents: Sci 0.2; Total 0.2

d. Scope of impact: Multistate; Integrated Research and Extension (CT-New Haven, DE, MA, ME, National Germplasm Resources Laboratory, NH, NJ, NY-Geneva, NY-Ithaca, PA, RI, USDA/ARS)

4. Role of UVB effects on Plants

a. Brief description of the activity

This project tested the hypothesis that UVB levels in the chloroplast and the thylakoid response (change in surface area) to UVB was facilitated by changes in the PQ REDOX state in the chloroplast. All experimental procedures described for this project have been completed. Analysis of the data for the PQ reduced state experiments (last experimental run) will not be completed until summer of 2007. However, results of earlier experiments in which PQ was in an oxidized state support the hypothesis that the level of UVB radiation reaching the chloroplast is measured by the REDOX state of PQ.

b. Short Impact/Accomplishment Statement

These results will help broaden our overall understanding of the way light and specifically UVB alters and affects plant chloroplast structure. Since plants are highly attuned to changes in their environment and light being one of the more important environmental factors, it is important that we understand the signaling system linkage between the environmental factor and the plant cell.

c. Source of funding/total expenditures/full time equivalent

Source of funding: Hatch  
Total expenditures: Federal - \$22,756  
State- 49,606  
Total – 72,362

Full-time equivalents: Sci. 0.3; Prof. 0.1; Total 0.4

d. Scope of impact: State Specific

5. Nutrient management for woody and perennial plants

a. Brief description of the activity

Nitrogen is an effective way to enhance growth; however, it has the potential to leach into ground water. Excess phosphorus contributes to surface water degradation. The original 4-year nitrogen trial was terminated and reported in 2005. The trial area was reconfigured in 2006 into larger plots around the remaining large green ash trees. A native shrub, *Amelanchier arbutifolias*, was added to each plot to test for nitrogen response. A second nitrogen trial with a grower-cooperator is in its second year but will have to be terminated due to the infestation of the *Acer rubrum* trees with a canker disease. A trial initiated in 2004 to test for phosphorus response in newly-planted *Picea pungens* seedlings has shown no treatment differences. Likewise, a statewide trial of bare-root shrubs using paired plus and minus P treatments at each location shown no growth response to P even on low-P soils after 2 years. An ongoing experiment is testing the addition of temporary insulating pot-covers for over-wintering container stock; this is the first trial in the nation to test this system.

b. Short Impact/Accomplishment Statement

The lack of response to phosphorus supports the reduction or elimination of the use of phosphorus on landscape plants. This will eliminate the unneeded expense of P and will reduce the amount of P in the environment. The potential for over-wintering container-grown plants by modifying the production system rather than moving and covering plants for the winter could save growers in the northeast thousands of dollars.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$14,447  
State- 30,547  
Total – 44,994  
Full-time equivalents: Sci. 0.3; Total 0.3

d. Scope of impact: Integrated Research and Extension; State specific

6. Development of Nutrient Management

a. Brief description of the activity

Certain soil chemical characteristics and agricultural management practices can contribute to an increased risk of offsite nutrient movement. Thirty-five soil series that represented the major soil orders found in NH were collected from agricultural fields around NH. Several soils were chosen from this group to conduct incubation studies and runoff studies to determine what soil properties were important in predicting phosphorus (P) movement. Preliminary phosphorus leaching data indicated that NH soils do have the capacity to lose phosphorus through leaching. To evaluate the use of phosphorus in the field, several studies were conducted using compost, chemical fertilizer and crop rotation effects including cover crops. With high P and potassium (K) levels in the soil, no difference in crop yields or quality were seen when no or excess P were applied.

b. Short Impact/Accomplishment Statement

Demonstrating that soil test phosphorus levels beyond the optimum or high range have no economic return and can increase the risk of environmental issues occurring on farms has helped farmers to reduce or eliminate phosphorus from chemical fertilizer sources. The guidelines for %P saturation levels developed as part of this project have been incorporated into the UNHCE soil test recommendations to alert farmer and nutrient managers of the increased risk of phosphorus movement. Alternative management strategies are provided to these farmers and managers.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$6,595  
State- 0  
Total – 6,595  
Full-time equivalents: Total 0.0

d. Scope of impact: Integrated Research and Extension; State specific

7. Strengthening Sustainable Local Food Systems

a. Brief description of the activity

The work of NE-1012 is performed through the Office of Sustainability's Food and Society Initiative. Work has continued on the following projects 1) NH Farm to School Program, which brings NH apples and cider to over half the schools in the state and offers related curriculum and educational opportunities continued to develop as a farm-to-school model and 2) reports of progress was presented at the 3rd National Farm to School Conference, Farm-to-College and institutional purchasing was also advanced through now annual third UNH Local Harvest Dinner. The dinner featured locally grown and produced items in one of the campus dining halls and attracted over 1800 diners and included displays by local farmers and student agriculture and nutrition students. A major initiative to establish the New Hampshire Center for a Food Secure Future (NHCFS) was undertaken in the form of a year-long strategic planning process. The planning was stakeholder focused and involved five listening sessions around the state as well as a statewide caucus. The strategic plan was finalized and implementation has begun. Efforts continued on the establishment of the UNH Organic Dairy Research Farm, including collaborations with the University of Maine, the Northeast Organic Dairy Producers Alliance and private sector partners. The farm became the first organic research dairy at a land grant in the US and has begun to provide needed support to dairy farmers in the region. Professional development and networking also was advanced through participation in the annual W.K. Kellogg Foundation Food and Society meeting and the Community Food Security annual meeting. NE 1012 work also resulted in the awarding of an honorary degree to Slow Food International founder, Carlo Petrini and a curriculum development project in collaboration with Slow Food International that has taken the form of a dual major in EcoGasntronomy. The dual proposal emphasizes the integration of agriculture, food entrepreneurship and nutrition through experiential and international education and a first phase draft received institutional support.

b. Short Impact/Accomplishment Statement

NE 1012 continued to demonstrate clear, practical solutions for strengthening local food systems economically and nutritionally. In addition, NE 1012 efforts have played a key role in building a long-term research capability in the region to support dairy farmers as well as broader food system research linking agriculture, food enterprises and nutrition. NE1012 also provided leadership in these critical areas that has helped strengthen national farm-to-school, nutrition and organic dairy research efforts.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal – \$7,269  
State-  
Total – 7,269

Full-time equivalents: Sci. 0.0; Prof 0.0; Total 0.0

d. Scope of impact: Multistate; Integrated Research and Extension (CA-Davis, KS, ME, MA, MI, MN, MO, NH, NJ, NY-Ithaca, OR, PA, PR, VT, WA, WV, WI)

## **Key Theme - Plant Health**

### 1. Inhibition of photosynthesis by UV-radiation

#### 1. Inhibition of photosynthesis by UV-radiation

##### a. Brief description of the activity

The interaction of salinity stress with ultraviolet stress was studied in a model system using the marine alga *Dunaliella tertiolecta* (Chlorophyta). Cell cultures were grown in three salinities covering a 20-fold range: 0.5 M, 0.1 M and 2.0 M. The upper and lower salinities produced oxidative stress, but slowed growth by less than 30% over optimal conditions. Various enzymes and substrates were examined in different conditions. The involvement of oxidative stress at high salinity is implied by the alterations in antioxidant enzymes and substrates, and major differences were observed between cellulose acetate versus liquid uric acid filtration systems. These studies showed that the widely used cellulose acetate filtration system amplifies the damaging effects of ultraviolet radiation compared to solar- liquid uric acid filtration system.

##### b. Short Impact/Accomplishment Statement

Both oceanic and land plant photosynthesis are adversely affected by salinity. In both environments, ultraviolet radiation interacts as an additional stress factor reducing productivity world-wide. *Dunaliella* is the most salt-tolerant eukaryotic photosynthetic organism known. An improved knowledge of its anti-oxidant responses to salt-ultraviolet stress can be significant in improving our understanding of all plant productivity. A highly effective ultraviolet exposure system was developed from this project and may have wide use in analyzing the effects of ultraviolet exposure in plants.

##### c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$6,401

State- 13,000

Total – 19,401

Full-time equivalents: Prof. 0.2; Total 0.2

##### d. Scope of impact: State Specific

## **Key Theme - Plant Genomics**

### 1. Molecular biology of seed coat development in pumpkin

#### a. Brief description of the activity

Although the technology of artificial seeds has made significant advances, there is still little known about the development of seed coat. A comparative study of molecular changes during development of seed coats was undertaken in wild type and a recessive hull-less mutant of pumpkin (*Cucurbita pepo* L.) with the goal of identifying key genes involved in secondary cell wall development in the testa. The expression patterns of several genes were determined by semi-quantitative PCR. The results showed differences in the level of expression of several genes between the two genotypes during the period of testa development, including a higher expression of genes involved in cellulose and lignin



biosynthesis in the wild type testa as compared to the mutant. Additional studies included a comparative analysis of cellular contents of free polyamines in different tissues of developing fruit and seed of the two genotypes (normal and hull-less seed mutant of pumpkin) were undertaken. All three polyamines declined in the testa upon maturity. The hull-less testa had higher levels of all three polyamines compared to the normal testa. The embryo, which had the highest polyamine levels of all tissues, showed a greater increase in putrescine with time in the normal seed as compared to the mutant seed.

b. Short Impact/Accomplishment Statement

An understanding of the molecular events during seed coat development will aid in the experimental modification of the hard seed coat of commercially useful plants (e.g. pumpkin, watermelon and cantaloupe), and lead to the development of genetically improved plants for enhanced nutrition and agronomic characteristics. Information about cell wall biochemistry will also aid in experimental modification of the secondary cell wall in seeds to increase their storage characteristics and their resistance to infection.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$22,078  
State- 36,451  
Total – 58,529

Full-time equivalents: Sci 0.1; Prof. 0.3; Total 0.4

d. Scope of impact: State specific

2. Characterization of Arabidopsis genes under varying environmental conditions

a. Brief description of the activity

Current research is focusing on the genes encoding the five catalytic subunits of protein phosphatase 2A in Arabidopsis. Eleven different homozygous T-DNA insertion lines have been identified. To date, RT-PCR has shown that there are three lines in which no transcript can be detected. These lines have been crossed to create double mutants. Both single and double mutants have been subjected to an array of phenotype analyses including growth under normal conditions and growth in the presence of various media supplements such as salts and sugars. Mutant lines have also been grown in the presence of plant growth regulators and inhibitors of these regulators. While these studies are still in the preliminary stages, a strong and consistent phenotype has been identified in the double-mutant plants.

b. Short Impact/Accomplishment Statement

Protein phosphatase 2A is known to regulate plant responses to three plant hormones, each of which is critical for normal plant growth and development. Since protein phosphatase 2A is a multi-subunit enzyme and hormone response defects have been observed with A subunit mutants, analysis of the C subunit is likely to reveal additional roles for these enzymes. The long-term outcome of this research will be a more detailed understanding of the mechanisms by which plant cells sense and respond to their environment.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$28,066  
State- 37,543  
Total – 65,609  
Full-time equivalents: Sci. 0.2; Prof. 0.3; Total 0.5

d. Scope of impact: State Specific

4. Genomic tools for Horticultural Crops

a. Brief description of the activity

Several genomic tools were initiated and/or developed as a basis for connecting specific genes to specific traits in the strawberry. The following are examples of some of the ongoing research. Based on fosmid sequence data, a suite of gene pair markers is being developed and tested for implementation in strawberry, and for transfer to other Rosaceae species. An initially developed gene pair locus based on the tandemly duplicated chalcone synthase gene can be amplified in strawberry, cherry, peach, rose and Rubus, but was problematic in apple. A second gene pair locus has been amplified in strawberry, cherry, rose and Rubus, but not apple. An investigation has been initiated on the genetic basis for variation in the cyanidin content of strawberry fruit and a candidate flavonoid hydroxylase gene has been cloned. The preliminary investigations showed that the content of the potentially healthful antioxidant cyanidin averaged 48 ug/g in the fruit of eleven sampled strawberry cultivars, but averaged 180 ug/gm in 20 accessions of the USDA Supercore collection of wild, octoploid strawberry species, pointing to the potential to introgress the genetic determinants of high cyanidin content from these wild species into the cultivated type.

b. Short Impact/Accomplishment Statement

The strawberry genomic resources that have been generated provide a basis for developing gene-based molecular markers for use in the economically important Rosaceae family, and for implementation as tools for marker assisted selection (MAS). If successfully implemented in strawberry, the robust and highly transferable gene pair markers we are developing could be similarly employed as an aid to breeding for desired traits such as fruit quality, flowering habit, and disease resistance in other rosaceous species. Anthocyanins confer fruit and flower color in the Rosaceae family and are also considered important antioxidants. Identification of the genetic determinants of high cyanidin content will facilitate development of gene-based molecular markers that could aid in the introgression of high cyanidin genetic determinants from wild octoploid strawberries.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$26,202  
State- 76,762  
Total – 102,964  
Full-time equivalents: Sci. 0.4; Prof 0.4; Total 0.8

d. Scope of impact: State specific

## Key Theme - Aquaculture

### 1. Genetic improvement of tilapia for aquaculture

#### a. Brief description of the activity

Public EST sequences of cichlid fishes have been blasted against the *Tetrodon* genome assembly. They are displayed as an annotation track in the GBrowse software at <http://hcg.unh.edu/gbrowse/> Other comparative genome browsers that have been developed are available at <http://hcg.unh.edu/comp/> These tools have facilitated the work in positional cloning of genes controlling red color and sex determination in tilapia. This project provided key critical preliminary data that resulted in a funded USDA-NRICGP grant. In another project, the tools to construct a next generation microarray for tilapia are being built. A new normalization technique that relies on Kamchatka crab duplex-specific nuclease is being used. cDNA libraries have been constructed for brain, kidney and gill. Normalized libraries have been constructed for brain and kidney.

#### b. Short Impact/Accomplishment Statement

The software developed in the genome project has organized existing DNA sequences into a form more useful to researchers. It provides rapid access to sequence data for particular regions of the genome that are of interest because they control economically important traits such as skin color and sex determination. We are using the genomic resources we have developed for tilapia to identify the genetic basis for several commercially important traits in tilapia, including sex, skin color and salinity tolerance. These discoveries have immediate applications for breeding improved strains of tilapia for commercial aquaculture. The development of genetic and physical maps is expected to lead to complete sequencing of the tilapia genome as a model fish species.

#### c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$35,564

State- 56,518

1 Total – 92,082

Full-time equivalents: Sci. 0.2, Prof. 0.1; Total 0.3

#### d. Scope of impact:

##### 1. State specific

2. Multistate Reseach (AL, AR, Beltsville Area, CA-Davis, DE, HI, IN, IA, KY, LA, MD, MI, MN, MS, NE, NV, NH, NJ, NM, NY-Ithaca, North Atlantic Area, NC, Ani. Health Trust - UK, City of Hope National Medical Center, Equine Research Institute, Fort Valley State Univ., INRA, Medical Univ. of SC, MI, National Marine Fisheries Service, Shelterwood Lab., Stormont Lab. Inc., Tufts, Univ. British Columbia Univ. Cincinnati Med Ctr., SC, OK, RI, SC - Clemson, TX, USDA-ARS, USDA-ARS Avian Disease & Oncology Lab, USDA-ARS MS, USDA-ARS OR, UT, WA WI)

### 2. Increased efficiency of producing sea urchins

#### a. Brief description of the activity

Declining wild harvests of green sea urchins in the Gulf of Maine will require hatchery

systems for both stock enhancement and aquaculture. The focus for this past year has been on maintaining a cohort of urchins that were produced in April 2005. Growth variation remains a problem for grow out of juveniles, but a number of individuals had grown to 26 mm in diameter by Dec 2005, which is a size where animals have viable gonads. By Sept 2006, members of this cohort had reached commercial size of 52 mm. This cohort will be used as brood stock for spawning studies to begin in March 2007. Collaboration on sea urchin hatchery development in Maine has been initiated through the University of Maine's Center for Cooperative Aquaculture Research in Franklin, Maine. Recruitment studies were conducted at a series of sites from NH to northern Maine and preliminary results indicate that settlement densities are similar to results from the last eight years when settlement appears to have stabilized after a sharp decline through the early 1990's. A major effort during this past year was on the planning and hosting of the 12<sup>th</sup> International Echinoderm Conference that was held at the University of New Hampshire in August, 2006. The information presented and shared during the conference will facilitate progress in the development of a sustainable sea urchin aquaculture industry in the Gulf of Maine.

b. Short Impact/Accomplishment Statement

Growth studies during the past year verify that sea urchins can be cultured to commercial size within a two-year period. Collaborations with researchers in Maine are leading to the development of at least one additional hatchery to support aquaculture in the Gulf of Maine Region. The hosting of the 12<sup>th</sup> International Echinoderm Conference at the University of New Hampshire brought together researchers, fishermen and members of the aquaculture industry to raise awareness of the potential for sea urchin aquaculture in the region and led to new collaborations between interested parties in the region and nationally.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$21,865  
State- 38,255  
Total – 60,120

Full-time equivalents: Sci. 0.3; Prof. 0.1; Total 0.4

d. Scope of impact:

3. Taxonomy and Phylogeography of the seaweed *Porphyra*

a. Brief description of the activity

Nori, the Japanese name for the red alga *Porphyra*, is the most valuable maricultured seaweed in the world with annual production US \$1.2 billion. Approximately 150 species of *Porphyra* are known worldwide with a few dozen species occurring in New England. The taxonomy of *Porphyra* has historically been problematic. The current project is aimed at correctly identifying and accurately circumscribing native and introduced species in New England. To date, morphological and cytological assessments of examined specimens have included blade shape, size and color, blade thickness, number of cell layers, cell size and shape, number of chloroplasts, presence or absence of marginal denticulation, the arrangement of reproductive areas of the thallus, and the division sequence of reproductive cells. Ecological data has been collected. From the ongoing studies and a previous Hatch project, there are six taxa of *Porphyra* in New England. One is an introduced Asian species. Another was previously

reported only to be from North Carolina. There are three additional species that will require further examination.

b. Short Impact/Accomplishment Statement

The project will clarify the putative *Porphyra* species that are present in New England by identification by morphological, ecological and molecular techniques. It will document introduced non-native and potentially invasive species.

c. Source of funding/total expenditures/full time

Source of funding: Hatch  
Total expenditures: Federal - \$18,474  
State- 60,261  
Total – 78,735

Full-time equivalents: Sci. 0.3; Prof 0.3; Total 0.6

d. Scope of impact: State specific

4. Marine finfish aquaculture

a. Brief description of the activity

The purpose of this study is to develop methodology for domestication and hatchery production of Atlantic cod in coastal New Hampshire waters. During this past year, wild Atlantic cod broodstock from Massachusetts Bay were captured by otter trawl during their spawning aggregation and transported to Great Bay Aquaculture where the ovulation experiments were conducted. Male and female cod were treated by implantation of control or a gonadotropin-releasing hormone (GnRH) analog to test for spermiation and ovulation, respectively. The mean viable fraction of the ovulated eggs from the GnRH-treated fish was significantly greater than that produced by the control fish. Similarly, fertilization and hatching success were significantly greater in the GnRH treated fish compared to controls. Preliminary data suggest that a GnRH analog is a useful tool for synchronizing ovulation in female Atlantic cod but was ineffective in stimulating spermiation in male cod.

b. Short Impact/Accomplishment Statement

This research is the first to control reproduction in Atlantic cod, an ingenious fish with enormous aquaculture potential in the Northeast. If as shown in future studies, that hormonal treatment can significantly increase the number and quality of larvae produced, this will be a critical step for future cod production.

c. Source of funding/total expenditures/full time

Source of funding: Hatch  
Total expenditures: Federal - \$21,351  
State- 42,587  
Total – 63,938

Full-time equivalents: Sci. 0.2; Total 0.2

d. Scope of impact:

## Key Theme - Other

### 1. Character and control of yeast regulatory interactions genes

#### a. Brief description of the activity.

There are two projects. The first project is investigating the functional and physical interactions of yeast regulatory genes to identify the factors that control gene expression. This past year, analysis of the poly A binding protein (PAB1) in the control of mRNA degradation has continued. The proline-rich region and RRM1 domain of PAB1 was identified as necessary for CCR4 deadenylation. Defects in these two regions inhibited the formation of a novel, circular monomeric PAB1 species that forms in the absence of poly A. These results support the model that the control of CCR4 deadenylation in vivo occurs in part through the removal of PAB1 from the poly A tail following its self-association into multimers and/or a circular species. In the second project the major novel significant result is the finding that Toll-like receptors (TLRs) play may recognize and respond to non-lipid compounds via the leucine-rich repeat (LRR) recognition domain.

#### b. Short Impact/Accomplishment Statement

The results are important to understanding how gene expression is controlled, especially in terms of the mRNA degradative process. The action of poly A binding protein has been clarified in its interaction with the CCR4-NOT group of proteins; all are important regulators of protein expression in plant and animal organisms. These studies may have broad implications in understanding how protein expression can be controlled in medically and agriculturally important organisms. In the second project, the significant result was the finding that TLR2 may recognize and respond to non-lipid compounds via the LRR recognition domain. This study also expanded the repertoire of biologically relevant ligands for TLR2 and revealed that the conserved motif identified in the preliminary study is neither required nor sufficient for activation of TLR2 via the LRR domain.

#### c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$42,284  
State- 104,128  
Total – 146,412  
Full-time equivalents: Sci. 0.5; Prof. 0.6, Total 01.1

#### d. Scope of impact: State specific

### 2. Role of charge in protein functional properties

#### a. Brief description of the activity

The electrostatic charge on purified B-LgA and B-LgB has been determined by membrane confined electrophoresis at pH 3 and pH 7. These two variants only differ by two amino acids, yet they exhibit very different functional properties upon gelation. It is hypothesized that the differences in functional properties are a consequence of these substitutions, with the substitution of the acidic asp residue with the uncharged gly residue at position 64 being important. The charge at pH 7 differs for the variants, with A having a lower charge than B. Again, these results are consistent with the pI differences.

Current research is focused on refining the relationship between charge and association state.

b. Short Impact/Accomplishment Statement

The difference in charge on B-LgA and B-LgB is consistent with their differences in pI. It is quite likely, therefore, that the differences in gel formation—where the dissociation of dimmers to monomers for B-LgB results in a clear, runny gel—is a consequence of the increased charge-charge repulsion between the monomers. These results show that knowing protein charge provides useful insights into protein functional properties, and will lead to protein additives with improved functional properties.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$38,343

State- 55,158

Total – 91,501

Full-time equivalents: Sci. 0.3; Prof 0. 3; Total 0.6

d. Scope of Impact: State specific

**Program Duration**

The research projects that contribute to this goal are generally of three to five years duration. All projects are targeted for mid and long term problems.

In 2005-2006 the New Hampshire Agricultural Experiment Station had 7.1 full time equivalents of scientists time assigned to Goal 1. Their research was funded with federal funds from the Hatch, McIntire-Stennis, and Multi-State Research Programs. There were 0.0 full-time equivalents of technical and clerical staff attached to these projects. Professional help, in the form of graduate students doing research on these projects, amounted to 7.3 students. For this goal, as well as all subsequent goals, the State of New Hampshire provides matching funds through a line item within the University of New Hampshire's budget. It is not anticipated that any small changes in federal funding in the next five years would significantly alter the spectrum of key program components for Goal 1.

**Goal 2: A Safe and Secure Food and Fiber System**

**Issue:** Foods are in constant threat of contamination by microorganisms. The agricultural system has a responsibility to ensure that the foods produced are safe to eat.

**Overview:**

The New Hampshire AES has established output indicators for Goal 2 as follows: 1) increase research results from projects dealing with microorganisms that are potential harmful contaminants of foods and 2) increase understanding of the processes whereby harmful microbes carry out their infective and disease-causing processes. As outcome indicators, we evaluate 1) an absence or decrease of bacterial contamination of foods and 2) the level of public awareness of the contribution of pathogenic microbes to animal and human illness. We continue a philosophy that the mission of the Agricultural Experiment Station is consistent with Goal 2 and thus

provide support to basic and applied sciences that help NH to 1) reduce bacterial illness, 2) determine the role of bacterial genes in diseases, 3) provide defense mechanisms against pathogenic bacteria, and 4) assess the impact of pathogenic bacteria on humans, animals and the environment. We also support programs to enhance public awareness of food safety issues. The NH AES also supported the following basic and applied projects within Goal 2 to create technology and research for the benefit of the state, region and nation. We believe these projects provided excellent results and value from the investment of AES funds and have positioned the NH AES well to successfully achieve the goals of its five year POW plan.

## **Key Theme - Food Safety**

### **1. Host defenses against Salmonella**

#### **a. Brief description of the activity**

Food borne disease in humans due to Salmonella continues to be a major health concern. Studies during this past year focused on the role of Salmonella on apoptosis in neutrophils by determining whether Salmonella grown aerobically or anaerobically had different effects on the rate of apoptosis in neutrophils. Anaerobically grown bacteria delayed the onset of apoptosis in activated neutrophils to a significantly greater extent than did the same bacterial strain grown aerobically. Caspases are key mediators of apoptosis. The levels of three caspases in activated neutrophils were determined using an enzyme-linked assay. Caspase-3 and -9, but not caspase-8 activity increased significantly during the time course of these studies. Based on these studies, it is concluded that Salmonella modulates the rate of apoptosis in neutrophils, but only once these host cells have become activated, either chemically or physiologically.

#### **b. Short Impact/Accomplishment Statement**

Salmonella are highly successful pathogens of both animals and humans. White blood cells, known as neutrophils, are the first host defense cells that interact with these bacteria in the intestine. Understanding how these neutrophils respond to encounters with Salmonella can help in developing intervention strategies for disease prevention due to these foodborne pathogens.

#### **c. Source of funding/total expenditures/full time equivalents**

Source of funding: Hatch  
Total expenditures: Federal - \$22,580  
State- 69,165  
Total – 91,745  
Full-time equivalents: Sci. 0.3; Total 0.3

#### **d. Scope of Impact: State specific**

### **3. Microcystins in New Hampshire lakes**

#### **a. Brief description of the activity**

Cyanotoxins are now generally regarded as a potential health threat in lakes that develop blooms of cyanobacteria. One objective of this project is to determine the toxicity of cyanoplankton (Pcy) in lakes of different trophy and evaluate their importance in



transferring microcystins into the next trophic levels. Using chlorophyll a fluorescence and ELISA methods indicate that the Pcy component of the phytoplankton may contribute significant quantities of microcystins in certain lakes. Experiments were initiated to measure the selectivity of filter feeding of the freshwater mussel *Elliptio complanata* on toxigenic *Microcystis* and green algae. Clearance rates of *E. complanata* did not differ significantly between the two foods, suggesting these freshwater mussels readily ingest the toxin-producing cyanobacteria. In the fall of 2006, a new developed in situ fluorometer was tested to detect cyanobacteria and the contribution of Pcy in lakewater. Laboratory results indicate considerable accuracy in estimating the concentration of *Microcystis* in mixed suspensions of cyanobacteria and green algae, both in well water lacking other plankton as well as in natural lake water. The results of this research will be applied to lake management and source water management and protection interests. The outreach component of the project includes the lake monitors providing samples to the Lakes Lay Monitoring Program. The investigators also provide technology transfer to lake associate members and regularly interact with biologists and water managers through the NH Dept of Environmental Services and the NH Lakes Association on matters of water quality, cyanobacteria toxins and public health matters.

b. Short Impact/Accomplishment Statement

Microcystins are a group of cyanobacteria toxins that have become a serious water quality problem worldwide. The present study is examining the sources of the microcystin production and pathways of their movement in the lake food web. The results of this research will be of use by lake managers and water suppliers and lead to a better understanding of the ecology of cyanotoxins and methods for control of toxic cyanobacteria blooms.

c. Source of funding/total expenditures/full time equivalents

Source of funding:	Hatch
Total expenditures:	Federal - \$34,387
	State- 56,299
	Total – 91,136
Full-time equivalents:	Sci. 0.3; Prof. 0.2; Total 0.5

d. Scope of Impact: State Specific

**Program Duration**

All projects under this goal are for a three to five year period. All projects are targeted for mid and long term problems.

In 2005-2006 the New Hampshire Agricultural Experiment Station had 0.6 full time equivalents of scientists time assigned to Goal 2. Their research was funded with federal funds from the Hatch Program. There were 0 full-time equivalents of technical staff attached to these projects. Professional help in the form of graduate students doing research on these projects amounts to 0.2 students. For this goal, there are matching funds from the State of New Hampshire through a line item within the University of New Hampshire's budget. It is not anticipated that any small changes in federal funding in the next five years would significantly alter the spectrum of key program components for Goal 2.

### **Goal 3: A Healthy, Well-Nourished Population**

**Issue:** The reasons people eat particular foods are complex and the foods that are included in a diet have short-term and long-term health consequences. Knowledge of food-consumption patterns and the results of those choices are needed.

#### **Overview:**

The New Hampshire AES has established as output indicators for Goal 3, 1) increased research results from projects dealing with why particular foods that make up a diet are chosen and 2) increased research results detailing the short and long term consequences of food consumption patterns on health issues.

We will evaluate as outcome indicators if our efforts within this goal are contributing to 1) healthier food choices resulting in a better balanced diet for consumers and 2) fewer incidences of disease or disorders directly related to improper diet choices.

We continue a philosophy that the mission of the Agricultural Experiment Station is consistent with Goal 3 and thus provide support to basic and applied sciences that help posture NH to 1) understand and control the metabolism and oxidation in adipose tissue, 2) assess the nutritional risk in the elderly, 3) understand relationships of diseases and gender or age, and 4) assess the functional properties of food protein. Each of these areas contributes to developing and assuring a healthy and well-nourished population. The NH Agricultural Experiment Station supports the following basic and applied projects within Goal 3 to create technology and research for the benefit of the state, region and nation. We believe these projects provided excellent results and value from the investment of AES funds and have positioned the NH AES well to successfully achieve the goals of its five year POW plan.

#### **Key Theme - Human Health**

##### **1. Environmental Pollutants in Human Breast Milk**

###### **a. Brief description of the activity**

Four goals were accomplished during this past year including 1) educating prospective subject by developing an educational pamphlet; 2) recruiting subjects and collecting breast milk samples; 3) performing a preliminary sample analysis for 12 polybrominated diphenyl ethers (PBDEs); and 4) exploring the endocrine-disrupting potential of PBDEs using the rat model. The educational pamphlet that was developed was called "Steps to a Healthy Future." This pamphlet informs women about the goal of this research and educates them about environmental chemicals and was distributed to offices of local pediatricians, obstetricians, and lactation consultants. For the second goal, breast milk samples were collected from forty lactating women from the Seacoast area of NH. To examine day-to-day variability, a subset of five women each provided nine breast milk samples. The forty-five, day-to-day variability samples have been analyzed for 12 PBDE congeners. The average range for the sum of PBDEs at month was 9.58 to 93.20 ng/g milk fat, at two months was 8.14 to 88.07 ng/g milk fat, and at 3 months was 9.16 to 75.30 ng/g milk fat. The dominant congener was BDE-47.

b. Short Impact/Accomplishment Statement

To date, this research shows the PBDE levels in breast milk of New Hampshire women are similar to levels reported in women's milk from other areas of the U.S. However, these levels are significantly higher than levels reported from other countries of the world. PBDEs can disrupt normal hormone balance of the body; therefore it is important and critical to further examine the biological effects of PBDEs in women.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$26,584

State- 25,577

Total – 52,161

Full-time equivalents: Sci. 0.3; Prof. 0.3; Total 0.6

d. Scope of Impact: State Specific

2. Control of adipose tissue metabolism

a. Brief description of the activity

During this past year, several objectives have been completed. Tetracycline-inducible genetic constructs have been produced that express constitutively active (caN1) and dominant (dnN1) human Notch 1 mutants. Stable preadipocytic lines have been produced that express the constitutively active Notch 1 construct after several generations. Alternative approaches are being investigated in production of a tetracycline-inducible adenoviral construct for this mutant. Phenotypic analysis of the adenovirally-transduced constructs yield novel data. It was also observed that manipulation of Notch 1 signaling does not appear to alter TNFa-induced apoptosis as measured by TUNEL staining. Manipulation of Notch 1 signaling alters some, but not all of the cellular processes associated with adipogenesis.

b. Short Impact/Accomplishment Statement

Fat cell enlargement is the hallmark feature of obesity. Obese individuals have abnormally high amounts of adipose tissue within their bodies and are at higher risk for development of complex pathological conditions including the Metabolic Syndrome/Type II Diabetes, cardiovascular disease and cancer. Given that the adipocyte is the primary cell found in adipose tissue, is sensitive to diet-induced signals (i.e. insulin, lipid) and is ultimately responsible for its fat-storing and endocrine activities, elucidation of the molecular mechanisms that regulate adipogenesis and adipose tissue function may ultimately increase our understanding of how external factors such as diet and exercise influence the development of severe obesity and the onset of obesity-related disease. In addition to these long-term contributions, it is also noteworthy to mention that reagents generated in this study such as the adenovirus-based Notch reporters have been shared with other laboratories both inside and outside of the University of New Hampshire.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$20,275

State- 32,239

Total – 52,514

Full-time equivalents: Sci. 0.2; Prof. 0.1; Total 0.3

d. Scope of Impact: State Specific

3. Molecular basis of visual function (2 Projects)

a. Brief description of the activity

Two projects are examining defects in visual function. Factors impeding progress in the isolation of physiologically competent suspensions of cone photoreceptors have been identified during the past year. Improvements in controlling the ionic composition of the cell culture medium used for preparing suspensions of photoreceptor cells has reduced osmotic swelling that causes eventual rupture of detached cone outer segments with attached ellipsoids. Cell viability assays have been developed using calcein AM (Molecular Probes). An independent approach to understanding the differences of rod and cone phototransduction has been to utilize evolutionary trace (ET) analysis. A series of searches of genome sequencing projects was done to compile a set of rod and cone photoreceptor phosphodiesterase (PDE) amino acid sequences. In some instances where only partial sequence was available, we performed direct sequencing of mRNA samples derived from retinal tissue. Rod and cone sequences from 14 vertebrate taxa spanning lamprey to humans was compiled and aligned using ClustalW. Further analysis showed that there is structural evidence for underlying functional differences in the regulatory and catalytic domains of rod and cone PDE6. The second project has developed cichlid crosses between species with different adult expression patterns and quantify opsin expression. Cichlid fishes have seven cone opsin genes that are spectrally distinct. These crosses will prove useful for mapping studies. To look for trans acting factors, a genome scan was done to try and identify genomic regions that contribute to the control of opsin expression. One region has been identified that is on tilapia LG 13. More markers will be used to more tightly locate the region.

b. Short Impact/Accomplishment Statement

The work from Project 1 will provide fundamental information for better understanding how cone photoreceptors differ from rod photoreceptors, and how to develop better treatments for retinal diseases that afflict humans and domestic and livestock animals. The expanding use of phosphodiesterase inhibitors as therapeutic agents for a variety of diseases requires that we evaluate potential adverse effects of these drugs on vision and on long-term retinal health. Opsins are the first proteins in the signaling transduction cascade which convert light into a neural output of the retinal photoreceptors. In the second project, one factor has been identified which may be important in opsin expression and so will help in development of gene therapies for retinal disease.

c. Source of funding/total expenditures/full time equivalents (for 2 projects)

Source of funding: Hatch

Total expenditures: Federal - \$35,239

State- 66,085

Total – 101,324

Full-time equivalents: Sci. 0.3; Prof 0.4; Total 0.7

d. Scope of Impact: State Specific

4. Regulation of zinc transport

a. Brief description of the activity

Zinc is an essential nutrient that needs to be present in the proper amounts to support optimal health. The cellular and molecular responses of the blood brain barrier (BBB) to zinc toxicity were investigated. An in vitro BBB model was used consisting of porcine brain capillary endothelial cells grown on a semi-permeable membrane suspended between two chambers of media, representing the blood and the brain interstitial fluid compartment. Several experiments were performed. In summary, the BBB model responded dynamically to the moderately high zinc environment. The capacity to uptake and retain zinc increased steadily throughout the 96 h period, though the amount of Zip1 in the cells remained relatively constant. Capacity for uptake and retention was four times greater at the abluminal surface of the BBB model (facing the interior of the brain) than the luminal (blood) side, presumably to enhance the BBB's ability to maintain brain zinc homeostasis.

b. Short Impact/Accomplishment Statement

The result from these studies will advance our knowledge of the molecular mechanisms that enables the brain to maintain zinc balance during periods of zinc excess. This knowledge will help doctors and research scientists interpret their clinical and experimental findings regarding the role of zinc malnutrition in neurological disorders like Alzheimer's disease and other types of dementia.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$29,192

State- 40,358

Total – 69,550

Full-time equivalents: Sci. 0.3; Prof. 0.2; Total 0.5

d. Scope of Impact: State specific

**Key theme - Human Nutrition**

1. Assessing the nutritional risk of the elderly

a. Brief description of the activity

Lutein and zeaxanthin, two carotenoids derived exclusively from the diet, accumulate in the human retina where they are collectively called macular pigment. Egg yolk is a bioavailable source of serum lutein (L) and zeaxanthin (Z). Investigations were done to determine if increased consumption of eggs would increase retinal L and Z. The concentration of carotenoid in egg yolk is modest relative to other sources, such as spinach, but the bioavailability to the retina appears to be high. Thus increasing carotenoid in egg yolk may be an effective way to increase MP. To test this hypothesis, a pilot study was undertaken feeding chickens diets supplemented with 200 to 400 ppm L supplement for one month. The results are being analyzed. Estimates of dietary carotenoids are important in determining dietary

practices associated with positive health outcomes.

b. Short Impact/Accomplishment Statement.

Cataract surgery accounts for the largest single line item expense on a medicare bill. The results from this project may directly benefit individuals at risk for aging eye diseases (macular degeneration and cataract) by prolonging the onset of symptoms of these diseases. These data suggest that dietary intake of L and Z from vegetables and/or egg yolk increase macular pigment in most individuals. Increased macular pigment and/or consumption of vegetables rich in L and Z has been associated with decreased risk of age-related eye disease.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$28,852  
State- 55,464  
Total – 84,316  
Full-time equivalents: Sci. 0.2; Total 0.2

d. Scope of Impact: Multistate Research (CT-Storrs, DC, LA, ME, MD, MA, MN, NH, PA, Purina Mills, RI, USDA/ARS)

2. Atherogenesis in normal and diabetic animals

a. Brief description of the activity

The effects of hyperglycemia was examined in relation to the inflammatory transcription factor PPAR gamma and the ATP binding cassette A1 (ABCA1) protein that is a product of PPAR gamma activation and is involved in high density lipoprotein cholesterol (HDL-C) mediated reverse cholesterol transport. Hamsters were treated with either a high fat-cholesterol diet or the high diet plus STZ induced hyperglycemia for 8 and 24 weeks. Hemoglobin A1C levels were higher in the hyperglycemic groups as were total cholesterol, plasma triglycerides, non-HDL-C and TC/HDL-C ratios. Aortic fatty streak lesions were more developed in the hyperglycemic groups at both time points and were most prominent in the 24 week hyperglycemic-hyperlipemic group. Hyperglycemia produced a more atherogenic lipid profile, greater lesion development, and increased expression of PPAR gamma and ABCA 1 than hyperlipemia alone. The potential beneficial effects of increased ABCA 1 expression were outweighed by the significantly more adverse lipid profile induced by hyperglycemia.

b. Short Impact/Accomplishment Statement

Diabetes Type II is a growing problem in developed countries and accelerated atherosclerosis is a major cause of death in these individuals. Understanding how the elevated blood glucose of diabetes affects cardiovascular disease may lead to better treatments. This study has demonstrated that although molecules involved in the beneficial reverse cholesterol transport are increased with elevated glucose, this is not sufficient to overcome the significantly elevated cholesterol and fat levels in the blood that put people at greater risk for atherosclerosis. Thus, diabetes promotes inflammation that is the basis for atherosclerosis and creates a harmful blood lipid profile even as the body is attempting to moderate the effects on blood lipid levels.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$35,293  
State- 66,314  
Total – 101,607

Full-time equivalents: Sci. 0.3; Prof. 0.4; Total 0.7

d. Scope of Impact: State Specific

3. Improving Plant Food Availability and Intake in Older Adults

a. Brief description of the activity

Four research stations are participating in the Improving Plant Food Availability and Intake in Older Adults. The protocol is designed as a one hour, structured interview to be implemented with adults 65 years of age or older who live independently and shop for and make at least one meal a day at home. The interview includes an activity to assess the cognitive processes used by older adults to determine if a sample grain food product is considered whole grain. From April through September 2006, each research station trained interviewers, recruited participants and conducted research interview with older adults. Trained interviewers included undergraduate and graduate students, Extension Educators and members of the core planning committee. As of Sept 2006, 74 research interviews were completed, 32 of which were in New Hampshire. It is anticipated that data collection will be completed by early 2007 as well as verbatim transcription of the recorded interviews.

b. Short Impact/Accomplishment Statement

Identification of food choice processes used by older adults to purchase whole grain foods will enable nutrition educators to design effective interventions for this target audience.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$3,193  
State-  
Total – 3,193

Full-time equivalents: Total: 0.0

d. Scope of Impact: Multistate Research (CT-Storrs, DC, LA, ME, MD, MA, MN, NH, PA, Purina Mills, RI, USDA/ARS)

**Program Duration**

The research projects that contribute to this goal are generally of three to five years duration. All projects are targeted for mid and long term problems.

In 2005-2006 the New Hampshire Agricultural Experiment Station had 1.6 full time equivalents of scientist's time assigned to Goal 3. Their research was funded with federal funds from the Hatch and Multi-State Research Programs. There were 0.0 full-time equivalents of technical and clerical staff attached to these projects. Professional help in the form of graduate students doing

research on these projects amounts to 1.4 students. For this goal, there are matching funds from the State of New Hampshire through a line item within the University of New Hampshire's budget. It is not anticipated that any small changes in federal funding in the next five year's would significantly alter the spectrum of key program components for Goal 3.

#### **Goal 4: An Agricultural system which Protects Natural Resources and the Environment**

**Issue:** Agriculture is a human activity and as such goes on within a larger environment. Agriculture and forestry activity can have major impacts on soil and water and land ecology and its environment because of their direct links to soil, water, air, and biological resources.

#### **Overview:**

The New Hampshire AES has established as output indicators for Goal 4, research activity that deals with the problems associated with agricultural and forestry practices as related to the environment. We will evaluate the outcome indicator of whether our efforts within this goal are contributing to an agricultural and forestry industry that is productive yet minimizes environmental impact. We continue a philosophy that the mission of the Agricultural Experiment Station is consistent with Goal 4 and thus provide support to basic and applied sciences that help posture NH to maintain a sustainable environment and forest industry.

The NH Agricultural Experiment Station supports the following basic and applied projects within Goal 4 to create technology and research for the benefit of the state, region and nation. We believe these projects provided excellent results and value from the investment of AES funds and have positioned the NH AES well to successfully achieve the goals of its five year POW plan. Each of the following projects contributes to maintaining a sustainable environment.

#### **Key Theme - Biodiversity**

##### 1. Genetic diversity of northeastern conifer species

###### a. Brief description of the activity

The chloroplast of spruce is transmitted through the pollen, and the mitochondrion is transmitted through the egg. Comparing chloroplast and mitochondrial haplotypes may be used to understand current population structure, and to infer historical patterns of population migration. Beginning in the previous 3-year segment of this project, single nucleotide polymorphisms (SNPs) were identified in chloroplast and mitochondrial genomes of red, black and white spruce, which differentiated populations and demonstrated introgression between the three species. To better understand population structure in red spruce, additional polymorphisms were sought in to additional mitochondrial genes. Twenty-four SNPs were distinguished for mh09 among four geographically remote accessions of red spruce, and fourteen polymorphisms were identified for mh27. Preliminary phylogeographic assessments were made showing that the northern-most population of red spruce (New Brunswick) is differentiated from the three more southern populations (White Mountains, Blue Ridge Mountains-Maryland and North Carolina).

###### b. Short Impact/Accomplishment Statement

As a result of periodic glaciations of the Northern Hemisphere, the geographic distribution of



red and black spruce has changed dramatically. New genetic markers were identified which distinguish northern and southern populations. Understanding the changing population structure of these forest species will help us predict how their distributions may change as a result of global warming.

c. Source of funding/total expenditures/full time equivalents

Source of funding: McIntire-Stennis

Total expenditures: Federal - \$4,821

State-

Total – 4,821

Full-time equivalents: Total 0

d. Scope of Impact: State Specific

2. Forest management and plant biodiversity

a. Brief description of the activity

A correlative survey of 63-forested plots in southeastern New Hampshire suggested that seed dispersal, landscape position, and the successional stage of the forest community influenced the presence and absence of the non-native, invasive shrub, glossy buckthorn (*Rhamnus frangula*). Glossy buckthorn was more likely to be present 1) on lower slope rather than middle or upper slope topographic positions and 2) in successional (post-agricultural) forests dominated by white pine and red oak rather than mature forests of hemlock and beech. The association of buckthorn with successional forests suggests that land use history affects invasion and that mature forests may be more resistant to invasion. Absence of glossy buckthorn was associated with certain sites, independent of soil fertility, topography, degree of canopy opening and forest community type. Density of glossy buckthorn was compared in forests that were clear-cut with less-intensively harvested stands. It was shown from these studies that recent buckthorn recruitment occurred under strong competition for light and soil resources. Collectively, the data suggest that, while opening the forest canopy speeds buckthorn population growth, buckthorn populations can invade and expand in undisturbed forest understories, albeit slowly.

b. Short Impact/Accomplishment Statement

Glossy buckthorn, an invasive shrub known to inhibit tree seedling establishment, invades and spreads within post-agricultural forests in southern New Hampshire. Opening such stands through tree harvest speeds invasion, but even undisturbed stands show increased buckthorn density over time. Modification of silvicultural regimes will probably not halt invasion. The scale and intensity of the buckthorn invasion may demand development of biological control agents.

c. Source of funding/total expenditures/full time equivalents

Source of funding: McIntire-Stennis

Total expenditures: Federal - \$41,326

State- 55,565

Total – 96,891

Full-time equivalents: Sci. 0.4; Prof 0.5; Total 0.9

d. Scope of Impact: State specific

### 3. Floristic diversity in old growth forests

#### a. Brief description of the activity

A plant biodiversity inventory and descriptive analysis of the vegetation of Timber Island, Lake Winnepesaukee, New Hampshire, was completed. An extensive reconnaissance resulted in the documentation of flora of 190 vascular plant species, none of which were listed as rare or endangered; 24 species of bryophytes were also recorded. A history of previous land use was also completed. In a broader view of the vegetation of the island can be characterized as a Hemlock-Beech-Oak-Pine Forest (per the 2004 classification of natural plant communities in New Hampshire published by the NH Natural Heritage Bureau). Abundance and frequency data from 106 plots allowed a refinement of the description of vegetation and resulted in the identification of six vegetation cover types.

#### b. Short Impact/Accomplishment Statement

This project is critical to a more comprehensive understanding of botanical diversity in forests of New Hampshire and the northeast. Floras of forests occupying islands of large lakes are poorly known and this study helps to establish baseline data. A better understanding of our forests is important in protecting ecologically significant sites.

#### c. Source of funding: McIntire-Stennis

Total expenditures: Federal - \$22,751

State- 35,935

Total – 58,686

Full-time equivalents: Sci. 0.2; Prof. 0.3; Total 0.5

#### d. Scope of Impact: State specific

### 4. Predicting range expansion in the Gulf of Maine for introduced species

#### a. Brief description of the activity

Seaweed biodiversity assessments are useful in evaluating both short and long-term changes. A comparison of long-term floristic changes (early 1900s versus present-day) within Casco Bay, Maine, showed about an 80% similarity for the Bay's biota between the early 1900's and today. Historical comparison of six other areas (Helgoland, Germany, the North Adriatic Sea, Denmark, Mount Desert, Maine southern California and the Florida Keys) were used to evaluate the stability of Casco Bay's flora and the impact of oil pollution. Rapid assessment surveys of fouling seaweed populations were recorded from 58 sites between Downeast, Maine and Staten Island during August of 2000, 2003, and 2005. In addition, a molecular and morphological survey of the *Porphyra purpurea* complex within the Northwest Atlantic has demonstrated several new taxonomic designations.

#### b. Short Impact/Accomplishment Statement

The significances of these studies are several fold: 1) the pattern and mechanisms of introductions of invasive species are being delineated, hopefully aiding with their management and control and 2) the recently funded Sea Grant studies will attempt to clarify if multiple and genetically diverse populations are colonizing the Gulf of Maine. Two other major goals of the present floristic studies are 1) to evaluate the pattern and mechanisms of introductions of invasive species that will aid in their management and control; and 2) to

utilize systematic and molecular studies in order to clarify patterns of species diversity and possible introductions.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$25,380  
State- 71,050  
Total – 96,430

Full-time equivalents: Sci. 0.4; Total 0.4

d. Scope of impact: State Specific

5. Biodiversity of aquatic plants

a. Brief description of the activity

Biodiversity in New England versus tropics is considerably underestimated. During this past year, field and herbarium studies were focused on the tropical aquatic flora of Costa Rica., especially relating to the preparation of taxonomic treatments of the aquatic families. The treatments included descriptions, keys for identification, habitat and distributional data. Field work was done in March to gain a detailed understanding of the distribution and morphology of the species of the Podosemaceae, which flower and fruit only when the level of water exposes the plants that grow attached to rocks in rapids. It was shown that increased pollution in several rivers has resulted in the loss of species previously known from those rivers.

b. Short Impact/Accomplishment Statement

The biodiversity studies continue to indicate that aquatic/wetland plant diversity appears to be richer in temperate regions of northeastern North America than in the neotropics. A better understanding of the biodiversity in our wetlands is needed to aid in conservation and management decisions by state and federal agencies and private organizations.

c. Source of funding/total expenditures/full time equivalent

Source of funding: Hatch  
Total expenditures: Federal - \$19,491  
State- 27,616  
Total – 47,107

Full-time equivalents: Sci 0.2; Total 0.2

d. Scope of Impact: State specific

**Key Theme - Biological Control**

1. Endocrine control of reproduction in fish

a. Brief description of the activity

The following are three of several studies that were completed on the control of GnRH in reproduction: the kinetics of the GnRH receptor; the identification of a lamprey gonadotropin; and identification of the GTH receptor (lGpH-R). A series of experiments were performed examining cAMP responses, binding kinetics, whole cell competitive binding assays, and internalization studies of the lamprey GnRH receptor using a series of three C-terminal tail truncations to better describe the functional significance of this unique

vertebrate GnRH receptor. In the second completed study, the first gonadotropin beta protein by cDNA cloning in sea lamprey was identified. Sea lamprey preGTHbeta cDNA was cloned from a plasmid cDNA library and encoded 150 amino-acids, in which the GTHbeta protein consisted of 134 amino-acid residues. The sequence comparisons and functional data provide the first evidence of a single GTH-like system in lampreys. In the third completed study, a full-length transcript encoding a functional lamprey glycoprotein hormone receptor was cloned from the testes of the sea lamprey. The current study is the first to identify a GpH-R transcript in an agnathan. The 719-amino acid full-length cDNA encoding IGpH-R I is highly similar and likely a homolog of the vertebrate glycoprotein hormone receptors.

b. Short Impact/Accomplishment Statement

The information from these studies provides insight into the function and evolution of the vertebrate reproductive ligands and their respective receptors. Gaining a further understanding of gonadotropin-releasing hormone, its analogs, its receptors, interactions with neurotransmitters and microencapsulation will be critical for development of novel strategies for improving and controlling reproduction.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$13,190  
State-  
Total – 13,190  
Full-time equivalents: Prof. 0.1; Total 0.1

d. Scope of Impact: State Specific

2. Hormonal control of beetle reproduction and rearing characteristics

a. Brief description of the activity

The overall of this research is to establish the role of juvenile hormone (JH) in reproductive physiology and behavior of burying beetles, which serve as a model species for insects, which rely on an opportunistic breeding resource. A juvenile hormone profile during a breeding cycle has been completed. Prebreeding titers of juvenile hormone of the non-parental carrion beetle, are similar to those of the parental species for both males and females. However, there are no consistent patterns of changes during breeding. In all of the biparental species, there was a significant rise in JH in both males and females within 12 hours of the discovery of a resource and no major decrease in females until larvae are three days old.

b. Short Impact/Accomplishment Statement

Through the studies of several investigators including this project, burying beetles have become a model species for the study of the roles of juvenile hormone in reproduction and behavior. Usually juvenile hormone serves as a gonadotropin and regulates cyclical bouts of egg maturation and oviposition. Beetles are an underrepresented group with regards to hormone studies and a better understanding of the role of juvenile hormone in reproductive physiology and behavior has the potential to improve pest control methods.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$20,337  
State- 44,564  
Total – 64,901

Full-time equivalents: Sci 0.3; Prof 0.1; Total 0.4

d. Scope of Impact: State specific

### 3. Microbial Pathogens and Bioremediation (2 Projects)

#### a. Brief description of the activity

The first project is examining Burkholderia. The genus Burkholderia is a functionally diverse group of Bacteria with unusually broad distribution in the natural environment. Two improved host models have been developed to measure Burkholderia cepacia complex (Bcc) (a group of ten closely-related species) virulence and potential for genetic adaptation. One model uses the nematode *Caenorhabditis elegans* grown axenically in liquid and then challenged in buffer containing a competing Bcc strain. In this assay, the bacteria and nematode are the sole food source for the other, and only one competitor survives. The second model uses the common yellow onion to evaluate infectious and growth potential of different Bcc strains. In this assay, color, odor, and tissue integrity all correlate with bacterial growth. Significant variation has been demonstrated among Bcc species and strains in their virulence in these models. The genetic determinants are now being identified. A new genetic toolkit for manipulating Bcc, has been developed using a vector that allows the insertion of genes encoding marker proteins in a single, defined site in the chromosome. From this new toolkit, several strains have been successfully marked with two different, best-of-class, engineered fluorescent proteins to discriminate the growth of different strains in the two host models. In the second project, tools are being developed to allow the genomic and proteomic analyses of *Frankia* physiology and the interactions with its host plants. A small-scale study of *Frankia* proteome was initiated to identify developmental-specific proteins. Methods were developed to improve and enhance protein extraction protocols and to allow for efficient breakage of vesicles. Several unique vesicle-specific proteins have been identified from 2D-gel protein patterns.

#### b. Short Impact/Accomplishment Statement

The need for natural and sustainable means of promoting agriculture, controlling pests, and cleaning waste products continues to build, and bacteria of the Burkholderia cepacia complex (Bcc) are promising solutions. This research seeks to identify those Bcc that are predisposed towards becoming human pathogens and those that are incapable of this transition to guide the development of safe probiotic and bioremedial agents. In the second project, the results will lead to the development of essential genetic and genomic tools for the *Frankia* bacterial system. These protocols will aid in the efforts to use actinorhizal plants to provide renewable resources for fuel and restore previously disrupted environments. An understanding of the *Frankia* genome will help further bioremediation and phytoremediation applications with this system, especially on heavy-metal-contaminated-land.

#### c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal – \$38,030

State- 42,375

Total – 80,405

Full-time equivalents: Sci 0.3; Prof 0.4; Total 0.7

#### 4. Impact and Control of Trematode Parasites

##### a. Brief description of the activity

Trematode parasites influence commercially and ecologically important marine species and human health. This project addresses what factors most strongly influence trematode species diversity and overall prevalence within marine nearshore communities and determines at what spatial scale they operate. A spatially explicit database has been compiled of the diversity and abundance of trematode parasites infecting the host snail, *Littorina littorea*, at more than 40 sites along the New England coast. At each site, environmental parameters were measured including the physical measurements of temperature, salinity and wave exposure as well as the biological measurements of crab, fish and bird abundance. In the summer of 2006, grazing rates were quantified of infected and uninfected individuals of the intertidal snail. In addition, numerous biological and physical metrics in each sampled area were quantified to correlate with measurements of parasite richness and abundance. Currently, physical degradation is being quantified in these marshes through FIS techniques.

##### b. Short Impact/Accomplishment Statement

Determination of the drivers of parasitic infection may ultimately be a powerful means to understand the determinants of trematode population dynamics across spatial scales, thus helping to predict and address trematode impacts on commercially and ecologically important nearshore marine species. Secondly, because impacts to nearshore environments may affect species in different ways, the power of using trophically-transmitted parasites as indicator species is that they potentially integrate the effects of nearshore impacts across many species from different trophic levels with different physiologies and life history strategies.

##### c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch

Total expenditures: Federal - \$22,583

State- 38,601

Total – 61,184

Full-time equivalents: Sci 0.2; Prof 0.2; Total 0.4

#### 5. Molecular Markers and Control of Two Flatworm Pests

##### a. Brief description of the activity

Marine flatworms commonly prey on mussels and oysters and can have great impact on bivalve aquaculture. The main goals of this project are to isolate DNA markers that can be used to track these flatworms. High molecular weight DNA has been isolated from three species of marine flatworms, two of which are native to the Gulf of Maine, the third is an invasive species. DNA was enriched for microsatellites and 192 clones have been sequenced. Nine potential loci have been identified, however, only two proved polymorphic. Three additional markers were identified and sequenced. In addition, using histology, it was determined that flatworms widely known as *Notoplana atomata* in available Gulf of Maine

identification guides, are actually *Pleiolana atomata*.

b. Short Impact/Accomplishment Statement

Two of the three flatworm species examined in this study are pests on commercially important aquaculture species, namely bivalve mollusks. The third species is an invasive that feeds on mussel spat and may compete for prey items with adult mussels. The identification of molecular markers to understand their population genetics is imperative for their control. In addition, routes of dispersal can be determined using these molecular markers.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$17,351  
State- 39,636  
Total – 56,987  
Full-time equivalents: Sci 0.3; Total 0.3

**Key Theme - Forest Resource Management**

1. Controls on Forest Soil Solution Chemistry

a. Brief description of the activity

Forest soil solution chemistry is an indicator of overall ecosystem function and a driver of stream water quality in forested watersheds. The effects of organic matter and nutrient supply on the solution chemistry of forest soils were determined by sampling soil solution from lysimeters at three long-term experimental manipulations. Results pooled across all the sites and experiments show that production of dissolved organic carbon (DOC) is remarkably insensitive to N additions and the changes in ecosystem structure (primary productivity, soil microflora) that accompany N fertilization. Dissolved organic nitrogen (DON), in contrast, is very sensitive to inorganic N application, with concentrations doubling or tripling with fertilization. These results suggest a fundamental decoupling of the C and N cycles with changes in nitrogen inputs as production of DOC and DON appear to be regulated by different mechanisms.

b. Short Impact/Accomplishment Statement

This project provides fundamental information about controls on soil solution chemistry in forest ecosystems, with an emphasis on factors controlling the production and delivery of dissolved organic carbon and nitrogen to surface waters. Dissolved organic carbon, an important contaminant in water supplies, changes its character but not its overall concentration when forests are amended with nitrogen. Better understanding of how forest nutrient cycles affect the DOC in groundwater will improve forest management, and result in better predictions of the impacts that changing forest conditions will have on water quality.

c. Source of funding/total expenditures/full time equivalents

Source of funding: McIntire-Stennis  
Total expenditures: Federal - \$39,496  
State- 51,950  
Total – 91,446

Full-time equivalents: Sci. 0.3; Prof. 0.2; Total 0.5

d. Scope of Impact: State Specific

## 2. Measuring stocking and structure in N. H. forests

### a. Brief description of the activity

One of the objectives of this project is to develop, test, and refine efficient methods for timber and structural legacy inventory in New Hampshire Forests. Timber inventory methods are focusing on refinement of “big BAF” sampling with particular attention to heterogeneous stands, and on the challenges of boundary overlap in cluster plot situations. This project has completed additional field studies on “big BAF” and related methods. In the second objective, to employ recent historical data and multiple sources of older information to evaluate trends in stocking and structure in managed lands of northern NH is ongoing. To date, using long-term plot data, a geographically-weighted growth model has been constructed for the tree species of the northeast, to examine large scale patterns of forest productivity. In addition, methods for modeling crown rise in eastern white pine stands, and those methods are being used to inform a hybrid empirical-process model of forest growth in these stands.

### b. Short Impact/Accomplishment Statement

This project is developing new tools for assessing forest stocking and structure, and for predicting future forest growth. These tools will lead to improved management of New Hampshire forests for both timber and non-timber objectives.

### c. Source of funding/total expenditures/full time equivalents

Source of funding:McIntire-Stennis

Total expenditures: Federal - \$29,139

State- 39,338

Total – 68,477

Full-time equivalents: Sci. 0.3; Total 0.3

d. Scope of Impact: State Specific

## 3. Remotely sensed forest vegetation mapping

### a. Brief description of the activity

This project combines the use of polygon-based classification approaches with higher spatial resolution imagery for mapping forest vegetation in Pawtuckaway State Park, NH. During the past year, a new reference data set required to more adequately evaluate the higher spatial resolution imagery was finalized. In addition, preliminary polygon-based classifications were performed. During this time, a completely new version of the image processing software was released by the vendor. While the new version of the software is a significant improvement, it did set the project back as the time to learn the new software was considerable. Preliminary results show that increased spatial resolution may not be the sole factor in increasing classification accuracy.

### b. Short Impact/Accomplishment Statement

The use of remote sensing and spatial data analyses are valuable tools for mapping and monitoring our natural resources and the environment and are critical to our wise use of



natural resources for key issues such as global warming and climate change. Development of better methods for producing these maps is vital to having the most accurate and timely information possible. This research contributes to improving these techniques and therefore to better understanding the earth.

c. Source of funding/total expenditures/full time equivalents

Source of funding: McIntire-Stennis  
Total expenditures: Federal - \$44,717  
State- 61,974  
Total – 106,691  
Full-time equivalents: Sci. 0.3, Prof. 0.6, Total 0.9

d. Scope of Impact: State specific

4. Genetic control of stress response of trees

a. Brief description of the activity

Transgenic cell lines of poplar with elevated levels of putrescine were analyzed for changes in various metabolites and expression of several genes involved in polyamine metabolism. It was shown that 1) poplar cells make most of their putrescine by the arginine decarboxylase pathway; 2) this enzyme is not feedback regulated by high putrescine; 3) the half life of putrescine turnover is around 5-6 h in contrast to that of spermidine and spermine, 4) that increased utilization of ornithine in the transgenic cells is accompanied by concomitant increase in nitrate and ammonium assimilation into glutamate, and the stimulation of key steps in the ornithine/arginine biosynthesis. The putrescine overproducing cells show altered levels of protein accumulation, mitochondrial activity, and response to treatment with altered levels of calcium and aluminum in the medium.

b. Short Impact/Accomplishment Statement

Understanding the regulation of polyamine metabolism in plants by itself will potentially have profound and far-reaching implications, from manipulating abiotic stress tolerance in plants to those in the field of human oncology and parasitology, where foods with reduced polyamine contents have proven desirable to retard tumor growth and combat parasite infections.

c. Source of funding/total expenditures/full time equivalents

Source of funding: McIntire-Stennis  
Total expenditures: Federal - \$40,115  
State- 39,840  
Total – 79,955  
Full-time equivalents: Sci. 0.1; Prof 0.6; Total 0.7

d. Scope of Impact: State Specific

5. Microbial Community Composition in Forest Soils

a. Brief description of the activity

The objective of this project is to determine how soil warming and nitrogen fertilization

interact to influence forest soil processes. In this first year of the project, a field experiment was set up with four treatments of six replicates, random design: control, heated plus nitrogen, heated only, and nitrogen only. Monthly samples were taken and measurements included soil respiration, nitrogen mineralization, enzyme activity, and microbial biomass, metabolism, and community composition. These data are currently being analyzed.

b. Short Impact/Accomplishment Statement

Climate warming and nitrogen deposition are two global changes of significance to the New England Region. Warming of 6-10 degrees Fahrenheit is projected for the region by 2090 in response to increasing atmospheric greenhouse gas concentrations. In addition to warming, another important regional change is the significant increase in nitrogen deposition to historically nitrogen-limited ecosystems. This project is determining how these two environmental changes are interacting to alter key ecosystem services provided by forest soils, including carbon storage, decomposition, and nutrient cycling.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$25,052  
State- 34,500  
Total- 59,552

Full-time equivalents: Sci 0.3; Prof. 0.1; Total 0.4

d. Scope of Impact: State Specific

6. Effects of Invasive shrubs in forest management activities

a. Brief description of the activity

During this past year, insect abundance and taxa richness were examined among invasive and native shrubs at eight sites where bird species richness was also examined. Four methods were used to investigate insect abundance and richness: net sweeping, net beating, flight intercept traps, and timed counts of individual branches. Timed counts were dropped after several attempts because it was immediately evident that this method was inefficient and provided a biased sample. There was no correlation between the number of insects collected and the percent of invasive shrubs found at a site. Based on beating and sweeping samples, native shrubs contained about three times the number of insects as invasive shrubs. These two methods of sampling also yielded somewhat different insects. The number of bird species ranged from 10 to 25 and there was no obvious relationship between bird species richness and the abundance of invasive shrubs.

b. Short Impact/Accomplishment Statement

Preliminary results suggest that invasive shrubs may alter the suitability of habitats they colonize, especially among insects and nesting songbirds. Land managers may need to consider proactive measures or follow-up treatments to reduce the spread of these shrubs in managed forests.

c. Source of funding/total expenditures/full time equivalents

Source of funding: McIntire -Stennis

Total expenditures: Federal - \$36,182  
State- 46,494  
Total- 82,676  
Full-time equivalents: Sci 0.3; Prof. 0.2; Total 0.5

d. Scope of Impact: State Specific

### **Key Theme - Water Quality**

#### 1. Insect-based water quality statements

##### a. Brief description of the activity

Updated illustrated keys covering the stream insects of the New England region have been updated for the second time and have been distributed to several participating scientists for continued testing. The updates focused on the major groups valuable as indicators of water quality: Ephemeroptera, 117 species; Plecoptera, 70 species; Trichoptera, 72 species; Odonata, 43 species; Megaloptera, 6 species. During this past year, there was also a season-long sampling in collaboration with White Mountain National Forest personnel that generated abundance and seasonality data for 119 stream species of small rivers (3-6m), adding a number of new species to the regional stream list, and providing data on two mayfly species of Special Concern for the National Forest. Significant differences were documented between the mayfly faunas of the White Mountain area and southern New Hampshire, and between large and small rivers of the White Mountain area. Stream size and water temperature, reflected in part by location in the state, are major factors in determining mayfly species composition.

##### b. Short Impact/Accomplishment Statement

The collection data is now online at [www.discoverlife.org](http://www.discoverlife.org). Baseline studies on species, their abundances and seasonality are now readily permitted through use of identification keys. Studies of small rivers in White Mountain National Forest comparing old-growth with previously managed areas reveal at most small differences in the stream insect fauna, suggesting that some levels of management may lead to no effective change in stream faunas.

c. Source of funding: Hatch  
Total expenditures: Federal - \$39,964  
State- 117,043  
Total – 157,007  
Full-time equivalents: Sci. 0.8; Total 0.8

d. Scope of Impact: State specific

### **Key Theme - Wildlife Science and Management**

#### 1. Forest Matrix and Westland Distribution of Amphibians (2 Projects)

##### a. Brief description of the activity

In the first project during the past year, an additional component was added to the study to examine whether clusters of wetlands support a higher number of amphibian egg masses than

isolated wetland and further, whether population sizes at neighboring wetlands as opposed to presence is a better predictor of egg mass counts at focal wetlands. The analysis is ongoing. Preliminary data suggest that the highest protection priority should be given to vernal pools that have a hydroperiod greater than 20 weeks post-ice out, that are not near a road (>100 m), and that are not within an area of continuous forest. In the second project, samples of amphibians were identified and collected from suitable wetlands in suburban and rural environments, in Strafford and Rockingham Counties, NH. 10 focal ponds in 10 different locations were selected. A total of 1608 samples from the clustered sites and 184 samples from the isolated sites were collected for genetic analysis. These samples are currently in the process of being genotyped followed by genetic data analysis.

b. Short Impact/Accomplishment Statement

In Project One, Successful conservation and management of vernal-pool dependent species requires an understanding of both upland and wetlands requirements. Few empirical studies have been conducted to examine patterns of wetland use by vernal pool-dependant species across both the wetland isolation and upland habitat availability gradients. The results of this study provide valuable guidelines for prioritizing vernal pool protection for vernal pool dependent species and will refine best management practices adjacent to vernal pools. In project 2, amphibians were successfully collected from two different environments. This research will provide novel information on the influence of habitat fragmentation on amphibian dispersal. These data will be evaluated for the effects of landscape features, such as roads and suburban development, on amphibian population connectivity. It is anticipated that these findings will be used by managers in evaluating plans for ecologically sustainable forestry practices.

c. Source of funding/total expenditures/full time equivalents

Source of funding: McIntire-Stennis  
Total expenditures: Federal - \$51,235  
State- 52,075  
Total – 103,310  
Full-time equivalents: Sci. 0.3; Prof 6.0; Total 6.3

d. Scope of Impact: State specific

**Program Duration**

The research projects that contribute to Goal 4 are generally of three to five-years duration. All projects are targeted for mid and long term problems.

In 2005-2006, the New Hampshire Agricultural Experiment Station had 5.0 full time equivalents of scientist's time assigned to Goal 4. Their research was funded with federal funds from the Hatch, McIntire-Stennis, and Multi-State Research Programs. There were 0 full-time equivalents of technical staff attached to these projects. Professional help in the form of graduate students doing research on these projects amounted to 9.3 students. For this goal, there are matching funds from the State of New Hampshire through a line item within the University of New Hampshire's budget. It is not anticipated that any small changes in federal funding in the next five years would significantly alter the spectrum of key program components for Goal 4.

## **Goal 5: Enhanced Economic Opportunity and Quality of Life for Americans Issue:**

Research is necessary to help people improve their economic status in order to improve their perceived quality of life.

### **Overview:**

The New Hampshire AES has established as an output indicator for Goal 5, increased applied and basic research to define the issues that improve quality of life, at what expense, and to improve the chances that rural communities can provide these opportunities.

We will evaluate the outcome indicators of 1) more rural communities capable of providing employment opportunities to their residents, and 2) rural communities better able to adjust and adapt to structural changes in agriculture and forestry so that they remain viable and exciting places in which families may reside. We continue a philosophy that the mission of the Agricultural Experiment Station is consistent with Goal 5 and thus provide support to basic and applied sciences that help posture to maintain enhanced economic opportunity and quality of life for Americans. The NH Agricultural Experiment Station supports the following basic and applied projects within Goal 5 to create technology and research for the benefit of the state, region and nation. We believe these projects provided excellent results and value from the investment of AES funds and have positioned the NH AES well to successfully achieve the goals of its five year POW plan. Each of the following projects contributes to maintaining economic opportunity and quality of life.

### **Key Theme - Community Development**

#### **1. Engaging Stakeholders of Specific Natural and Agricultural Resource Management**

##### **a. Brief description of the activity**

Studies were designed and implemented to assess stakeholders of a variety of natural resource management and development programs in New Hampshire, New England, and the Northeast. Stakeholders include residents of two distinct watersheds (Lamprey River Watershed and Patuxent River Watershed), customers of public drinking water and waste water management utility; users of water supply reservoirs, members of innovative organizations responding to management and regulatory change in rural and urban/interface communities in New England, forest land owners, recreation users, forest land managers in the Northeast's Northern Forest and a variety of stakeholder groups actively engaged in cooperative research and the establishment of marine protected areas. The findings to date suggest that there are substantive differences across stakeholder groups and management/policy issues.

##### **b. Short Impact/Accomplishment Statement**

The design, development, implementation and evaluation of specific tools have engaged stakeholders in a variety of important issues facing the management of natural resources and the development and evaluation of a variety of communication and data collections tools. As an example, 6000 stakeholders were directly contacted in the watershed studies. As another example, 380,000 stakeholders were exposed to science based information and provided an

understanding of the inherent complexity of the management of a variety of natural resources via the design and evaluation of the effectiveness of education web sites, web-based public involvement tools, press releases and other communication strategies.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$17,130  
State- 42,316  
Total – 59,446  
Full-time equivalents: Sci. 0.3; Total 0.3

d. Scope of Impact: State Specific

2. Rural Communities, Rural Labor Markets and Public Policy (2 Projects)

a. Brief description of the activity

In the first project, the market for locally produced goods and services in New Hampshire was investigated and compared to neighboring states of Maine and Vermont. Basic results to date, show that producers, do in fact feel better served (on average), but average willingness to pay a premium for locally produced goods has not changed significantly. In the second project, the changing farmland preservation policies in New Hampshire were compared and contrasted. The major policy shift is that protecting farmland was once the sole target of programs and funds, whereas with the latest state programs, farmland is competing with other land uses, as well as historic buildings. The term agricultural land has been replaced in the purpose section of the new program by natural resources.

b. Short Impact/Accomplishment Statement

In the first project, the expected impact from this work is a better understanding of consumer motivations and producer needs for NH Made, the organization that promotes New Hampshire made goods and services. In the second project, government officials, both elected and career, at all levels can benefit from the policy implications and operational attributes dealing with land preservation programs as they are evolving from state level funded and administered to local initiatives and funding.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$45,148  
State- 76,979  
Total – 122,127  
Full-time equivalents: Sci 0.6; Prof 0.4; Total 1.0

d. Scope of Impact: Multistate; Integrated Research and Extension (AR, CO, DE, GA, ID, IA, IN, KY, ME, MI, MN, MO, NV, NH, NY-Ithaca, NC, ND, OH, OR, PA, RI, SC, USDA/ERS, UT, VA Tech, WA, WI)

3. Economic considerations in municipal solid waste disposal

a. Brief description of the activity

During this past year, the analysis of data on privatization of municipal solid waste management suggest that political ideology and lower self-described fiscal stress make it more likely that a town will privatize selected services, rather than providing them in-house. Smaller towns are more likely to have existing private contracts. From an in-depth econometric analyses of data regarding adoption of pay as your throw trash (PAYT) programs by NH towns, it was shown that the presence of curbside collection programs increased per capita generation, an effect which was not evident in the initial econometric analyses.

b. Short Impact/Accomplishment Statement

Primary accomplishments this past year are analysis of data on privatization of municipal solid waste management and other services by NH communities and an in-depth econometric analyses of data regarding adoption of pay as your throw trash programs by NH towns. Local governments, especially those in rural areas, are facing ever-increasing stress on their limited revenues. This is especially true in New Hampshire where the major source of revenue is the property tax. Town governments have looked to the possibility of privatizing provision of some municipal services as a way to increase efficiency and reduce costs. The current study and its extensions will provide valuable information to these decision makers in terms of what services work best when privatized, what factors influence privatization and satisfaction with privatization, and which towns have had the most success with privatization.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$19,561  
State- 49,130  
Total – 68,691

Full-time equivalents: Sci. 0.3; Prof 0.1; Total 0.4

d. Scope of Impact: State specific

4. Benefits and costs of resource policies (2 projects)

a. Brief description of the activity

In the first project, to date, 2000 questionnaires have been mailed to two resident groups: 1) residents of Cape Cod, Nantucket and Martha's Vineyard; and 2) Residents of the entire state of Massachusetts. The overall response rate is 51%. Basic findings show a majority of both groups favoring wide park development in the Nantucket Sound. The top reasons for favoring the wind park as a follows (in order): a desire to reduce dependence on foreign oil, the need for electricity at affordable prices, and a desire for cleaner air. The top reasons for opposing the wind park are (in order): concern over destruction of the natural beauty of Nantucket Sound, worry about environmental impacts that may occur, and dislike that a private developer would gain profits from a public resource. In the second project, field research has been conducted in Havana, Cuba to the social economic, and political influences on urban community gardening practices and outcomes. Data was collected from a variety of types of community gardens, including co-ops, communal farms, and state farms. The data is being currently analyzed. In addition, research is being done to determine the relationships between demographic characteristics of Boston neighborhoods and the physical location of

the city's 250 community gardens. Interviews were conducted on 25 community garden leaders in Boston to determine how demographic shifts in the city have impacted the form, function, extent and ethnic participation in Boston's 250 community gardens.

b. Short Impact/Accomplishment Statement

In the first project, it is hoped that this work will better inform policy makers who are still determining the outcome of this controversial proposal. In the second project, this research is examining the social, economic, and political influences on urban community gardening practices and outcomes.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$28,705  
State- 79,855  
Total – 108,560  
Full-time equivalents: Sci. 0.5; Total 0.5

d. Scope of Impact: Multistate; Integrated Research and Extension (AL, CA-Administration, CA-Berkeley, CA-Davis, CT-Storrs, CO, DE, GA, IA, IL, KY, LA,ME, MD, MA, MI, NH, NY-Ithaca, ND, OH, OR, PA, OR, RI, TX, UT, WA, WV, WY)

5. Welfare reform and the well-being of rural low-income families

a. Brief description of the activity

This project has tracked over time the individual and family circumstances, functioning and well being of rural low-income families with children in the context of welfare reform and has developed a dynamic website. NH has maintained contact with the seventeen continuing participants through short telephone calls, or home visits when no phone was available. Regular contact with participants has continued through a periodic newsletter, birthday and holiday cards. The majority of NH families continued to live close to the poverty line, even when family members are employed. Although those in the labor force can maintain their families through their wages, they are not thriving. The vagaries of seasonal employment continue to be an issue for several participants. Mothers who are not in the labor force have either mental or physical health issues. For rural mothers to move toward economic self-sufficiency, they need to work at least 40 hours a week in paid employment when wages are low.

b. Short Impact/Accomplishment Statement

The NC1011 team maintains a dynamic website that allows the researchers to share the latest findings and links to other studies that complement the understanding of rural families in the context of changing welfare policies. The URL is <http://www.ruralfamilies.umn.edu> The New Hampshire portion of the website has a profile of NH participants.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal \$4,582  
Total 4,582



Full-time equivalents: Total 0.0

d. Scope of Impact: Multistate; Integrated Research and Extension (CA-Davis, CA-Riverside, IA, KY, LA, MD, MA, MI, MN, NC, NH, NJ, NY-Ithaca, OH, OR, SD)

6. Corporate Outsourced Functions

a. Brief description of the activity

During this past year, two online pilot surveys were developed in order to ascertain the degree of corporate interest in offering a portion of currently off-shored jobs to individuals in rural (lower cost of living) areas in America. Preliminary results from one survey showed that high level executives highly engaged in off-shoring, indicated a strong interest in moving meaningful job opportunities back to America if adequate numbers of motivated and educationally qualified clusters of potential employees could be identified. In addition, 75% of the administrators interviewed were highly receptive to Rural-Sourcing a significant percentage of Off-shored positions if several specific conditions could be met. Geographic, demographic and psychographic data were obtained from the pilot survey to provide a clear pathway to bridging the information gap between Corporate America and talented rural (and urban) individuals interested in offering both full and part time Business Process, Information Technology, and Business Transformational services.

b. Short Impact/Accomplishment Statement

Specific skill sets and educational levels required to meet corporate Business, Transformational, and Informational Technology employment needs (many of which are currently being obtained offshore) were identified. Additionally, community skill clusters in selected rural areas were identified. Because of the research information obtained to date, a pilot web-based clearing-house can be developed which will provide a much needed mechanism to reduce rural unemployment by providing the necessary bridge between businesses interested in rural-sourcing and heavily engaged in off-shoring and individual interested in offering their talents (both full and part-time) to corporate America. The actual economic and potential social impacts on rural communities (to be addressed in the next survey) are expected to be important.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$4,397  
State-  
Total - 4,397  
Full-time equivalents: Total 0

d. Scope of Impact: State specific

7. Food Security and Open Space Conservation

a. Brief description of the activity

A sequel to the book entitled "The Wisdom of Small Farms and Local Food: Aldo Leopold's Land Ethic and Sustainable Agriculture (2005) is being prepared. Research has been completed during this past year on the history and philosophy of sustainable grass farming

and grazing. Grass farming and grazing are the key to a viable long-term sustainable agriculture in New England, given the reality of the New England environment. Research has now been completed on constructing maps on the best grazing soils in the region, with the cooperation of USDA-NRCS and state soil scientists.

b. Short Impact/Accomplishment Statement

A number of presentations were given regionally to organic farming groups, garden clubs, Master Gardeners and graziers. Efforts and initiatives are also being undertaken with the organic dairy, the campus community organic farm, biodiesel from both food waste and oil crops and other aspects of agricultural sustainability and farm utilization on the UNH campus, including the university's Food and Society Initiative. The Real Dirt (on sustainable agriculture) has been launched and is now being taught directly from the findings of this project. Agricultural plans for six town conservation easements in the Town of Durham are being generated from this project.

c. Source of funding/total expenditures/full time equivalents

Source of funding: Hatch  
Total expenditures: Federal - \$26,077  
State- 61,682  
Total – 87,759  
Full-time equivalents: Sci. 0.3; Prof. 0.1; Total 0.4

**Program Duration**

The research projects that contribute to this goal are generally of three to five years duration. All projects are targeted for mid and long term problems.

In 2005-2006 the New Hampshire Agricultural Experiment Station had 2.0 full time equivalents of scientist's time assigned to Goal 5. Their research was funded with federal funds from the Hatch, McIntire-Stennis, and Multi-State Research Programs. There were 0 full-time equivalents of technical staff attached to these projects. Professional help in the form of graduate students doing research on these projects amounted to 0.6 students. For this goal, there were matching funds from the State of New Hampshire through a line item within the University of New Hampshire's budget. It is not anticipated that any small changes in federal funding in the next five years would significantly alter the spectrum of key program components for Goal 5.

**B. Stakeholder Input**

The N. H. Agricultural Experiment Station developed an External Advisory Committee, **representing a diverse group of stakeholders** in 2002. The composition of the advisory committee was formed after obtaining broad input from various people and groups including the NH Commissioner of Agriculture. The group continues to meet once or twice per year to exchange ideas for increasing this station's effectiveness in serving stakeholders and the citizens of our state. The station welcomes stakeholder input through this committee as well as individually. The Advisory Committee is comprised of the following members:

**David Babson**  
Farmer/Active Citizen

**Jeff Huntington**  
Pleasant View Gardens

**Deanna Howard**  
Dartmouth-Hitchcock Medical Center

**Barry Kelley**  
Forest industry

**Jeanie McIntyre**  
Upper Valley Land Trust

**John McLean**  
UNH Farm Manager

**Anne Sprague**  
Edgewater Farm

**Edith Tucker**  
*The Coos County Democrat*

**Hal Bodwell**  
Dairy Producer

**Stacia Sower**  
**Interim Associate Director of AES**  
**Associate Dean of COLSA**

**Tom Kelly**  
UNH Sustainability Program

**Peter Lamb**  
New Hampshire Charitable Foundation

**Chris Streeter**  
Blue Seal Feeds  
N. H. CARET representative

**Sharon Francis**  
Connecticut River Joint Commission

**Julie Brussell**  
UNH Cooperative Extension

**Tina Sawtelle**  
Director, COLSA Business Service Center

**William Trumble**  
**Dean of COLSA and AES Director**

1. COLSA developed an on-line yearly newsletter in 2006 targeted largely to stakeholders that was sent to an audience of approximately 10,000 per issue via the hire of a new marketing and promotion position. Yearly issues of "INSIGHTS" address events, people and contributions from the College of Life Sciences and Agriculture (COLSA) and the NH AES. A separate issue of "Research Highlights" emphasized the contributions and impacts of research sponsored by the NH AES and COLSA—this issue was not produced in 2006 and is being reconsidered for future years. Constituent reactions to these NH AES publications are encouraged.
2. The AES UNH Research Advisory Committee continued to assist the Agricultural Experiment Station administration in AES proposal reviews and to recommend research areas of State and regional importance for particular AES focus.
3. The NH AES Director served on the NH Current Use Board, attended community fact-finding meetings and served on the State Conservation committee to obtain stakeholder input.
4. The NH AES has been a participant in several State Fairs as well as the NH Farm and Forest Exposition. These activities facilitate direct stakeholder input.

5. The NH AES Director attended meetings with the Farm Bureau, representatives of the NH Horticulture Association the NH Equine Committee, and the Farm and Forest Expo Leadership.
6. Representatives of the NH AES have visited NH farms, orchards, greenhouses and extension twilight meetings to speak directly with constituents.
7. Representatives of the NH AES have been very active in the initiation, planning, and building temporary barns and a milking parlor for the first Organic Dairy Research farm at a land grant institution. Activities include outreach to the community through farmers, veterinarians, nutritionists, researchers, educators, students and others throughout the northeast who are interested in organic, sustainable, and low input farming practices. In addition, a 20-person External Organic Dairy Advisory Group was established to provide the organic expertise as we develop the expertise within UNH.
8. During this past year in 2006, COLSA underwent a Strategic Planning Process guided by an outside facilitator from Oregon State University. During this process, a wide variety of stakeholders (about 30) including under-served and under represented were invited to a series of workshops to provide their input for the future of the college and agricultural experiment station.
9. During the search for a new Dean of COLSA and Director of the NH Agricultural Experiment Station, an open forum was held for external and internal stakeholders to provide an opportunity for a question and answer period for each of the four candidates.

**Statement of the process used to identify stakeholders and collect input.**

We continue to meet once or twice per year with the NH-AES Advisory Committee to exchange ideas for making this station most effective in serving stakeholders and the citizens of our state.

In addition to the interaction with our Advisory Committee, the NH AES is currently sending its information about our programs online to citizens of the state and region requesting input on research areas, concerns and needs. The NH AES and the College of Agriculture representatives accompany a prepared display to state and regional fairs and expositions to meet stakeholders, distribute information and obtain input. The NH AES Administrators also meet stakeholders and acquire input by presenting talks at meetings of various grower groups, the Grange and Farm Bureau. The AES Administrators and others working with the NH AES visit state and regional farms, orchards, greenhouses, and extension meetings to assess needs and collect input. The AES Administrators frequently travel to different counties with Extension Specialists to obtain input on integrated needs.

**Statement of how collected information was considered.**

Information from a variety of stakeholder sources has been incorporated into AES policy. Concerns over AES-funded projects that might better serve the needs of the state and region led to a change in the criteria for evaluating AES program proposals. An explanation of how the project will impact state and/or regional needs is now required. Concerns over limited support

for horticulture, the fastest growing area of the NH agricultural economy, and concerns for water quality led to AES project funding targeted in those two areas. Unfortunately, during this past year, one of our key horticulturists faculty left for another position at a Florida University. This will be addressed in the next two to three years. Our college has had a freeze on hiring during the past three years. In addition to our expanded efforts to identify and engage internal stakeholders, the NH-AES developed a farm survey to assess the use and needs of the farms at UNH—this survey was sent to all faculty, staff and students within COLSA. Additionally, the External Advisory Committee assists the AES to identify important current and emerging needs, and to advise the AES on matters such as preferred mechanisms for timely delivery of research findings to end users. Through the AES, a Steering Committee for the Organic Dairy Farm was established to provide oversight and provide a review of financial, operational and management plans for the Organic Dairy Farm. This committee ended its term in 2006. A new Planning Committee for development of regional academic and research plans is being established.

### **C. Program Review Process**

The New Hampshire Agricultural Experiment Station has had a peer review process for projects for over fifteen years. The proposal process applies to all Goals and is as follows. Each August a letter is sent to all faculty in the College of Life Sciences and Agriculture and to Deans of other Colleges announcing a competition for Hatch and McIntire-Stennis funds. Faculty must submit a one page description of their proposed project and subsequently meet with the AES Associate Director to discuss the work. If the proposed project is determined to fit within the guidelines for support from either of these two funds, the faculty member develops a full proposal using the CSREES/USDA format. Faculty must also suggest five potential external (non-UNH) peer reviewers from whom the Associate Director obtains at least two anonymous reviews. After the reviews are returned, the faculty member then has the opportunity to revise the proposal or rebut the reviewer's comments, if they wish. The next step in the process is the project funding priority evaluation performed by an internal committee of five faculty members who are experienced in research. All proposals are reviewed, taking into account the external reviewer's evaluations and the faculty member's response. From this, the committee recommends a priority for submission to USDA for approval. The AES Administrators use this recommendation and their own evaluation to make the final decision as to which projects the Experiment Station will fund. Usually about 80% of the proposals submitted are forwarded to CSREES/USDA for their approval for funding. We will continue this process in New Hampshire. However, we have modified it to utilize the results of stakeholders input. When the call for proposals is sent out each year, it now includes guidelines of the criteria used for internal proposal evaluation. These criteria include, 1) research quality and potential, 2) how the proposal addresses state, regional and stakeholder issues, 3) the quality of the prior year progress report, and 4) outcomes (including publications and grant submissions) from the work performed.

### **D. Evaluation of the Success of Multi and Joint Activities**

#### **1. Did the planned programs address the critical issues of strategic importance.**

The NH AES is involved with multi-state and joint activities focusing on topic areas that are included in our POW. Each area and project addresses a critical issue of strategic importance as described by its placement within the list of the five national goals above. These activities include:

- Conservation of plant genetic resources
- National Animal Genome Research Program
- Assessing the nutritional risk of the elderly
- Rural economic development alternatives in the northeast
- Benefits and costs in natural resource planning
- Welfare reform and the well-being of rural low-income families
- Sustainable local food systems
- Improved supply of nutrients to dairy cows
- Predicting bovine fertility
- Improving nutrition for dairy calves
- Control of plant growth systems (also extension)
- Genetics and breeding of Cucurbita (not listed as multistate)
- Landscape establishment of trees and shrubs
- Foodweb pathways in NH Lakes

Many of these projects originated as the result of stakeholder input and continue to address stakeholder needs.

## **2. Did the planned programs address the needs of under-served and under-represented populations?**

While not all of the multistate and joint projects were designed to serve the under-represented and under-served populations, most of the projects in the multistate list above do, in fact, directly serve under-represented and under-served populations. These include the poor, the homeless, small communities with less than adequate resources and representation, families in rural areas, the elderly, the undernourished, those seeking self-sufficiency, and farmers seeking new crops or replacement crops for species with declining sales, among others.

## **3. Did the planned programs describe the expected outcomes and impacts?**

Individual projects are at different stages of maturity and have exhibited different levels of impact. Each multistate and joint project, in our opinion, has been a sound investment of federal and state funds, thereby continuing research progress and benefiting the citizens of the state and region. Examples of the outcomes and impacts derived from these projects are indicated below.

Examples below indicate some of the outcomes and impacts derived from these projects.

- The Ruminant Feed Analysis Consortium started in 2003 resulted from two Hatch and multi-state projects and was incorporated as an industrial consortium at UNH in 2006 as a non-profit organization. This is considered a landmark accomplishment. As a membership based organization, the extent of its success is expected to parallel the needs of the animal and feed industries for advances in feed analysis and nutritional modeling and the need for a North American Feed Information System.
- Improving reproductive efficiency is an economic concern to the cattle industry. Ongoing research to understand late embryonic/early fetal mortality in cattle and to determine effects of environmental/metabolic stressors will assist the design of improvement strategies in regulating ovarian function and fertility.

- New cultivars of acorn and Sweet-Dumpling-type squash developed at UNH provide growers in northern latitudes with varieties having good tolerance to powdery mildew, the most prevalent disease on cucurbits in the northeast, and with better eating quality than that of most commercial cultivars. Adoption of these varieties by growers will reduce pesticide inputs, and because of improved eating quality, should increase consumer demand and expand the market for acorn and related types of squash.
- NE 1012 continued to demonstrate clear, practical solutions for strengthening local food systems economically and nutritionally. In addition, NE 1012 efforts have played a key role in building a long-term research capability in the region to support dairy farmers as well as broader food system research linking agriculture, food enterprises and nutrition. NE1012 also provided leadership in these critical areas that has helped strengthen national farm-to-school, nutrition and organic dairy research efforts.
- The strawberry genomic resources that have been generated provide a basis for developing gene-based molecular markers for use in the economically important Rosaceae family, and for implementation as tools for marker assisted selection (MAS). If successfully implemented in strawberry, the robust and highly transferable gene pair markers we are developing could be similarly employed as an aid to breeding for desired traits such as fruit quality, flowering habit, and disease resistance in other rosaceous species.
- The changing farmland preservation policies in New Hampshire were compared and contrasted. The major policy shift is that protecting farmland was once the sole target of programs and funds, whereas with the latest state programs, farmland is competing with other land uses, as well as historic buildings. The term agricultural land has been replaced in the purpose section of the new program by natural resources.

**4. Did the planned programs result in improved effectiveness and/or efficiency?**

Multi-state research has allowed NH to leverage its results beyond the value of the funds expended. We have increased communication and coordination among states but decreased duplication of efforts. Multistate research expenditures have the best project return for dollars invested across the NH portfolio of AES-sponsored research. Further efficiency has been realized through efforts to improve our integrated research. Communication between the NH AES and NH-Extension had become poor because the two entities did not have same University reporting lines. Efforts to improve integrated research have enhanced communication and provided the opportunity for effective collaboration. The two entities have started to work together to produce a joint publication highlighting the services and research of each unit.

**E. Multistate Extension Activities**

This section is not applicable to the NH-AES

**F. Integrated Research and Extension Activities**

From the table of integrated projects below, one may see that the NH AES spent at least \$410,599 of a combined Federal allocation for Hatch and Multistate of at least \$1,363,744. This represents a 30.1% integrated portfolio, in excess of the 20% agreed to in FY 2000. Pertinent information is included in the table below. A brief description of the progress to date on each planned activity follows the table.

**Integrated Projects**

<b>Name</b>	<b>Project Number</b>	<b>Project description</b>	<b>FY 2006 (2005-2006)</b>
Loy, J. Brent	H-462-R	Conservation and utilization of plant genetic resources	Federal \$ 19,862
	H-074	Genetics, Breeding and Physiology of Yield in Cucurbits	Federal \$ 19,446
Kocher, Thomas	H-474-R	National Animal Genome Research Program	Federal \$ 16,903
Fisher, Paul	H-463-R	Developing and integrating components for commercial greenhouse production system	Federal \$ 9,258
Curran-Celentano, Joanne	H-475-R	Improving Plant Food (Fruit, Vegetable and Whole Grain) Availability and Intake in Older Adults	Federal \$ 28,852
Violette, Catherine	H-477-R	Improving Plant Food (Fruit, Vegetable and Whole Grain) Availability and Intake in Older Adults	Federal \$ 3,193
Neal, Catherine	H-461	Cultural Factors Influencing Production and Landscape Establishment of Trees and Shrubs	Federal \$ 14,447
Smith, Cheryl Eaton, Alan	H-464	UNH Young Plant Center	Federal \$ 104,522
Haney, James Schloss, Jeffrey Sasner, John	H-469	Sources of Microcystins (MCs) and Food Web Pathways in NH Lakes	Federal \$ 34,837
Giraud, Kelly	H-442-R	Rural communities, rural labor markets and public policy	Federal \$ 19,760
Schwab, Charles	H-447-R	Metabolic relationships in supply of nutrients for lactating cows	Federal \$ 37,465
	H-448-R	Management systems to improve the economic and environmental sustainability of dairy enterprises	Federal \$ 37,452
Morris, Douglas	H-449-R	Rural communities, rural labor markets and public policy	Federal \$ 25,389
Erickson, Peter	H-450-R	Management systems to improve the economic and environmental sustainability of dairy enterprises	Federal \$ 23,683
Dolan, Elizabeth	H-460-R	Rural low-income families: tracking their well-being and Function in an era of welfare reform	Federal \$ 4,582
Kelly, Tom	H-473-R	Sustaining Local Food Systems in a Globalizing Environment: Forces, Responses, Impacts	Federal \$ 7,269
Sower, Stacia	H-111	Assoc. Director, NH-AES	Federal \$ 69,209
<b>Assessments</b>			<b>\$ 15,519</b>
<b>TOTAL</b>			<b>\$ 491,648</b>

**Integrated Project Descriptions**

Loy J. Brent                                H-462-R Conservation and utilization of plant genetic resources

New cultivars of acorn and Sweet-Dumpling-type squash developed at UNH provide growers in northern latitudes with varieties having good tolerance to powdery mildew, the most prevalent disease on cucurbits in the northeast, and with better eating quality



than that of most commercial cultivars. Adoption of these varieties by growers will reduce pesticide inputs, and because of improved eating quality, should increase consumer demand and expand the market for acorn and related types of squash.

Loy, J. Brent            H-074 Genetics, Breeding and Physiology of Yield In Cucurbits

Most fresh market squash is usually no longer stored for long periods of time prior to being distributed to supermarkets. Squash is either direct retail-marketed or is stored only for a short period following harvest and transit before it is purchased by the consumer at supermarkets. Research aimed at defining when fruits from different species and varieties of squash reach an acceptable degree of maturation for good eating quality, can assist growers and distributors of squash in making proper decisions regarding the harvesting and post-harvest handling of squash.

Kocher, Thomas            H-474-R National Animal Genome Research Program

This program is using genomic resources for tilapia to identify the genetic basis for several commercially important traits in tilapia, including sex, skin color and salinity tolerance. These discoveries have immediate applications for breeding improved strains of tilapia for commercial aquaculture. The development of genetic and physical maps is expected to lead to complete sequencing of the tilapia genome as a model fish species.

Fisher, Paul            H-463-R Developing and integrating components for commercial greenhouse production system

This program has developed decision-support tools for flowering potted plants based on plant growth and development models that resulted in workshops, an internet case study, a training website called FloraSoil, a collaborative book called "Lighting Up Profits" and development of a training guide using powerpoint slides. Twenty-one universities are using these systems to train new growers in an integrated, scientific approach to crop management.

Curran-Celentano, Joanne    H-475-R H-477-R Improving Plant Food Availability and Intake in  
Violette, Catherine            Older Adults

Cataract surgery accounts for the largest single line item expense on a medicare bill. The results from this project may directly benefit individuals at risk for aging eye diseases (macular degeneration and cataract) by prolonging the onset of symptoms of these diseases. These data suggest that dietary intake of L and Z from vegetables and/or egg yolk increase macular pigment in most individuals. Increased macular pigment and/or consumption of vegetables rich in L and Z has been associated with decreased risk of age-related eye disease.

Neal, Catherine            H-461 Cultural Factors Influencing Production and Landscape  
Establishment of Trees and Shrubs

Nitrogen is an effective way to enhance growth; however, it has the potential to leach into ground water. Excess phosphorus contributes to surface water degradation. A trial area was reconfigured in 2006 into larger plots around the remaining large green ash trees. A native shrub, *Amelanchier arbutifolia*, was added to each plot to test for nitrogen response. A statewide trial of bare-root shrubs using paired plus and minus P treatments at each location shown no growth response to P even on low-P soils after 2 years. An ongoing experiment is testing the addition of temporary insulating pot-covers for overwintering container stock; this is the first trial in the nation to test this system.

Smith, Cheryl  
Eaton, Alan

H-464 UNH Young Plant Center

Eight large commercial greenhouses received in-depth training in reduced leaching. Grower education workshops were presented to approximately 400 individuals in several states. Five new cultivars were provided to the horticulture

Haney, James  
Schloss, Jeffrey  
Sasner, John

H-469 Sources of Microcystins (MCs) and Food Web Pathways  
in NH Lakes

Microcystins are a group of cyanobacteria toxins that have become a serious water quality problem worldwide. The present study is examining the sources of the microcystin production and pathways of their movement in the lake food web. The results of this research will be of use by lake managers and water suppliers and lead to a better understanding of the ecology of cyanotoxins and methods for control of toxic cyanobacteria blooms.

Giraud, Kelly

H-442-R Rural communities, rural labor markets and public policy

In the first project, the market for locally produced goods and services in New Hampshire was investigated and compared to neighboring states of Maine and Vermont. Basic results to date, show that producers, do in fact feel better served (on average), but average willingness to pay a premium for locally produced goods has not changed significantly.

Schwab, Charles

H-447-R Metabolic relationships in supply of nutrients for  
lactating cows

Improving the efficiency of conversion of feed protein to milk protein is fundamental to both environmental and economic sustainability of the US dairy industry. This project continues research directed at determining the metabolizable Met values for commercially available Met supplements. Obtaining these values is difficult because of product differences with regard to solubility, particle size and density, site of degradation and absorption. An ongoing experiment is testing the lactational performance of cows fed a Met deficient diet supplemented with either Smartamine M or MetaSmart.

Schwab, Charles                      H-448-R Management systems to improve the economic and environmental sustainability of dairy enterprises

The protein research provides information that is needed for more precise formulation of dairy cattle diets for protein. More precise feeding of protein increases the conversion of feed nitrogen to meat and milk protein, decreases feed costs, and reduces the potential for nitrogen pollution.

Morris, Douglas                      H-449-R Rural communities, rural labor markets and public policy

The changing farmland preservation policies in New Hampshire were compared and contrasted. The major policy shift is that protecting farmland was once the sole target of programs and funds, whereas with the latest state programs, farmland is competing with other land uses, as well as historic buildings. The term agricultural land has been replaced in the purpose section of the new program by natural resources.

Erickson, Peter                      H-450-R Management systems to improve the economic and environmental sustainability of dairy enterprises

Lactoferrin may increase intestinal development resulting in more efficient nutrient use and healthier calves. Up to now, lactoferrin has only been evaluated in conventional milk replacer feeding regimens. This study is determining its efficacy in high protein milk replacer feeding programs and whether lactoferrin enhances intestinal development. Lactoferrin may enhance IgG uptake in the neonatal calf and thus increase intestinal development resulting in more efficient nutrient use and healthier calves.

Dolan, Elizabeth                      H-460-R Rural Low-Income Families: Tracking their Well-Being and Function in an Era of Welfare Reform

This project has tracked over time the individual and family circumstances, functioning and well being of rural low-income families with children in the context of welfare reform and has developed a dynamic website. NH has maintained contact with the seventeen continuing participants through short telephone calls, or home visits when no phone was available. Regular contact with participants has continued through a periodic newsletter, birthday and holiday cards. The majority of NH families continued to live close to the poverty line, even when family members are employed.

Kelly, Tom                      H-473-R Sustaining Local Food Systems in a Globalizing Environment: Forces, Responses, Impacts

NE 1012 continued to demonstrate clear, practical solutions for strengthening local food systems economically and nutritionally. In addition, NE 1012 efforts have played a key role in building a long-term research capability in the region to support dairy farmers as well as broader food system research linking agriculture, food enterprises and nutrition. NE1012 also provided leadership in these critical areas that has helped strengthen national farm-to-school, nutrition and organic dairy research efforts.