Annual Report of Accomplishments and Results
October 1, 2002 to September 30, 2003

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

COLLEGE OF LIFE SCIENCES AND AGRICULTURE

UNIVERSITY OF NEW HAMPSHIRE
DURHAM, NEW HAMPSHIRE

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2002-2003

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 3100 between 2001 and 2002 (but greater than ten years ago). During this same period, the agricultural sector contribution to the State's Economy decreased slightly from $179.5 to $173.2 million. Total farm assets increased from $1,063.6 to 1,097.0 million between 2001 and 2002, while total farm debt increased during this same period from $113.4 million to 119.5 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 farming endeavors, and 4) create opportunities for farm and rural community development. Each of these areas contributes to the development of a highly competitive agricultural system for the global market.

(*) Sources: New England Agricultural Statistics, 2002

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

a. Brief description of the activity

Two projects are devoted to this issue. Improving the efficiency of conversion of feed protein to milk protein is fundamental to both environmental and economic sustainability of the US dairy industry. Nitrogen and phosphorus are the nutrients of greatest environmental concern. This requires a better understanding of the nitrogen and amino acid requirements of growing and lactating cows, increased efficacy of ruminally protected amino acids, enhanced characterization of feeds, and further refinement of computer-based nutrition models. A collaborative effort among researchers, feed testing laboratories, and the commercial feed industry established the Ruminant Feed Analysis Consortium. This group will provide feed analysis for ruminants, quantify relationships between the chemical composition of feeds and nutritive value, and stimulate feed analysis development and standardization.

b. Short Impact/Accomplishment Statement

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

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

Source of funding:	Hatch
Total expenditures:	Federal - $ 55,296
	State- 96,969
	Total - 152,266
Full-time equivalents:	Sci. 0.6; Prof 0.2; Tech 1.0; Total 1.8

d. Scope of impact: Multistate; Integrated Research and Extension Project 1 - (CA, FL, IN, IA, KS, KY, LA, MI, MN, NYC, NH, NE, OH, PA, SD, TX, UT, VA, WI,).

Project 2: Multistate; Integrated Research and Extension (AL, AZ, CA, IN, IA, KS, LA, MI, MN, ND, NH, OH, PA, SD, UT, VT, WA, WI).

2. Predicting bovine fertility

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, to determine if environmental/metabolic stressors affect fertility as well as embryonic/fetal

survival, and to design strategies to improve reproductive efficiency.

b. Short Impact/Accomplishment Statement
Increased MCP-1 expression is associated with immune cell recruitment and regression of the corpus luteum (CL). Considering that PGF is the hormone most widely used for induction of luteolysis and estrous synchronization, continued work to understand the cellular mechanisms of PGF-induced luteolysis is essential to the formulation of new methods to improve sensitivity of the CL to PGF and to potentially improve fertility. Similarly, while uterine fluid collections in postpartum cows do not appear to affect ovarian function per se, conception rate is diminished in cows with large fluid collections. Further study of uterine involution in the postpartum cow with regard to conception is warranted, and offers tremendous potential for improving fertility in multiparous cows. Understanding the mechanisms by which heat shock proteins act in the corpus luteum may improve the lower fertility rates associated with high environmental temperatures during the summer months in the northeast United States. This will minimize economic losses to dairy producers.

c. Source of funding/total expenditures/full time equivalents (for 2 projects)
Source of funding: Hatch
Total expenditures: Federal - $45,214
State- 82,960
Total - 128,175
Full-time equivalents: Sci. 0.6; Prof 0.3; Total 0.9

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

3. Improving nutrition for dairy calves
a. Brief description of the activity
Lactoferrin, a milk protein, has antibacterial, antiviral, and growth promoting activity. Our present study is investigating lactoferrin added to conventional milk replacer fed to calves. Measurements include weight gain, skeletal growth, feed intake, days medicated and fecal scores. Blood samples are being taken at 10 d of age after calves receive xylose. Blood xylose concentration is used as an indicator of intestinal development. Lactoferrin has been shown to increase intestinal development in laboratory animals and chickens.

b. Short Impact/Accomplishment Statement
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 will determine its efficacy in high protein milk replacer feeding programs and whether lactoferrin enhances intestinal development.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $21,804
State- 24,073
Total - 45,877
Full-time equivalents: Sci. 0.3; Prof. 0.3; Total 0.6

d. Scope of impact: Multistate; Integrated Research and Extension (CA, FL, GA, IN, IA, KS, KY, LA, MI, MN, NE, NH, NYC, OH, PA, SD, VA, WI)

4. Lobster habitats and survival

a. Brief description of the activity

This project seeks to improve methods for measuring the area fished by a lobster trap to translate catch data into a calculation of the actual lobsters abundance on the bottom. To date, lobsters equipped with transmitters have been monitored within an underwater enclosure via a tracking system, for a total of 170 lobster days. Twenty-five lobsters tracked had an average daily home range of 1052 square meters (range 166 to 3000 square meters). Lobsters that passed closer than 11m from a trap were able to detect the trap bait. We also determined that 60% of the lobsters that passed within 11m, actually approached the trap; the rest were not attracted by the bait. By combining our data on the bait attraction area with our lobster home range calculations, we estimated that 2642 square meters is fished by one trap.

b. Short Impact/Accomplishment Statement

We have used ultrasonic telemetry to determine the area of bait attraction around a lobster trap, the home range of a lobster, and the area fished by a trap. This first description of this type using the American lobster significantly enhances our knowledge of this valuable species. We plan to use the data obtained to better estimate the abundance of lobsters, and thus determine fishing impact on the lobster population.

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

Source of funding:	Hatch
Total expenditures:	Federal - $32,494
	State- 80,095
	Total - 112,589
Full-time equivalents:	Sci. 0.6, Prof. 0.3; Total 0.9

d. Scope of impact: State Specific

5. Regulation of bovine follicular activity

a. Brief description of the activity

There is a need to develop methods to identify proteins that may contribute to improved reproductive fertility in agriculturally important animals. This project analyzes important cell signalling proteins that may interact with each other to improve fertility.

b. Short Impact/Accomplishment Statement

Antibody methods to determine when estrogen hormone receptors are in their active state have been optimized. These antibodies also identify peptides that can potentially block estrogen receptor activity. Identification of drugs that block growth of estrogen-dependent tumors and drugs that modulate reproductive effects of estrogen will be possible.

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

Source of funding:	Hatch

Total expenditures: Federal - $18,627
State- 34,256
Total - 52,883
Full-time equivalents: Sci. 0.3; Prof. 0.3; Total 0.6

d. Scope of impact: State Specific

Key Theme - Animal Health

1. Genetic bases for resistance to avian diseases

a. Brief description of the activity

B2B5L1L2 parents produced progeny segregating for all possible combinations of B and L types to examine their effects on immune responses. The L alloantigen system or closely linked genes affect the antibody responses to sheep red blood cells (SRBC) and Brucella abortus (BA). B genotype but not L genotype affected the response to Eimeria tenella. Matrix metalloproteinases (MMP) mediate tumor invasion and progression by degrading the extracellular matrix (ECM) around tumor cells. Congenic lines 6.6-2 (B2B2) and 6.15-5 (B5B5) were compared for RSV tumor growth and MMP staining reactions. Tumor growth over time and TPI were significantly higher in B5B5 chickens compared with B2B2 chickens. B5B5 tumors had significantly more tumor sections positive for MMP-2 and MMP-9 than did B2B2 tumors.

b. Short Impact/Accomplishment Statement

Poultry health will be improved by greater understanding of the genes that affect avian immunity. Improved health 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 - $24,574
State- 188,495
Total - 214,421
Full-time equivalents: Sci. 0.3; Prof 0.2; Lab&Cler. 1.0; Total 1.5

d. Scope of impact: Multistate Research (AL, AR, CA, CTS, DE, IA, NH, NYC, NC, SC, TX).

2. Characterizing avian tumor viruses

a. Brief description of the activity

Matings between Line UNH 193 trisomic chickens (B19B19B19) parents produced progeny having disomic, trisomic or tetrasomic MHC chromosome doses. Disomic chickens had a significantly lower Rous sarcoma tumor profile index (TPI), than trisomic but not tetrasomic chickens. Other matings produced progeny having B5B19 (disomic) and B5B19B19 (trisomic) MHC chromosome doses. Tumor growth over time and TPI were significantly lower in B5B19B19 chickens compared with B5B19 chickens. Two doses of the regressive B19 haplotype are significantly more effective against Rous sarcomas than one dose of the

B19 haplotype when combined with the progressive B5 haplotype. Congenic lines carrying six B complex recombinants (R1-R6) differed in their primary and secondary antibody responses to sheep red blood cells (SRBC). The primary total antibody titer to was significantly higher in genotype R5R5 and R6R6 compared with genotypes R1R1, R2R2, R3R3, and R4R4. The primary ME-resistant antibody titers did not differ significantly. Both total and ME-resistant secondary antibody titers were significantly higher in R5R5 chickens compared with the other five genotypes.

b. Short Impact/Accomplishment Statement
Knowledge of genes, in addition to the MHC, that influence immune responses will improve poultry health. Improved health provides substantial economic benefit to the poultry industry.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch- animal health
Total expenditures: Federal - $5,272
Full-time equivalents: Sci 0.1; Total 0.1

d. Scope of impact: State Specific

3. Causes of soft shell clam decline
a. Brief description of the activity
We produced a polyclonal antibody to the fifth DNA binding domain in the core sequence of both Map53 and Map63/73. Western blotting with this antibody shows that Map63/73 is significantly up-regulated in leukemic clam hemocytes. Both proteins are rendered non-functional by their perinuclear, cytoplasmic distribution. A similar phenotype is observed for p53 protein in a subset of human cancers, but has not been observed for human p63 or p73. In leukemic clam hemocyte cytoplasm, the distribution of clam p53 and 63/73 proteins mirrors that of clam tubulin. We identified clam mortalin 2 from leukemic clam hemocyte cDNA. It is a 79% match for 197 bp at the nucleotide level and 100% match at the amino acid level with mouse mortalin 2 which also causes cytoplasmic sequestration. Immunocytochemistry demonstrates that the cytoplasmic distribution of clam mortalin 2 mirrors that of p53. Currently, we are using this authentic clam sequence as a probe against our leukemic clam hemocyte cDNA library to recover full-length clam mortalin sequence. Treatment with etoposide or mitoxantrone defeats cytoplasmic sequestration of p53 family members in clam hemocytes and leads to pan cytoplasmic distribution of clam mortalin 2.

b. Short Impact/Accomplishment Statement
We now understand one mechanism leading to clam leukemia, a devastating disease in selected clam beds throughout New England. In leukemic clam hemocytes, the protein, mortalin leads to cytoplasmic sequestration of p53 family members, which are tumor suppressors and transcription factors. Since these proteins do not have access to the nucleus, they cannot bind DNA and promote the expression of apoptotic genes, that would selectively destroy leukemic hemocytes. Such immortalized cells can be selectively destroyed however, by human chemotherapy agents that defeat mortalin's anchoring properties. Application of these treatments to affected individuals in clam beds is underway.

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

Source of funding: Hatch
Total expenditures: Federal - $20,406
State- 29,579
Total - 49,985
Full-time equivalents: Sci. 0.3; Prof 0.1; Total 0.4

d. Scope of impact: State Specific

Key Theme - Plant Production Efficiency

1. pH and plant nutrition relationships

a. Brief description of the activity

The pH of container media affects the availability of fertilizer nutrients and the resulting plant health. There are important gaps in our knowledge about how to correct pH imbalances. This project examined approaches for managing pH and the availability of micronutrients in greenhouses containing multiple crops.

b. Short Impact/Accomplishment Statement

Improved use of lime products for correcting low media-pH problems are now widely used in the industry, and recommendations following this research have been communicated particularly for flowable lime and potassium bicarbonate drenches. Iron-EDDHA is now more commonly-used as a corrective material for iron deficiency at high pH, with improved recommendations based on this research. Growers are beginning to group plant species more effectively according to pH needs. All of these changes have assisted in reducing (a) crop losses associated with out-of-range media-pH, (b) the associated loss in income and (c) the need for additional pesticide and fertilizer applications to stressed plants.

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

Source of funding: Hatch
Total expenditures: Federal - $12,706
State- 24,519
Total - 38,364
Full-time equivalents: Sci. 0.2; Prof 0.2; Total 0.4

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

2. Control of plant growth systems

a. Brief description of the activity

This work seeks to develop decision-support tools for flowering potted plants based on plant growth and development models. Specific projects are prediction and control of development rate of Easter and hybrid lilies, and management of media pH. Models will be calibrated in a research greenhouse and validated with commercial production data.

b. Short Impact/Accomplishment Statement

The decision-support systems developed by UNH allow growers to reduce chemical use

(fertilizer, growth retardants, and pesticides) by tracking actual versus optimum production levels and are used by 200 growers. Twenty-one universities are using these systems to train new growers in an integrated, scientific approach to crop management. Nutrition research will reduce nutrient loading on the environment, and improve crop quality. Communication and technologies for accurate pH and EC management could lead to 50% reduction in fertilizer load over current greenhouse practice. Lighting research will increase energy efficiency, reduce the financial risk associated with investment in technology, and increase the production season of flowering plants for growers and consumers.

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

Source of funding:	Hatch
Total expenditures:	Federal - $9,319
	State - 9,373
	Total - 19,830
Full-time equivalents:	Sci 0.2; Total 0.2

d. Scope of impact: Multistate; Integrated Research and Extension (CTH, CTS, KY, MI, NH, NJ, NYC, OH, PA)

3. Genetics and breeding of Cucurbita

a. Brief description of the activity

A study on nitrogen (N) fertility and planting density in snackseed (hull-less seeded) pumpkins revealed that the highest level of N (180 kg/ha) significantly increased seed size, seed yield, N content of seeds, fruit number and weight per plant, and fruit yields per plot. Density and N level had no interaction on any yield component. The study on stem (peduncle) maturation in jack-o'-lantern pumpkin suggested that synthesis of secondary wall material continues even after maximum dry matter accumulation has occurred. The cultivar Orange Smoothie exhibited faster stem maturation and less peduncle shrinkage than the cultivars Racer and Jackpot. A comparative study of trichome morphology and distribution in normal (spiny) and glabrous mutant plants of summer squash was completed. The trichomes on non-glabrous plants were simple (non-branched), and most were either conical and unicellular or small, filiform and multicellular (2 to 3 cells). Glabrous plants displayed an almost complete absence of multicellular trichomes on the surface of leaves, petioles and fruits, but formed some small, unicellular trichomes along the veins on the underside of leaves. Different fruit quality parameters at different harvest dates in a popular commercial cultivar and an experimental hybrid acorn squash were compared. The overall results indicate that acorn squash should not be harvested until at least 40 DAP because otherwise excessive amounts of mesocarp reserve compounds are remobilized to developing seeds during storage.

b. Short Impact/Accomplishment Statement

For introduction of hull-less seeded pumpkin as an important agronomic crop, it is critical to determine optimum planting densities and fertilizer regimes for maximizing seed yields. The present study indicates that high N levels after the vegetative stage can increase seed yield and protein N levels in seed. Higher seed protein increases its nutritional value as a food source. Stems are one of the most important attributes of an ornamental pumpkin because their deterioration renders pumpkins unmarketable. This study on pumpkin stem maturation

will allow development of better grower guidelines for pumpkin culture and management.

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

Source of funding: Hatch
Total expenditures: Federal - $16,923
State- 35,205
Total - 52,127
Full-time equivalents: Sci. 0.2, Prof 0.4; Total 0.6

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

4. Strawberry production in modified environments

a. Brief description of the activity

Current matted row strawberry culture requires excessive inputs of labor and chemical weed control agents. The harvest period in this system is short, and is susceptible to weather extremes. The annual hill system offers growers a tool for expanding the harvest season and increasing market exposure. The use of raised, black plastic covered beds potentially reduces the use of chemical week control agents significantly.

b. Short Impact/Accomplishment Statement

Strawberry floral initiation and development can be altered by day-length extension following induction. This finding is a cost-effective technique for maximizing fruit size for early season marketing of premium priced strawberries through specialty retail markets, or for use as a premium priced specialty commodity or loss leader in the early season roadside stand market. An over-wintering and trellis design experiment on thornless blackberry cultivars was established. Plants were trained to a low head swing-arm trellis. The first season of over-winter protection studies are currently underway using plants covered with floating row-covers or nursery over-winter covers compared to unprotected plants.

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

Source of funding: Hatch
Total expenditures: Federal - $24,189
State- 49,780
Total - 77,160
Full-time equivalents: Sci. 0.6, Prof. 0.1, Total 0.7

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

5. Genetic tools for strawberry

a. Brief description of the activity

Initial BAC (Bacterial Artificial Chromosome vector) clones of high molecular weight (HMW) DNA from a diploid strawberry, Fragaria vesca, were found to carry inserts in the 50 to 100 kb range. The linkage map positions of over 20 SSR (simple sequence repeat) markers developed by two different collaborators were determined using DNA samples from our diploid strawberry (Fragaria vesca) mapping population.

b. Short Impact/Accomplishment Statement
The knowledge and genomic tools being developed by this project will enable more effective identification, preservation, and utilization of wild Fragaria germplasm for the purpose of developing improved cultivated varieties. The strawberry and mint genome libraries under development will facilitate positional cloning of genes of potential economic interest, and isolation of useful gene promoters. Construction of the strawberry library also constitutes an important first step toward the eventual sequencing of the strawberry genome.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $23,261
State- 54,996
Total - 78,256
Full-time equivalents: Sci. 0.4; Prof 0.4; Total 0.8

d. Scope of impact: State specific

6. Evaluation of new apple cultivars
a. Brief description of the activity
Apple growers in NH are struggling to survive a weak wholesale market. This project studies the potential role new apple cultivars could play in enhancing farm profitability as well as their unique cultural and pest management needs.

b. Short Impact/Accomplishment Statement
The shift of the NH apple industry from a wholesale market orientation to a retail market orientation requires that growers offer consumers unique and exceptional varieties. Fruit yields were good for most cultivars. Data collected include harvest date(s), number of fruit harvested and total weight, starch iodine rating, length/diameter ratios, drops and drop weight. Storage quality out of cold storage was also evaluated. Several cultivars in this planting (Silken, September Wonder Fuji, Autumn Blush, Ambrosia, and Hampshire) have potential for these retail operations at the roadside stand and U-Pick markets.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $7,883
State- 21,541
Total - 32,616
Full-time equivalents: Sci. 0.2; Total 0.2

d. Scope of impact: Multistate; Integrated Research and Extension (AL, AR, CTH, IN, MA, ME, MI, NC, NH, NJ, NYC, NYG, OR, PA, UT, VT, VA, WA, WI, WV)

7. Conservation of plant genetic resources
a. Brief description of the activity
Seven experimental hybrids of yellow straightneck squash carrying the glabrous trait (smooth, spineless foliage) were evaluated. Fifteen experimental acorn squash F1 hybrids

with tolerance to powdery mildew were evaluated. A gourd breeding program developed several inbred lines of spoon and egg gourd that are earlier, more productive than currently available varieties, exhibit additional color patterns, and have the bush habit of growth for easier culture. The first commercial hybrid from a breeding program to develop orange-fruited tomatoes, "Orange Blossom", was offered for commercial sale in the Fall of 2003.

b. Short Impact/Accomplishment Statement
Four glabrous hybrids were as early and productive as the best commercial hybrid tested. New glabrous summer squash varieties should eliminate leaf and petiole spine harvest injury to fruit, and eliminate skin irritation in field workers. Several acorn squash hybrids were productive and had superior eating quality to currently available commercial varieties. This breeding program is part of an overall research strategy to educate growers, consumers, produce managers, and produce distributors about factors that determine eating quality in squash, and to develop quality guidelines for winter squash. New gourd varieties being released will extend gourd culture to more northernly regions, and should be an attractive autumn season addition at retail roadside markets. The new Orange Blossom tomato variety is the first orange class early slicing tomato that has eating quality equivalent to red varieties.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $14,445
State- 30,450
Total - 44,895
Full-time equivalents: Sci 0.2; Prof 0.1; Total 0.3

d. Scope of impact: Multistate; Integrated Research and Extension (CTS, MA, ME, NH, NJ, NYG, PA, RI, WV)

8. Role of ethylene in signal transduction in plants
a. Brief description of the activity
Changes in expression of ethylene receptors are predicted to regulate sensitivity of plants to the plant hormone ethylene. To determine how over-expression of receptors modifies the ability of the plant to respond to ethylene, we established a dexamethasone-inducible system using a wildtype ethylene receptor ETR1 transgenic Arabidopsis lines. Expression levels of ETR1 in these lines following dexamethasone treatment were higher than those previously obtained using other non-inducible promoter systems. Thus, this inducible system should be useful to examine effects of differing levels of ETR1 upon the plant responses to ethylene.

b. Short Impact/Accomplishment Statement
An inducible system allowing the levels of ethylene receptors to be varied in planta has now been generated. This system can now be used to determine how differing receptor levels affect perception and signaling by the plant hormone ethylene. Changes in ethylene perception are predicted to affect such economically important traits as fruit ripening, organ abscission, and stress responses.

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

Source of funding: Hatch
Total expenditures: Federal - $13,194
State- 32,366
Total - 45,559
Full-time equivalents: Sci. 0.3; Prof. 0.2; Total 0.5

d. Scope of impact: State Specific

9. Nutrient management for ornamental plants
a. Brief description of the activity
The appropriate use of fertilizers has economic and environmental implications. Nitrogen is an effective way to enhance growth; however, it has the potential to leach into ground water. Phosphorus fertilizer is routinely used but may not be warranted for woody plants. Excess phosphorus contributes to surface water degradation. This project examines nitrogen and phosphorus fertilizer management practices for woody and perennial landscape plants. It is intended to improve nutrient use efficiency and prevent excess nutrients in the environment.

b. Short Impact/Accomplishment Statement
If current trends continue, extension recommendations will change to emphasize spring/early summer nitrogen application rather than fall fertilization in order to achieve greater N use efficiency and reduce excess N in the environment. The results apply both to nursery production and landscape maintenance fertilization practices.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $12,179
State- 22,432
Total - 35,749
Full-time equivalents: Sci. 0.3; Total 0.3

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

10. Breeding and genetics of ornamental plants
a. Brief description of the activity
Breeding and genetic research has continued on Anagallis, Browallia and Nolana. Sales of Anagallis cultivars Wildcat Blue and Wildcat Orange developed at UNH surpassed 300,000 cuttings on their first year of release. Currently, 22 Anagallis breeding lines, seven Browallia lines and three Nolana lines developed at UNH are on a second year of commercial trials. We have a proposed model for flower color inheritance of blue, orange and red flower colors in this species. Knowing the anthocyanin content of specific Anagallis plants, we have been able to design hybridization schemes aiming to obtain new combinations of pigments and novel flower colors. We are developing artificial hybrids between six Nolana species from Peru and five from Chile to gain insight on relationships between species and phylogeny.

b. Short Impact/Accomplishment Statement
Two new vegetatively-propagated Anagallis (Pimpernel) cultivars bred at UNH were on their

first year in the trade. Release of other Anagallis cultivars and other annuals is expected in the near future. Collaboration with other researchers has resulted in development of a genetic model for flower color inheritance of A. monelli, and on studies of taxonomic relationships of Chilean Nolana species.

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

Source of funding: Hatch
Total expenditures: Federal - $7,973
State- 1,500
Total - 10,611
Full-time equivalents: Prof. 0.1; Total 0.1

d. Scope of impact: State specific

11. Nutrient management on organic farms

a. Brief description of the activity

Increased agricultural application of organic soil amendments offers opportunities to improve soil quality and weed management as well as challenges to the environment. This study seeks improve nutrient management on farms using organic soil amendments as a fertility source while examining effects of these amendments on weed-crop interactions.

b. Short Impact/Accomplishment Statement

The study of nutrient management on organic farms will define best management practices for organic amendment use. It will address the environmental risks of current nutrient management practices. Experiments will examine potential reduced the risk of erosion when farmers switch from the perennial alfalfa to the annual forage soybean in their crop rotation.

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

Source of funding: Hatch
Total expenditures: Federal - $15,895
State- 21,816
Total - 37,711
Full-time equivalents: Sci. 0.2; Prof. 0.3; Total 0.5

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

Key Theme - Plant Health

1. Inhibition of photosynthesis by UV-radiation

a. Brief description of the activity

Two projects are assessing this issue. These efforts are investigating 1) long-term effects of high salinity on growth, photosynthesis and antioxidant parameters, and 2) whether UV-B radiation is detected via the redox system in chloroplasts.

b. Short Impact/Accomplishment Statement

Salinity is a major stress factor reducing crop productivity world-wide. The precise roles of anti-oxidants in mediating this stress are not understood. As Dunaliella is the most salt-tolerant eukaryotic photosynthetic organism known, an improved knowledge of its anti-oxidant responses to salt stress can be significant in improving crop plant productivity. The second project will provide valuable information on the means by which chloroplasts detect changes in UV radiation. Our results will also contribute to a growing body of knowledge about the role and importance of the chloroplast redox state in plant signalling and acclimation to environmental change.

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

Source of funding: Hatch
Total expenditures: Federal - $32,981
State- 68,416
Total - 101,397
Full-time equivalents: Sci. 0.6, Prof. 0.1; Total 0.7

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, we still know little about the development of seed coat to mimic this process. The proposed research is aimed at delineating the molecular events related to seed coat and embryo development so that these processes can be manipulated in a desirable way. An example of such manipulations will be the production of soft-seed-coated or `hull-less' varieties of commercially important seeds.

b. Short Impact/Accomplishment Statement

An understanding of the molecular events during seed coat and embryo development will aid in the cloning of commercially useful plants, and lead to the development of genetically improved plants for enhanced nutrition and agronomic characters in crop plants.

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

Source of funding: Hatch
Total expenditures: Federal - $20,249
State- 26,410
Total - 46,659
Full-time equivalents: Sci 0.2, Prof 0.1, Total 0.3.

d. Scope of impact: State specific

2. Calcium control of plant enzyme activity

a. Brief description of the activity

Thirty-four genes for calcium-dependent protein kinases (CDPKs) have been identified in the fully-sequenced genome of the model plant Arabidopsis thaliana, although only 29 of these

genes are known to be expressed. Preliminary RT-PCR (reverse transcription-polymerase chain reaction) experiments indicate that, as expected, expression levels are not the same for all tissues; however these experiments have not been repeated enough times to allow us to draw final conclusions about expression patterns.

b. Short Impact/Accomplishment Statement
Calcium-dependent protein kinases are known to be important for plant responses to pathogen attack, drought stress, wounding, etc. This research has the potential to identify the specific CDPKs involved in the response to each stress so that the correct CDPK can be modified to adapt plants for specific environments.

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

Source of funding:	Hatch
Total expenditures:	Federal - $17,280
	State- 46,115
	Total - 63,396
Full-time equivalents:	Sci. 0.3, Prof. 0.6; Total 0.9

d. Scope of impact: State Specific

Key Theme - Aquaculture

1. Genetic improvement of tilapia for aquaculture
a. Brief description of the activity
Two projects continue to develop and use genetic maps to study commercially important traits in tilapia. A patent will be awarded for our discovery of a method to use a microsatellite in the prolactin gene to identify fish with appropriate genotypes for rearing at different salinities. We have also identified sex-determining genes on linkage groups 1 and 3 segregating in Nile and blue tilapia. We continue the positional cloning of a gene for red skin color in tilapia, and have preliminary information to suggest that independent red mutants in O. niloticus and O. mossambicus are allelic.

b. Short Impact/Accomplishment Statement
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. Our 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 - $25,758
	State- 36,185
	Total - 61,943
Full-time equivalents:	Sci. 0.4, Prof. 0.7; Total 1.1

d. Scope of impact:
1. State specific
2. Multistate Reseach (AL, CA, CTS, LA, NH, NJ, VA)

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. Without active intervention, the potential for a sustainable urchin fishery will not be realized. The purpose of this project is to expand and refine procedures for a semi-commercial scale hatchery system for green sea urchins as a demonstration facility to promote urchin aquaculture in the Gulf of Maine. Multiple hatchery systems are needed to service both stock enhancement and sea ranching of sea urchins to maintain an active fishery.

b. Short Impact/Accomplishment Statement

Successful hatchery production of juvenile urchins was accomplished for the sixth year in a row, confirming that a hatchery for urchin aquaculture is feasible. Suspended cage systems have proved to be effective for both juvenile grow out and for increasing production through natural recruitment into the cages.

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

Source of funding:	Hatch
Total expenditures:	Federal - $31,924
	State- 86,068
	Total - 117,993
Full-time equivalents:	Sci. 0.3, Prof. 0.5; Total 0.8

d. Scope of impact: State Specific

3. Control of pigment production of summer flounder

a. Brief description of the activity

Correct establishment of body asymmetry is important in cultured flatfish because of its links to pigmentation development. It is also crucial to the normal development of other vertebrates, including humans, in whom situs abnormalities cause serious clinical defects. This study will enhance our knowledge of asymmetry development in flatfish, and open the possibility of using them as a general model for studying control of vertebrate asymmetry.

b. Short Impact/Accomplishment Statement

Initial progress on this project lays the necessary groundwork for further analyses that will enable us to examine the establishment of flatfish asymmetry in more detail, and thus better understand the relationship between asymmetry and pigmentation abnormalities that are costly to the aquaculture industry.

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

Total expenditures:	Federal - $15,365
	State- 34,148

Total - 49,513
Full-time equivalents: Sci. 0.3; Prof 0.2; Total 0.5

d. Scope of impact: State Specific

4. Taxonomy of the seaweed Porphyra

a. Brief description of the activity

The red seaweed Porphyra ("nori") is the basis of a US$1.8 billion per year industry in Asia, primarily for use as human food (sushi). There is interest in establishing a nori industry in the U.S. based on native species of Porphyra. The goal of this study is to examine the taxonomy and ecophysiology of Porphyra species native to the coast of New England.

b. Short Impact/Accomplishment Statement

There is interest in establishing a nori industry in New England based on native species. The ultimate success depends on basic research knowledge that focuses on taxonomy and ecophysiology of native Porphyra species. Of the 7 native species, at least two are species complexes; that is, they are multiple species confused under a single name. Our recent work has revealed at least five new species in these complexes. Based on specific sequences, 2 of these new taxa are closely related to Japanese species P. yezoensis, yet they thrive in New England and would be excellent candidates for aquaculture. An understanding of physiological tolerance and response to light, temperature, and nutrient stress is critical for matching native Porphyra species to cultivation conditions.

c. Source of funding/total expenditures/full time

Source of funding: Hatch
Total expenditures: Federal - $16,281
State- 23,900
Total - 40,181
Full-time equivalents: Sci. 0.3; Prof 0.2; Total 0.5

d. Scope of impact: State specific

5. Marine finfish aquaculture

a. Brief description of the activity

Declines in wild fisheries necessitate aquaculture of marine finfish. The purpose of this study is to develop methodology for marine finfish culture in coastal New Hampshire waters.

b. Short Impact/Accomplishment Statement

Microsatellite analysis of 2 Atlantic cod populations revealed no significant differences for 7 loci. These results suggest that there are no genetic differences between these 2 reproducing cod populations in the Gulf of Maine. The findings have important implications for managing the cod fishery. The development of marine fish aquaculture in NH waters has the potential for tremendous impact on the local seafood market. Culturing cod and striped bass in NH coastal waters would diversify the aquaculture industry in the northeast and likely provide regional seafood at competitive prices.

c. Source of funding/total expenditures/full time

Source of funding: Hatch
Total expenditures: Federal - $16,838
State- 45,908
Total - 62,746
Full-time equivalents: Sci. 0.3; Prof 0.5; Total 0.8

d. Scope of impact: State specific

Key Theme - Other

1. Genetic transposition in soil nematodes

a. Brief description of the activity

These studies will enhance our understanding of agriculturally important nematodes through genetic analysis in these species. Characterization of mut-2 should provide insight into the mechanism and role of RNAi, and its relation to transposon control, in C. elegans. We want to know the role of this gene and the function of the encoded product in RNAi, transposon control and other aspects of genomic integrity in this organism.

b. Short Impact/Accomplishment Statement

We confirmed that the mutation, mut-2(r459) confers an RNAi-resistant phenotype. We will use RNAi and ts-sterile phenotypes to clone other genes by rescue. We will determine if r459 and r461 represent new alleles of known mut or rde genes. This work will enhance our understanding of the genetic mechanisms that ensure genome stability in metazoans. It may serve to identify new components of the eukaryotic RNAi machinery, and may reveal links between RNAi and other aspects of genome stability such as transposon control. The work has direct implications for agriculturally important nematodes.

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

Source of funding: Hatch
Total expenditures: Federal - $19,797
State- 40,952
Total - 60,749
Full-time equivalents: Sci. 0.3; Prof. 0.3, Total 0.6

d. Scope of impact: State Specific

2. Character and control of yeast regulatory interactions genes

a. Brief description of the activity.

Two projects contribute to this activity. The first study is investigating the functional and physical interactions of yeast regulatory genes to identify the factors that control gene expression. The second work is analyzing the mechanisms by which a leucine-rich repeat (LRR)-containing yeast protein recognizes and binds to other proteins.

b. Short Impact/Accomplishment Statement

The results are important to understanding how gene expression is controlled both in terms of

synthesis and degradation. Project one demonstrated close connections between two regulatory complexes that appear to control several aspects of gene expression. Project two found a highly conserved 4-residue consensus motif in many unique peptide aptamers isolated by their ability to bind to a model LRR protein, S. cerevisiae CCR4. The discovery of a putative LRR-binding consensus motif is a novel and highly significant result. The studies may have broad implications in understanding gene regulation and protein interaction in medically and argriculturally important organisms.

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

Source of funding:	Hatch
Total expenditures:	Federal - $40,579
	State- 95,982
	Total - 136,561
Full-time equivalents:	Sci. 0.6; Prof. 0.8, Total 1.4

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 fiscal year 2003 the New Hampshire Agricultural Experiment Station had 9.2 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 2.0 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 7.5 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 decease 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. Role of bacterial genes in diseases

a. Brief description of the activity

A better solution to reducing the bacterial population on meats without collateral hazards or radiation-induced spoilage, and more practically applicable is needed. The project's aim is to assess the susceptibility of wild type and regulatory mutants of E. coli to environmentally benign acidification and probiotics.

b. Short Impact/Accomplishment Statement

Confirmation that the yihG sequences influence toxin production in E. coli 0157:H7 provides a basis for better understanding the pathogen in general and additional results may eventually lead to a means for control of the pathogen.

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

Source of funding:	Hatch
Total expenditures:	Federal - $23,409
	State- 51,527
	Total - 74,937
Full-time equivalents:	Sci. 0.3, Prof. 0.3; Total 0.6

d. Scope of impact: State Specific

2. Host defenses against Salmonella

a. Brief description of the activity

Foodborne disease in humans due to Salmonella continues to be a major health concern. The purpose of this project is to determine how salmonella attach to human cells and to explore approaches that may block that attachment and thus prevent disease. Food-associated illness due to animal-derived Salmonella remains a major health problem in humans. By understanding the molecular and cellular events involved in Salmonella infections we can develop intervention strategies for reducing illness associated with these bacteria.

b. Short Impact/Accomplishment Statement

Our findings that a serum protein from pigs can enhance the ability of human phagocytic cells to recognize Salmonella supports the concept of highly conserved innate host defenses. Thus findings from one animal species may transcend that system to others.

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

Source of funding:	Hatch
Total expenditures:	Federal - $20,589

State- 41,826
Total - 62,415
Full-time equivalents: Sci. 0.3; Prof. 0.1; Total 0.4

d. Scope of Impact: State specific

3. Impact of microcystins on lakes

a. Brief description of the activity

Cyanobacteria toxins, microcystins, are found world-wide in lakes and are linked to serious health problems. This work will measure the pico-plankton, nano-plankton, and net phytoplankton contributions to the microcystin load in lakes of varying trophic status. The data will help develop an action/response plan for managers responsible for monitoring water quality/safety in lakes, ponds and reservoirs experiencing toxic cyanobacteria.

b. Short Impact/Accomplishment Statement

This study suggests picoplankton is a potentially important source of microcystins in lakewater that is generally not considered in toxicity studies. We are collaborating with NH DES to develop a statewide system for monitoring microcystin toxins occurring in beach areas of lakes.

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

Source of funding:	Hatch
Total expenditures:	Federal - $23,484
	State- 55,263
	Total - 78,747
Full-time equivalents:	Sci. 0.3, Prof. 0.4; Total 0.7

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 fiscal year 2002 the New Hampshire Agricultural Experiment Station had 0.9 full time equivalents of scientists time assigned to Goal 2. Their research was funded with federal funds from the HatchProgram. 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 0.8 student. 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. Obesity, insulin resistance and asthma in women

a. Brief description of the activity

Overweight and asthma are two chronic health conditions that are closely related. Both conditions are higher in females than males. Present research is aimed to determine whether the relationship between asthma and overweight are caused by imbalances in sex hormones and loss of insulin sensitivity. This study will test the hypothesis that insulin resistance is a risk of asthma development.

b. Short Impact/Accomplishment Statement

Findings suggest that insulin resistance may be a risk condition of allergy and asthma development in women. Insulin resistance which is a preventable condition, increases not only with weight gain but also in diabetes and with use of oral contraceptives.

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

Source of funding:	Hatch
Total expenditures:	Federal - $24,685
	State- 137,384
	Total - 162,069

Full-time equivalents: Sci. 0.4, Prof. 0.6; Tech 1.0 , Total 2.0

d. Scope of Impact: State Specific

2. Control of adipose tissue metabolism
(**Carey DONE**)

a. Brief description of the activity

Obesity, characterized by excess adipose tissue accumulation, has reached epidemic proportions world-wide. This project studies metabolic processes in intact adipose tissue that contribute to adipose tissue accumulation in the Yucatan miniature swine model.

b. Short Impact/Accomplishment Statement

Fat cell enlargement is the hallmark feature of obesity. The findings of this project contribute to our understanding of how fat cells may regulate their own size. The long-term impact of these findings is the knowledge toward reducing the negative health, economic and social outcomes of obesity.

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

Source of funding: Hatch
Total expenditures: Federal - $23,832
State- 46,001
Total - 69,833
Full-time equivalents: Sci. 0.3; Prof 0.2; Total 0.5

d. Scope of Impact: State Specific

3. Molecular basis of visual function

a. Brief description of the activity

Two projects are examining defects in visual function. Blindness and visual disorders in humans and animals are often caused by biochemical disorders of the retina such as genetic diseases involving faulty opsin genes or errors in opsin gene expression. The goal is to characterize the poorly studied cone visual signaling pathway to understand how defects in cone function lead to photoreceptor degeneration, visual impairment and ultimately, blindness. Furthermore, work will identify genetic factors which control opsin gene expression. Identifying these factors will be lead to a better understanding of these diseases and might enable gene therapies to cure them.

b. Short Impact/Accomplishment Statement

Studying how cone photoreceptor cells function at the biochemical level is essential for understanding the initial events in daytime vision and color discrimination. Much less is known about cones than rods, because they are present in much smaller numbers in mammalian retinas, and are difficult to isolate and purify. Our recent advances in understanding the cone visual pathway, particularly the cone phosphodiesterase enzyme, may help design better therapeutic agents that selectively target this enzyme in cone cells. Opsins are the first proteins in the signaling transduction cascade which convert light into a neural output of the retinal photoreceptors. Because of their critical function, misexpression of opsins or mutation at sites which are key to opsin function and signal transduction lead to photoreceptor cell death and often blindness. We will identify the control of opsin gene expression as well as sites which are critical for opsin function. This information is needed to

develop effective treatments to slow or reverse diseases of the photoreceptor cells that lead to visual impairment or even total blindness (e.g., macular degeneration, retinitis pigmentosa).

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

Source of funding: Hatch
Total expenditures: Federal - $31,357
State- 41,217
Total - 72,575
Full-time equivalents: Sci. 0.3; Prof 0.3; Total 0.6

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. This project examines potential mechanisms for cellular zinc transport and its regulation. The results will help us understand how the proper amounts of zinc are delivered to the proper locations in the body. Emphasis will be placed on how the brain gets zinc, since zinc is especially important for good mental function.

b. Short Impact/Accomplishment Statement

This project is making progress to identify how the brain carefully adjusts the relative rates of zinc (Zn) transport into the brain to accommodate high or low blood Zn concentrations. The blood-brain barrier (BBB) is the classic representation of this concept and we developed an in vitro BBB model using porcine brain capillary endothelial cells (BCEC). These cells responded to changes in Zn status by altering their Zn transport rate in a manner consistent with the BBB actively working to sustain brain Zn homeostasis. Two DNA sequences were identified that may represent cellular zinc transporters in the pig, a possibility that currently awaits confirmation. This data will improve our ability to evaluate the significance of zinc malnutrition in the development of brain disorders like Alzheimer's disease and dementia.

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

Source of funding: Hatch
Total expenditures: Federal - $20,883
State- 30,659
Total - 51,542
Full-time equivalents: Sci. 0.3; Prof. 0.1; Total 0.4

d. Scope of Impact: State specific

Key theme - Human Nutrition

1. Assessing the nutritional risk of the elderly

a. Brief description of the activity

Fruit and vegetable consumption is associated with a decreased chronic disease risk, especially conditions related to oxidative stress. Retinal macular pigment, composed of

carotenoids, is thought to act as an antioxidant to protect the visual system. Since humans do not synthesize carotenoids, these must be of dietary origin, and dietary supplements are being marketed with a focus on eye health. Biochemical markers and dietary assessment tools for nutritional status, coordinated with intervention and education strategies are imperative for decreasing disease risk in the elderly. This project has focused on dietary carotenoids and their deposition in the retina, as measured by macular pigment optical density.

b. Short Impact/Accomplishment Statement.
The density of macular pigment (MP), composed of the dietary carotenoids lutein (L) and zeaxanthin (Z) is being evaluated as a biomarker of fruit and vegetable consumption. Adults aged 45-75 were evaluated for dietary practices, anthropometrics, serum carotenoids and MP measured as macular pigment optical density (MPOD). Serum and dietary L and Z are correlated with MPOD. There is a significant difference in MPOD for low consumers versus the medium to very high consumers of fruit and vegetables. There was a difference observed in age quartiles and most significantly, BMI appears related to MPOD. Modifiable factors such at diet and weight appear to influence MPOD. These findings may have significant public health implications if MP is determined to protect the retina from aging eye diseases.

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

Source of funding:	Hatch
Total expenditures:	Federal - $30,145
	State- 36,220
	Total - 66,365
Full-time equivalents:	Sci. 0.3; Prof 0.3; Total 0.6

d. Scope of Impact: Multistate Research (CTS, DC, ME, MD, MA, NH, NYC, PA, RI)

2. Atherogenesis in normal and diabetic animals

a. Brief description of the activity
Cardiovascular disease is the number one cause of mortality in American men and women. Diabetes, whose incidence is increasing in America, accelerates atherosclerosis development. This project examines the role of diabetes in the development of atherosclerosis.

b. Short Impact/Accomplishment Statement
Hamsters that were either hyperlipidemic or hyperglycemic had positive immuno-histochemical (IHC) staining for low density lipoprotein (LDL) receptor (LOX-1) in endothelial cells and smooth muscle cells. Lipid hydroperoxides correlated with (log) total cholesterol, (log) non-HDL-C, and (log) HDL-C. If Lox-1 and other scavenger receptors for oxidized low density lipoproteins on the surface of vascular endothelial cells are found to be upregulated in the diabetic hamster model they may be a mechanism by which the initiation of atherosclerotic lesions may be blocked. Understanding this phenomenon may help clarify why diabetic individuals have accelerated cardiovascular disease.

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

Source of funding:	Hatch
Total expenditures:	Federal - $22,526

State- 75,446
Total - 97,972
Full-time equivalents: Sci. 0.3; Prof. 03.; Total 0.6

d. Scope of Impact: State Specific

3. Atherogenesis at the cellular level

a. Brief description of the activity

Spontaneous atherosclerosis in pigeons is an autosomal recessive trait. The purpose of this study is to isolate and characterize the gene responsible for susceptibility/resistance to atherosclerosis in pigeons.

b. Short Impact/Accomplishment Statement

Genomic DNA (gDNA) libraries from atherosclerosis-susceptible and resistant pigeons were prepared. Aortic cell culture cDNA will be used to probe these gDNA reference libraries to verify and isolate candidate genes in vivo. Initial steps in Representational Difference Analysis (RDA) to isolate candidate susceptibility and resistance genes have been optimized. Sequential extraction (based on solubility) of proteins from aorta cell cultures of each breed was optimized followed by proteome display on 2-D gels. After alignment of protein spots on gels from each breed, major differentially expressed spots were excised for mass spectrometry identification. Extractions of proteins from specific sub-cellular fractions, as well as isoelectric focusing over narrower pH ranges are being developed to simplify the search for differentially expressed proteins. Identification of this autosomal recessive gene will help explain the development of heart disease in more complex cases such as humans.

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

Source of funding: Hatch
Total expenditures: Federal - $25,425
State- 62,616
Total - 88,041
Full-time equivalents: Sci. 0.4; Prof 0.2; Total 0.6

d. Scope of Impact: State Specific

Key Theme - Food Quality

1. Protein Structure During High-pressure Cycling

a. Brief description of the activity

High pressure is used as a method of sterilization and preservation of food substances. There is no conclusive data showing how pressure cycling affects biological molecules. While scientists understand the effects of static high pressure on molecular structure, the causes of the reported effects of the pressure cycling are not known. The purpose of this project is to design, construct and test modifications to a pressure-cycling apparatus that will permit optical evaluation of molecules throughout pressurization and depressurization cycles.

b. Short Impact/Accomplishment Statement

Rapid cycling of pressure has different consequences on protein structure than does static pressure. The effect of pressure cycling on solutions of spider silk protein reveal, surprisingly, that gel formation is favored. Pressure cycling may allow unfolded protein intermediates to be trapped kinetically explaining the reason pressure cycling is more effective at sterilization than static pressure. Further work is needed to test this hypothesis.

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

Source of funding: Hatch
Total expenditures: Federal - $15,489
State- 65,025
Total - 80,514
Full-time equivalents: Sci. 0.5; Prof 0. 5; Total 1.0

d. Scope of Impact: State specific

2. Nutritional content of vegetable brassicas

a. Brief description of the activity

The vegetable Brassicas are significant sources of RDA nutrients as well as beneficial health promoting phytonutrients, such as carotenoids. There is limited data on the genetic and environmental factors affecting the nutritional content of these crops. this study seeks to determine the potential for nutrient and phytonutrient enhancement within B. oleracea L.

b. Short Impact/Accomplishment Statement

Twenty-three different B. oleracea cultigens showed significant genetic variation (2.4-fold average difference) for accumulation of Ca, Mg, K, Fe, Zn, lutein and beta-carotene over two years. The rank order of the cultigens did not change from year to year for accumulation of monitored materials. Results for the cultigen evaluations, provided to stakeholders through publications and web-site dissemination, have directly impacted vegetable growers in New Hampshire and the New England region. Simple cultivar selection and fertility modifications are cultural practices that are easily manipulated by commercial growers in order to provide the highest quality produce.

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

Source of funding: Hatch
Total expenditures: Federal - $16,482
State- 30,899
Total - 47,381
Full-time equivalents: Sci. 0.3; Prof 0.2 ; Total 0.5

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 fiscal year 2002 the New Hampshire Agricultural Experiment Station had 2.9 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 1.0 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 2.6 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 - Air Quality

1. National atmospheric deposition program
   a. Brief description of the activity
   Spreading dogbane and broad leaf aster were studied as ozone-damage indicator species.

   b. Short Impact/Accomplishment Statement
   This project identified several species of native plants that can serve as bioindicators for ozone in Acadia National Park (ACAD) and elsewhere. It further demonstrated that some species of native plants are being injured at current levels of ambient ozone in ACAD. Information generated on the nature and appearance of ozone symptoms, the pattern of foliar injury development over time, and the threshold levels of ozone exposure required to produce foliar injury allow a meaningful program of field assessment to be developed at ACAD and elsewhere. This understanding provides National Park Service with information it can use to

develop positions and policies on local and regional air quality issues.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $12,665
State- 19,186
Total-31,852
Full-time equivalents: Sci 0.2; Prof. 0.1; Total 0.3

d. Scope of Impact: Multistate Research (AR, CA, IA, IL, IN, LA, MA, MD, ME, MI, MN, NE, NH, NYC, OH, PA, TX, UT, VA, VT)

2. Tardigrade diversity as a bioindicator of sulfur dioxide pollution
a. Brief description of the activity
Sulfur dioxide pollution affects lichen health and diversity. Lichens provide a habitat for numerous invertebrates, including tardigrades. Changes in lichen communities may affect tardigrade diversity, which in turn, may represent another measure of sulfur dioxide pollution. The project will monitor lichen health by measuring photosynthetic pigment degradation and the extent of cell membrane damage. Additionally, the work will determine if tardigrade diversity can be used as a second-level indicator of sulfur dioxide pollution.

b. Short Impact/Accomplishment Statement
Lichen health, as measured by cell membrane permeability and chlorophyll content can be used to assess sulfur dioxide pollution. A clear link exists between changes in tardigrade community composition and sulfur dioxide pollution when controlled for humidity. The use of tardigrade diversity represents a valid bioindicator for air quality assessment. Using tardigrades is recommended in cases where equipment may be limited.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $15,399
State- 27,136
Total - 42,535
Full-time equivalents: Sci 0.3; Total 0.3

d. Scope of Impact: State specific

Key Theme - Biodiversity

1. Genetic diversity of northeastern conifer species
a. Brief description of the activity
Deforestation, air pollution and climate change impact the distribution and population structure of conifers species in forests. This project studies changes that have occurred in the population structure of conifers as a result of climate change and anthropomorphic impacts.

b. Short Impact/Accomplishment Statement

In order to understand the current population structure of New England's dominant spruce species, it is important to understand evolution of the species. Red and black spruce have hybridized frequently as the species range moved North and West since the last glaciation. These results help explain how different populations of spruce respond to climate changes.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $26,151
State- 51,050
Total - 77,201
Full-time equivalents: Sci. 0.3; Prof 0.2; Total 0.5

d. Scope of Impact: State Specific

2. Forest management and plant biodiversity

a. Brief description of the activity

The biodiversity of forested ecological reserves is dynamic and may decline due to natural succession and as adjacent areas become developed. Our purpose is to determine natural disturbance regimes in forested ecological reserves and determine how these factors influence biodiversity of these sites.

b. Short Impact/Accomplishment Statement

The research is divided into two parts: 1) dynamics of pitch pine stands and 2) disturbance and invasive species in transition hardwood forests. In Ossipee, NH Pine Barrens, pitch pine communities were found at 63% of sites in 1952, but had declined since. Mixed pine-hardwoods peaked at 58% of sites in 2002, but were predicted to decline to 37% by 2052 as sites transitioned to red maple. Information on exotic woody plants will allow screening of exotic introductions so that potentially invasive species can be excluded. Glossy buckthorn was negatively related to seedling density and was associated with altered abundance of other plant species. Buckthorn abundance was a better predictor of seedling abundance than canopy openness, pH, or soil clay or sand content. The research suggests that Buckthorn should be a target for eradication in NH transition communities.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $33,384
State- 75,333
Total - 108,717
Full-time equivalents: Sci. 0.5; Prof 0.6; Total 1.1

d. Scope of Impact: State specific

3. Floristic diversity in old growth forests

a. Brief description of the activity

Both the world scientific community and public have become increasingly concerned with

the state of the world's biodiversity at local, national and global scales. The composition of a forest's flora is one truly important measure of forest biodiversity. Thus, this study's purpose is to gain a more comprehensive understanding of biodiversity in New Hampshire's forests.

b. Short Impact/Accomplishment Statement
Old-growth forest floras were significantly richer in total flora, total herbaceous species, shade-tolerant woodland herbaceous species, and species unique to either the old-growth or secondary growth sites. More woodland herbaceous species of rare, infrequent, or dominant abundance rank occurred in old-growth sites. Tree community data did not reflect differences in floristic diversity, suggesting that reliance on tree data alone to infer system regeneration from disturbance would be inadequate and misleading.

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

Source of funding:	McIntire-Stennis
Total expenditures:	Federal - $15,119
	State- 50,133
	Total - 65,252
Full-time equivalents:	Sci. 0.2, Prof 0.2, Total 0.4

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. Detailed field studies have been conducted at several sites within Casco Bay and the Gulf of Maine to evaluate seaweed biodiversity patterns and numbers of invasive species.

b. Short Impact/Accomplishment Statement
Floristic comparisons of primary sites have been made [i.e. Mount Desert Island, Casco Bay and Brave Boat Harbor, Maine, plus the nearshore open coast of New Hampshire between Portsmouth and Seabrook], with these having varying historical databases. Some plants apparently disappeared whereas others were introduced from different geographies. Several other unique populations of seaweeds have also been documented. The delineation of these 'new' taxa has been based upon a combination of morphological, ecological, and molecular studies. In contrast to the four introduced species, the other two 'new' species are cryptic and have probably not been previously differentiated. These studies provide a 'unique meter' to assess the impacts of humans on nearshore coastal ecosystems, including eutropication, global warming, and the introduction of invasive species. Further they are fundamental to maintaining biodiversity and productivity of critically important coastal/estuarine habitats.

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

Source of funding:	Hatch
Total expenditures:	Federal - $23,177
	State- 56,456
	Total - 79,633

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

d. Scope of impact: State Specific

5. Biodiversity of aquatic plants

a. Brief description of the activity

Biodiversity in New England vs tropics is considerably underestimated. There is a need to assess our wetlands for the impact of aquatic invasives. We hypothesize that New England aquatic ecosystems are as rich and sometimes much richer that those in the tropics. This makes conservation of our wetlands and aquatic ecosystems extremely important.

b. Short Impact/Accomplishment Statement

The study shows that aquatic/wetland plant diversity appears to be richer than that of the tropics and therefore conservation of our wetland ecosystems of northeastern North America is extremely important. A better understanding of the biodiversity in our wetlands is needed to aid in conservation and management decisions.

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

Source of funding: Hatch
Total expenditures: Federal - $13,958
State- 7,915
Total - 21,873
Full-time equivalents: Sci 0.2, Prof. 0.2; Total 0.4

d. Scope of Impact: State specific

Key Theme - Biological Control

1. Endocrine control of reproduction in fish

a. Brief description of the activity

In the Great Lakes Region and Lake Champlain, lampreys are considered a major deterrent to fish populations because of the lamprey's parasitic phase in the lake in which it feeds on other fish with its suctorial mouth and extracts body fluid often causing high mortalities. Our purpose is to develop an alternate method of sterilizing male sea lampreys using analogs to brain hormones that control reproduction.

b. Short Impact/Accomplishment Statement

We continue to investigate the function of GnRH and its receptors. This information can be used for sterilizing lampreys in a sterile-release program in the Great Lakes Region and Lake Champlain as well as in fish aquaculture. Using cDNA comparisons, our data suggest that the lamprey gonadotropin-releasing hormone (GnRH-III) of the two southern hemisphere species are highly divergent from the lamprey GnRH-III of the northern hemisphere species, which supports the phylogeny based on dentition. The molecular evolution of the GnRH family was recently described as being divided into three families, which include GnRH-I, GnRH-II, and GnRH-III. We performed a phylogenetic analysis using GnRH cDNA sequences available on GenBank with the lamprey GnRH-III cDNAs. The lamprey GnRH forms group together to

form an additional fourth lineage of the GnRH family.

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

Source of funding: Hatch
Total expenditures: Federal - $24,308
State- 57,038
Total - 81,346
Full-time equivalents: Sci. 0.3; Prof. 0.7; Total 1.0

d. Scope of Impact: State Specific

2. Hormonal control of beetle reproduction and rearing characteristics

a. Brief description of the activity

Hormonal control of parental care and reproduction are not well understood in insect species with multiple, opportunistic reproductive bouts. This project will explore the possible role of neuropeptides on reproduction. It will also examine the role of stimulation from begging larvae on juvenile hormone titers of parental females.

b. Short Impact/Accomplishment Statement

Many beetles that have regular or opportunistic reproductive cycles with some period of parental care are pests (e.g. passalid beetles and bark beetles). Juvenile hormone (JH) agonists and antagonist have been used to control these populations. This project is using burying beetles as a model system because they are easy to manipulate and the behaviors and hormone profiles are so striking. An understanding of the potential role of JH in reproductive behaviors, e.g. pheromone production and obligatory parental care behaviors, might increase the scope of pest control compounds.

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

Source of funding: Hatch
Total expenditures: Federal - $15,303
State- 37,917
Total - 53,220
Full-time equivalents: Sci 0.3; Prof 0.3; Total 0.6

d. Scope of Impact: State specific

3. Microbial mechanisms for bioremediation

a. Brief description of the activity

To effectively use bacteria to clean-up contaminted areas, we must fully understanding how bacteria degrade pollutants. These studies examine the mechanism and purpose of bacteria internally pooling oily petroleum-based pollutants within their cells. This information will help to facilitate using bacteria to clean-up contaminated sites.

b. Short Impact/Accomplishment Statement

Microorganisms capable of degrading hydrocarbons are challenged with bringing the hydrophobic substrate into the hydrophilic interior of the cell. Transmission electron

microscopy revealed large, discrete, inclusion bodies when Acinetobacter sp. RAG-1 cells were grown on alkanes but not on non-hydrocarbon substrates. A model of inclusion body formation was developed. Comparison of other pure cultures or environmental samples to Acinetobacter sp. RAG-1 suggests that the inclusion body formation mechanisms are specific to different alkane-degrading microorganisms. Petroleum products are the most common pollutants in the environment, and the use of bacteria to degrade these toxic chemicals can be enhanced when we understand of the microbial mechanisms involved in this process.

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

Source of funding: Hatch
Total expenditures: Federal - $16,619
State- 39,112
Total - 55,731
Full-time equivalents: Sci 0.3; Prof 0.7; Total 1.0

Key Theme - Forest Resource Management

1. Organic matter supply effects on forest soils

a. Brief description of the activity

The chemistry of soil solution and surface water is often dominated by organic substances, which affect trace metal toxicity, pesticide mobility, and trihalomethane formation. Yet the sources of this dissolved organic matter are poorly known. This project quantifies various sources of dissolved organic matter in forest floor soil solution by sampling soil solution from zero tension and tension lysimeters in the Harvard Forest DIRT plots.

b. Short Impact/Accomplishment Statement

Field and laboratory studies examined relationships between litter inputs, carbon dioxide flux, and production of dissolved organic carbon and nitrogen (DOC and DON) in an attempt to understand the factors controlling DOC and DON production in forests. DOC losses in surface runoff are correlated with soil organic matter quality (C:N ratio). Our recent results show that both DOC production and soil CO2 flux are also linked to soil C:N, and respond as predicted to changes in organic matter inputs. DOC production decreases when organic matter supply is reduced, and increases when organic matter supply is increased. An unexpected result is that dissolved organic nitrogen increased with all treatments, including both the addition and removal of organic matter sources. This suggests a fundamental decoupling of the C and N cycles, with production of DOC and DON regulated by different mechanisms. Better understanding of forest nutrient cycles will improve forest management and facilitate predictions of changes in forests with changing climate.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $21,736
State- 28,942
Total - 50,678
Full-time equivalents: Sci. 0.2, Prof. 0.6, Total 0.8

d. Scope of Impact: State Specific

2. Role of fungi in forest floor nutrient availability

a. Brief description of the activity

Removal of coarse woody debris from the forest may adversely affect soil nutrient availability. This project determines if the decay fungi found in decaying coarse woody debris are linked to and transport minerals from mineral soil. Decay fungi transport elements into decaying wood but the origin of these elements is not clear. If the fungi in the wood are connected to the mineral soil, from which they obtain certain elements, ultimately replenishing the organic soil, then forest management practices may need to be modified.

b. Short Impact/Accomplishment Statement

By comparing DNA sequences of organisms from different substrates, one organism, Hypholoma capnoides, a basidiomycete that causes a white rot of wood, was identified in all substrates. Additional DNA markers are being used to determine if these isolates represent the same individual organism or clone. Preliminary results suggest that this fungus does form a hyphal bridge from mineral soil to the decaying woody debris.

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

Source of funding:McIntire-Stennis
Total expenditures: Federal - $24,512
State- 41,738
Total - 66,249
Full-time equivalents: Sci. 0.4; Total 0.4

d. Scope of Impact: State Specific

3. Measuring stocking and structure in N. H. forests

a. Brief description of the activity

Improved description of forest stocking and structure is needed to meet increasing social demands for market and non-market benefits of managed forests. This project tests a series of stocking and structural measures, and develops guidelines for their use.

b. Short Impact/Accomplishment Statement

Measurements continue on the statewide network of eastern white pine plots, including pre- and post-treatment measurement of plots on private lands that have been subject to timber sales. Litterfall and other measurements continue on the intensive plots. Initial site selection and field assessment are underway to establish a network of hardwood-dominated plots. In collaboration with state Division of Forests and Lands personnel, analysis of existing inventory from the Caroline A. Fox Research and Demonstration Forest and the Bear Brook State Forest is underway. This project will assist foresters in conducting efficient inventories and in evaluating non-timber management objectives on private and public forest lands.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $20,401

State- 29,833
Total - 50,234
Full-time equivalents: Sci. 0.3, Total 0.3

d. Scope of Impact: State specific

4. Remotely sensed forest vegetation mapping

a. Brief description of the activity

Forest vegetation maps derived from moderate spatial resolution remotely sensed imagery have lesser accuracy than most of the user community desires. The overwhelming complexity and mixture of tree species in the New England and Great Lakes states makes this problem especially true. With the advent of higher spatial resolution imagery and greater computer power, it may be possible to improve the accuracy of these forest vegetation maps. This study investigates the new imagery and make better forest vegetation maps.

b. Short Impact/Accomplishment Statement

This project incorporates very high spatial resolution remotely sensed data including Space Imaging IKONOS imagery and EMERGE digital camera imagery. Traditional supervised and unsupervised classification approaches were used on these image data sets yielding very poor results. The main reason for the failure is that increases in spatial resolution create increased amounts of informational detail. This higher spatial resolution also creates higher within class spectral variability, causing lower classification accuracies when solely using per-pixel classification techniques based upon spectral comparisons. Currently, our work is concentrating on other image processing techniques such as texture analysis and image segmentation. Segmenting images into clusters of unique texture followed by classifying those polygons based on their spectral response patterns offers the most potential for both: 1) increasing the accuracy of utilizing very high resolution images for classification, and 2) increasing the accuracy of mapping forest cover types in the northeast.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $28,084
State- 44,858
Total - 72,942
Full-time equivalents: Sci. 0.3, Prof. 0.2, Total 0.5

d. Scope of Impact: State specific

5. Genetic control of stress response of trees

a. Brief description of the activity

The goal of this research is to genetically manipulate the metabolism of polyamines (putrescine, spermidine and spermine) in poplar cells in order to test if this alteration causes a positive physiological responses of the cells to osmotic, salinity and aluminum stress.

b. Short Impact/Accomplishment Statement

The results of research will lead to the modeling of the regulation of a metabolic pathway

that will allow the use of polyamine pathway as an early stress indicator in plants. The availability of an early indicator of stress is useful in devising strategies at mitigation of stress and management of forest trees.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $21,939
State- 38,107
Total - 60,046
Full-time equivalents: Sci. 0.2; Prof 0.4; Total 0.6

d. Scope of Impact: State Specific

6. Nitrogen deposition effects on soil microbes

a. Brief description of the activity

Human activities have doubled inputs to the terrestrial nitrogen cycle in the past century. One result is the significant increase in nitrogen deposition in forest ecosystems. These studies examine how nitrogen enrichment impacts the composition, diversity and activity of the litter and soil microbial community in a forest ecosystem exposed to chronic nitrogen additions.

b. Short Impact/Accomplishment Statement

We examined the effects of nitrogen (N) enrichment on bacteria and fungi in a forest soil exposed to chronic N additions at Harvard Forest. Active fungal biomass was lower in the fertilized compared to control plots in the hardwood and pine stands, respectively. N enrichment altered the pattern of microbial substrate utilization, with the relative response to the addition of carboxylic acids and carbohydrates being significantly lower in the N treated plots, even after the data were normalized to account for differences in microbial biomass. Specific information on the influence of nitrogen deposition on different forest stands (pine versus hardwood) will help identify forests particularly susceptible to this disturbance and to anticipate forest decline of economic importance in New England.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $24,584
State- 23,708
Total - 48,292
Full-time equivalents: Sci. 0.3; Prof 0.5; Total 0.8

d. Scope of Impact: State Specific

Key Theme - Water Quality

1. Eelgrass nutrient pollution indicator

a. Brief description of the activity

It is difficult to detect the early stages and signs of nutrient over-enrichment (eutrophication) in coastal water. The project will investigate the use of eelgrass status as an indicator of early

nutrient over-enrichment in estuaries. The data will contribute to a new plant-based indicator, the Nutrient Pollution Indicator (NPI).

b. Short Impact/Accomplishment Statement
The project is identifying New England eelgrass distribution to establish a suite of plant parameters as an robust early indicator of estuarine and coastal nutrient pollution in New England, called the Nutrient Pollution Indicator (NPI). The NPI and a companion instructional CD-ROM will give coastal managers and scientists information on the nutrient status of coastal waters before obvious eutrophication occurs.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $8,504
State- 3,041
Total - 11,545
Full-time equivalents: Prof 0.1; Total 0.1

d. Scope of Impact: State specific

2. Insect-based water quality statements
a. Brief description of the activity
This project deals with evaluating water quality in New Hampshire streams and develops biotic indices for estimating water quality. The data will form the basis to build identification keys for aquatic insects used to develop water quality indices.

b. Short Impact/Accomplishment Statement
Focused sampling in stream systems of New Hampshire has revealed different species lists and abundances for those sites based on physiographic regions. A broad survey of this type is necessary to develop identification keys that will be of value to the state and region, rather than those just useful for a particular river system. Development of the keys for identification of aquatic insects and determination of their tolerance values for species will allow rapid and more precise assessment of water quality.

c. Source of funding: Hatch
Total expenditures: Federal - $31,659
State- 77,695
Total - 109,354
Full-time equivalents: Sci. 0.8; Prof. 0.3; Total 1.1

d. Scope of Impact: State specific

3. Pathogen persistence in Class B limed sludge (2 projects)
a. Brief description of the activity
Land application of biosolids may pose a public health risk due to the presence of pathogenic microorganisms. This project examines Two projects evaluate the effectiveness of several conventional biosolids treatment processes on the fate of pathogens (adenovirus, astrovirus

and Cryptosporidium).

b. Short Impact/Accomplishment Statement
To help alleviate the anxieties associated with the land application of biosolids, several different pathogens and potential indicator organisms were assessed for their survivability in alkaline stabilized biosolids. Similar inactivation conditions used at treatment plants in NH and across the US were evaluated at a bench scale level. All the pathogens tested to date are rapidly inactivated by alkaline treatment. In addition, bacteriophage may serve as a candidate indicator organism. The use of cell culture to assess the infectivity of Cryptosporidium oocysts is a rapid, cost effective method to determine whether oocysts have been inactivated by treatment methods in comparison with the standard test of animal infectivity.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $33,022
State- 56,788
Total - 89,809
Full-time equivalents: Sci 0.6; Prof 0.5; Total 1.1

d. Scope of Impact: Project 1 - Integrated Research and Extension; State specific
Project 2 - State specific

4. Application of sewage biosolids to agricultural soils (3 projects)
a. Brief description of the activity
Land application of biosolids has proven to be a controversial agricultural practice. Biosolids are valuable as soil amendments, but their land application can affect numerous systems. Three projects examine the effects of long-term application of biosolids on water quality, pathogen persistence and soil microbial biodiversity.

b. Short Impact/Accomplishment
Application of sludge as biosolids to the land remains a practice enveloped in controversy. Our results showed that regulations and permit conditions were not sufficiently protective of groundwater quality at sites where repeated applications of biosolids are made. Changes in NH state regulations were made as a result of this study. Further research is being done on the survival and migration of pathogens once they have been applied to the land. Chemical analyses carried out on the soils from all plots and on pre-application manufactured topsoil (MTS) indicated that all potentially toxic heavy metals (Cd, Cu, Ni, Zn, and Pb) were all at least 10 fold below their EPA 503 Rules limit concentrations set for high quality soil. The microbial soil community diversity data are consistent with the likelihood that lime stabilization and in situ composting of biosolids as MTS may aid in the removal of bacterial pathogens. However, by as long as seven years post application of MTS, the local soil microbial community remains measurably different from that of a nearby control site.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $39,990

State- 80,859
Total - 120,850
Full-time equivalents: Sci 0.7; Total 0.7

d. Scope of impact:
1. State specific
2. Multistate; Integrated Research and Extension (DE, MA, NJ, PA, NYC, NH)
3. Multistate; Integrated Research and Extension (DE, MA, NJ, PA, NYC, NH)

5. Transport of E. coli in New Hampshire aquifer sediments

a. Brief description of the activity

Feces from livestock and poultry are potential sources of enteropathogenic microorganisms such as bacteria, viruses, and protozoa. Because of the common use of the normally nonpathogenic E. coli as an indicator organism for fecal contamination of drinking water supplies, this research will focus on understanding the transport behavior of E. coli through aquifer sediments commonly found in southern New Hampshire. These data will assist regulatory agencies in establishing guidelines for protecting groundwater supplies for contamination by pathogenic bacteria.

b. Short Impact/Accomplishment

Groundwater contamination by enteropathogenic microorganisms is a national health concern in the United States. Bacterial transport through aquifers occurs via the processes of advection (transport only due to the flow of water), dispersion (when a zone of mixing spreads mass beyond the region of advection), attachment and detachment. Bacteria that have attached to the aquifer material can remain there permanently or become detached from the solid phase and re-enter the aqueous phase. Transfer of bacteria from the solid phase to the aqueous phase can result in the long-term bacterial release into drinking water supplies posing a potential human health risk. Slow detachment of bacteria from soil particles is often observed but not well understood. By understanding the mechanisms controlling bacterial detachment, we can design ways to protect groundwater against pathogen contamination.

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

Source of funding: Hatch
Total expenditures: Federal - $16,301
State- 33,378
Total - 49,679
Full-time equivalents: Sci 0.3; Prof 0.4; Total 0.7

d. Scope of Impact: State specific

6. Anaerobic cyanobacterial cell maintenance, growth and toxin production

a. Brief description of the activity

Lakes and ponds contain microcystin-LR related to their level of production. Nutrient loading is a likely explanation for elevated levels of cyanotoxins such as microcystin-LR. The toxins can affect public health by oral consumption leading to liver toxicity. The study will determine conditions under which cyanotoxins are produced, stored, and released.

b. Short Impact/Accomplishment
Studies of biotoxin production and release have a potential to affect public health whenever/wherever surface waters containing cyanobacteria are used in private or municipal water supplies. Biological control of biotoxin producers may be feasible as demonstrated during the course of this investigation, and is preferable to chemical control measures.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $19,047
State- 37,474
Total - 56,521
Full-time equivalents: Sci 0.3; Total 0.3

d. Scope of Impact: State specific

7. Trematode parasites as environmental indicators
a. Brief description of the activity
Trematode parasites influence important marine species and human health. This project addresses what factors most strongly influence trematode species diversity, their overall prevalence within marine nearshore communities and at what spatial scale they operate.

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. Such data helps to predict trematode impacts on marine species. Second, 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.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $16,030
State- 23,952
Total - 39,982
Full-time equivalents: Sci. 0.3; Prof 0.1; Total 0.1

d. Scope of Impact: State specific

Key Theme - Wetlands Restoration and Protection

1. Iron speciation in spodosols and wetland soils
a. Brief description of the activity
Iron oxides in soil can adsorb and immobilize trace elements. When iron oxides dissolve, sorbed trace elements may be released to the environment. Thus, the stability of iron oxides in soil can dictate trace element mobility in the environment. This project is designed to

develop methods to determine iron stability in forest and wetland soils.

b. Short Impact/Accomplishment Statement
Iron dissolution by reduction can occur in subsurface iron-rich and organic-rich soil horizons, though assumptions about Eh (status of oxygenation) control by iron oxides may not be appropriate in forested wetlands. Also, this study indicates that organically-complexed iron (II) can be a significant form of iron in the soil solutions prior to draining of the profile. These results indicate that heavy metals and phosphorus in forested wetland soils could be released to groundwater in late spring or early summer if the soils flood.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $4,118
State- 10,827
Total - 14,944
Full-time equivalents: Sci. 0.2; Total 0.2

d. Scope of Impact: State specific

Key Theme - Wildlife Science and Management

1. White-tail deer energetics
a. Brief description of the activity
Winter survival of white-tailed deer and wild turkeys is dependent upon specific forest habitat, winter severity, and relative body condition (fat deposits) before/during winter. This project examines specific physiological and bioenergetic adaptations that enhance their winter survival of white-tailed deer and wild turkeys.

b. Short Impact/Accomplishment Statement
Metabolizable energy intake (MEI) of adult, female deer was measured in July-December for maintenance rations or ad libitum feed. Maintenance deer increased consumption 10-20% in September and October to maintain weight. Deer fed ad libitum had the highest consumption in September-October. Both groups decreased consumption in November and December. Ad lib deer gained weight with 90% of weight gain occurring in September and October when consumption was 57-75% above the minimal monthly consumption rate for December. A seasonal rhythm of metabolism and energy intake is a physiological adaptation that theoretically enhances fat deposition critical for winter survival of white-tailed deer, their subsequent reproduction and recruitment. The relationship between autumnal forage/habitat on body condition may not be as strong as believed previously. The common use of autumnal body weights to assess herd health may not necessarily reflect the quality of forest habitat, winter survival of deer, or their productivity.

c. Source of funding/total expenditures/full time equivalents
Source of funding: McIntire-Stennis
Total expenditures: Federal - $30,170
State- 66,705

Total - 96,875
Full-time equivalents: Sci. 0.3; Prof 0.5; Total 0.8

d. Scope of Impact: State Specific

2. Small animal populations and forests

a. Brief description of the activity

Expanding suburban and urban developments have fragmented natural habitats and wildlife populations. This project examines the role of various land uses on long-term survival of wildlife populations

b. Short Impact/Accomplishment Statement

Approximately 1600 patches of suitable habitat were searched for New England cottontails (NEC) in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, and New York. Several distinct groups have been identified. Their range of habitats includes riparian corridors, former agricultural lands, and native shrublands. The distribution of NEC will be imposed on layers of a GIS-data base to estimate of landscape features that facilitate and limit the distribution of this species. Specific results from this investigation also may facilitate restoration of populations of New England cottontails, a species that is being considered for threatened or endangered status by the U.S. Fish and Wildlife Service.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $25,411
State- 36,464
Total - 61,876
Full-time equivalents: Sci. 0.3; Prof 0.1; Total 0.4

d. Scope of Impact: State specific

3. Predation effects on food stream webs

a. Brief description of the activity

Salamanders can achieve high densities and biomass in streams; however, few studies have examined the role of salamanders in stream food webs. The relative importance of salamanders as predators in streams is poorly understood. The purpose of this project is to determine the effects of different top predators on stream food webs.

b. Short Impact/Accomplishment Statement

This study constitutes one of the only large-scale manipulative experiments to address the role of top predators in stream food webs. It compares streams with and without trout for their invertebrate assemblage structure as well as invertebrate and salamander density and activity. In streams to which trout were added, we expected lower density of some prey taxa due to trout consumption and increases in other taxa due to reduced competition or other positive indirect effects of trout addition. Salamander activity and density were lower in trout occupied streams than in streams without trout. Following trout addition, the activity of larval two-lined salamanders decreased immediately whereas over the long-term, salamander

activity and density decreased. This project provides valuable insight into the role that stream-breeding plethodontid salamanders can play in stream bioassessment.

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

Source of funding: McIntire-Stennis
Total expenditures: Federal - $28,271
State- 45,980
Total - 74,252
Full-time equivalents: Sci. 0.3; Prof 0.6; Total 0.9

d. Scope of Impact: State specific

Key Theme - Other

1. Developing genetic systems for Frankia

a. Brief description of the activity

The purpose of this study is to develop new tools for the genetic manipulation of Frankia. The physical properties of the Frankia genome are being investigated to aid in efforts to exploit the potential of this microbial system to provide renewable resources for fuel and to restore previously disrupted environments.

b. Short Impact/Accomplishment Statement

Bacterial Artificial Chromosome (BAC) libraries for two Frankia strains (CcI3 and EAN1pec) are have been created for further analysis and use in a genome sequencing project. We are also developing site-specific mutagenesis PCR protocols for Frankia. 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 - $19,440
State- 61,493
Total - 80,933
Full-time equivalents: Sci. 0.3, Prof. 0.9, Total 1.2

d. Scope of Impact: State Specific

2. Land ethics

a. Brief description of the activity

Ethics are basic to land-based activity such as the practice of agriculture and natural resource management. Public welfare will be advanced to the extent that we can learn to chart a path toward resource and food sustainability through the observation of a land ethic. The articulation of a land ethic in the context of today's land grant universities is extremely relevant. It is the intent of this study to so articulate that ethic in all of its key dimensions.

b. Short Impact/Accomplishment Statement

Study of the sustainable agriculture programs of three land grant universities - the University of Maine, the University of Vermont and the University of Wisconsin, continued. Study of the program of Iowa State University's Leopold Center for Sustainable Agriculture was initiated. Substantial data was gathered concerning the research, teaching and extension missions of these four land grant universities. Special attention was also given to private non-profit organizations' demonstration/education efforts, to privately owned farms, and to county agricultural extension activities, in addition to campus visits. Expected impact includes a new four credit course in applied agrarian values, a possible new degree program at UNH in sustainable/ecological agriculture and local food systems which incorporates land ethics and a book designed to guide the use of an ethical value system in establishing and maintaining college sustainable agriculture programs.

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

Source of funding:	Hatch
Total expenditures:	Federal - $21,457
	State- 43,560
	Total - 65,017
Full-time equivalents:	Sci. 0.3; Total 0.3

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 fiscal year 2003 the New Hampshire Agricultural Experiment Station had 9.0 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 8.3 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. Improvement of rural and agricultural sample survey methods

a. Brief description of the activity

To be effective, local state and federal agencies and non-profit organizations need to be able to identify, characterize, and communicate with all stakeholder groups of a specific program or policy. The research is designed to test methods and evaluate approaches for identifying, characterizing, and communicating with stakeholder groups of a specific program or policy.

b. Short Impact/Accomplishment Statement

We designed, developed, implemented and evaluated methods for characteristing and communicating with stakeholder of two disinct resource management programs/policies, the Statewide Comprehensive Outdoor Recreation Planning (SCORP) and a cooperative research program. The initiative expanded the number of people contributing to SCORP and a cooperative research program planning process from 40 people to 400. Funding was secured to replicate this study with an alternative but related focus (tourism planning). Relative to cooperative research, a methodology for improving both the quantity and quality of data collected though a multi-method study of cooperative research stakeholders. The results were well received by both policy makers, program administrators and the stakeholders.

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

Source of funding:	Hatch
Total expenditures:	Federal - $13,619
	State- 39,264
	Total - 52,883
Full-time equivalents:	Prof. 0.3; Total 0.3

d. Scope of Impact: State Specific

2. Rural economic development alternatives in the northeast (3 projects)

a. Brief description of the activity

The future of rural America depends on decisions made by citizens, businesses, and legislators. Local and national leaders can use the results of the first research project not only

to understand the forces affecting them, but also to design strategies for strengthening their economies. The second project examines the health care problem in rural New Hampshire and evaluates alternative policies that could improve the situation. The third project surveys New Hampshire business owners to get a better understanding of how e-commerce has effected their business and what support services would be most beneficial.

b. Short Impact/Accomplishment Statement
Better defining the economic base of a given region using the reported multipliers will make a greater understanding of the unique character of each of these regions. Knowledge of these multipliers should help target investment in tourism in order to develop this industry in a more sustainable and compatible manner with a local community. The second project assesses the economic role of the health-care sector in rural areas. The study will show the other economic impacts in addition to loss of health care options for residents if rural hospitals close in the face of economic difficulties. Comparison of consumer internet buying preferences with producer internet selling patterns is shared with the business owners through the 'New Hampshire's Own' program so that they can better know their potential in the e-commerce market. The consumer and producer surveys will be repeated in subsequent years to see if e-commerce shopping and selling patterns change over time in New Hampshire.

c. Source of funding/total expenditures/full time equivalents
Source of funding: Hatch
Total expenditures: Federal - $58,460
State- 89,287
Total - 147,747
Full-time equivalents: Sci 0.8; Prof 0.5; Total 1.3

d. Scope of Impact: Multistate; Integrated Research and Extension (AR, CO, DE, IA, IN, MI, MN, NC, ND, NH, NV, NYC, OH, OR, PA, SC, TX, UT, VA, WA, WI)

3. Transborder forestry relations
a. Brief description of the activity
This project investigates a bioregional approach to the dimensions of dependency and sustainable development of rural communities in northern New England and southern Qubec on forest resources. It further examines how that dependency impacts wood products trade, bilateral community relations, and the forest resource itself.

b. Short Impact/Accomplishment Statement
This project has identified small markets as a key barrier to regional efforts to expand chain-of-custody marketing of certified wood products. Results have also identified sources of tension between wood products companies in northern New England and their Canadian counterparts. Knowledge of these issues will help researchers and policy makers in their efforts to understand and resolve long-standing bi-lateral wood products trade disputes.

c. Source of funding/total expenditures/full time equivalents
Source of funding: McIntire-Stennis
Total expenditures: Federal - $20,975

State- 58,384
Total - 79,359
Full-time equivalents: Sci. 0.4, Prof. 0.3, Total 0.7

d. Scope of Impact: State Specific

4. Economic considerations in municipal solid waste disposal

a. Brief description of the activity

Solid Waste Management in the U.S. has become a major problem for local government, especially in rural areas. Specific issues relate to cost considerations, environmental quality, facility siting, and economic efficiency. The purpose of this research is to examine cost effective methods for meeting waste management goals, to assist communities in program design, and to further examine the problems of siting noxious facilities.

b. Short Impact/Accomplishment Statement

Models were used to estimate the effects of unit-based pricing on per capita generation rates and the factors influencing whether towns adopted unit based pricing (pay as you throw, or PAYT). Average household size, existence of a master plan, existence of a capital improvement plan, and marginal price to dispose of waste were statistically significant influences, regardless of the price variation in the PAYT program. Towns adopting PAYT can reduce annual per capita waste generation substantially. Towns with relatively high property tax rates are more likely to adopt PAYT than those with lower tax rates.

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

Source of funding: Hatch
Total expenditures: Federal - $16,826
State- 51,443
Total - 68,269
Full-time equivalents: Sci. 0.3; Prof 0.4; Total 0.7

d. Scope of Impact: State specific

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

a. Brief description of the activity

Out of state visitors to New Hampshire often seek out locally made products and services while in the state. This project seeks to identify opinions and motivating factors for buying New Hampshire made products and services from out of state visitors. The second project examines factors that influence the preservation of open space land in New Hampshire.

b. Short Impact/Accomplishment Statement

This study was conducted prior to the launch of the 'New Hampshire's Own: A Product of Yankee Pride' marketing campaign. The study will be repeated in the following years to estimate the impact of that campaign on New Hampshire businesses, especially agricultural businesses. An analysis of community gardens in the city of Boston clearly indicates that the majority of community gardens are concentrated in the highest density census tracts. Research indicates that individuals and families in lower density neighborhoods tend to have

personal gardens, whereas high density neighborhoods tend to pool resources to form community groups to plant on public or vacant land.

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

Source of funding: Hatch
Total expenditures: Federal - $38,353
State- 61,348
Total - 99,701
Full-time equivalents: Sci. 0.6, Prof. 0.3; Total 0.9

d. Scope of Impact: Project 1 – Multistate; Integrated Research and Extension (AL, CA, CO, GA, IA, KY, LA, MA, ME, MI, NC, ND, NH, NYC, PA, TX, OH, OR, UT, WA, WV, WY) Project 2 – Multistate research (AL, CA, CO, GA, IA, KY, LA, MA, ME, MI, NC, ND, NH, NYC, PA, TX, OH, OR, UT, WA, WV, WY)

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

a. Brief description of the activity

This effort 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. Changes in the NH Employment Program (NHEP) will be tracked through membership in the Welfare Advocates Advisory Group.

b. Short Impact/Accomplishment Statement

The project website has facilitated data sharing for the multi-state project researchers. Central data processing has facilitated the merging of the multi-state data that has revolved around three themes: food security, economic well-being, and health. The findings related to food security indicate a need for more concerted educational efforts on budgeting and meal planning for those who are food insecure. Employment data indicate that the primary barriers to overcome are job availability, child care, and transportation. Lastly, participation in this study has decreased the isolation of the participants, which is endemic among this population, allowing them to feel more connected to others as well as to the community.

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

Source of funding: Hatch
Total expenditures: Federal $10,521
Total 10,521
Full-time equivalents: Total 0.0

d. Scope of Impact: Multistate; Integrated Research and Extension (CO, IN, KY, LA, MA, MD, MI, MN, NE, NH, NYC, OH, OR, UT, WY)

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 fiscal year 2003 the New Hampshire Agricultural Experiment Station had 2.3 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 1.8 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 has developed an Advisory Committee, **representing a diverse group of stakeholders**. The group will meet about 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
N. H. State Representative

Nancy Berliner
N. H. Rural Development Council

Bill Berndtson
UNH Animal Sciences

Hal Bodwell
Dairy producer

Bruce Clement
UNH Cooperative Extension

Sharon Francis
Connecticut River Joint Commission

Deanna Howard
Dartmouth-Hitchcock Medical Center

Jeff Huntington
Pleasant View Gardens

Barry Kelley
Forest industry

Tom Kelly
UNH Sustainability Program

Peter Lamb
New Hampshire Charitable Foundation

Jeanie McIntyre
Upper Valley Land Trust

John McLean
UNH Farm Manager

Dean Moreau
Yankee Farm Credit

Anne Sprague
Edgewater Farm

Chris Streeter
Blue Seal Feeds
N. H. CARET representative

Edith Tucker
The Coos County Democrat

Other efforts to reach and interact with a cross-section of stakeholders include the following:

1. Two publications targeted largely to stakeholders have been produced and each sent to an audience of approximately 10,000 per issue. Twice 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" emphasize the contributions and impacts of research sponsored by the NH AES and COLSA. Constituent reaction to these NH AES publications is encouraged.

2. The 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 was engaged with the State of NH Agricultural Advisory committee to inform them of NH AES activities and to request input.

4. 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.

5. 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.

6. The NH AES Director attended meetings with NH Vegetable Growers, the Farm Bureau, and representatives of the NH Horticulture Association.

7. Representatives of the NH AES have visited NH farms, orchards, greenhouses and extension twilight meetings to speak directly with constituents.

8. The Associate Director attended the annual N.H. Farm Bureau meeting and the Farm and Forest Exposition.

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

We will continue to meet at least 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. We expect that other, regular means of communication will be implemented as this new initiative progresses.

In addition to the interaction with our Advisory Committee, the NH AES sends its INSIGHT and Research Highlights publications 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.

C. 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 have led to AES project funding targeted in those two areas. In addition to our expanded efforts to identify and engage stakeholders, the NH-AES has begun efforts to have a survey instrument developed to assess the needs of a larger population of stakeholders. The AES is sponsoring **(with preparation through the UNH Department of Resource Economics)** the creation of a survey instrument and the survey of New Hampshire citizens to obtain input on the needs and results of AES projects as defined by the five national goals. Additionally, the 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.

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:

- Genetic bases for resistance to avian diseases
- 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)
- Strawberry production in modified environments
- Evaluation of new apple cultivars(also extension)
- Conservation of plant genetic resources
- Genetic improvement of tilapia for aquaculture
- Assessing the nutritional risk of the elderly
- National atmospheric deposition program
- Impact sewage biosolid application to agricultural soils
- 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

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.

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

- The Ruminant Feed Analysis Consortium resulted from two Hatch and multistate projects. The consortium represents a collaborative effort among researchers, feed testing laboratories, and the commercial feed industry to analyze ruminant feed, quantify relationships between the chemical composition of feeds and nutritive value, and stimulate feed analysis development and standardization.

- Lactoferrin may increase intestinal development resulting in more efficient nutrient use and healthier calves. Research indicates that lactoferrin, is effective in high protein milk replacer feeding programs and appears to enhance intestinal development.

- Improving reproductive efficiency is an economic concern to the cattle industry. 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.

- Breeding of squash, gourds, and tomatoes has improved productivity, decreased harvest injury, and enhanced produce quality. The results offer new crop opportunity for farmers as well as a new sales opportunity for retailers.

- Day-length extension altered strawberry floral initiation and development. This is a cost-effective technique to maximize fruit size for early season marketing of premium priced strawberries.

- Modifiable factors such at dietary carotenoids and weight appear to decrease risk of aging-related eye disease. These findings have significant public health implications to prevent eye diseases.

- Decision-support systems developed by UNH are currently used by 200 growers to reduce chemical use (fertilizer, growth retardants, and pesticides) by tracking actual versus optimum production levels. These systems are also being used to educate new growers in 21 universities in an integrated, scientific approach to crop management.

- Genomic resources developed to identify the genetic basis for several commercially important traits in tilapia, including sex, skin color and salinity tolerance have immediate applications for breeding improved strains of tilapia. A patent was awarded for the NH AES-developed microsatellite method to identify fish for rearing at different salinities.

- Research identified several species of native plants that can serve as bioindicators for ozone. The work further demonstrated that some species of native plants are being injured at current levels of ambient ozone in Acadia National Park.

- Changes in NH state regulations resulted from NH AES research on land application of sludge biosolids. Previous regulations and permit conditions were not sufficient to protect groundwater quality at sites undergoing repeated biosolid applications.

- Opinions and motivating factors for buying New Hampshire made products and services were identified from out-of-state visitors. The work was in conjunction with the 'New Hampshire's Own: A Product of Yankee Pride' marketing campaign.

- Analysis of community gardens in the city of Boston found most community gardens concentrated in the highest density census tracts. individuals and families in lower density neighborhoods tend to have personal gardens, whereas high density neighborhoods tend to pool resources to form community groups to plant on public or vacant land.

- State and national leaders can use the results of research on rural communities to design strategies for strengthening their economies. Investments should be targeted in health-care, tourism, and e-commerce.

- Individual and family circumstances, functioning and well-being of rural low-income families with children in the context of welfare reform have been tracked. Central data processing has effectively facilitated the merging of information on food security, economic well-being, and health themes.

- Ongoing investigatation to study factors affecting carotenoid levels in plants and the effect of carotenoids on vision was funded by a large IFAFS grant. This grant was originally leveraged from two NH AES investigators' Hatch-related research.

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

Multistate 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.

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 $363,482 of a combined Federal allocation for Hatch and Multistate of at least $ 1,366,688. This represents a 26.6% 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

Name	Project Number	Project description	FY 2003	
Loy J. Brent	H-074	Genetics, breeding and physiology of yield in cucurbits	Federal $	16,279
	H-387	Conservation and utilization of plant genetic resources	Federal $	13,868
Lord William	H-375	Multidisciplinary evaluation of new apple cultivars	Federal $	7,568
	H-436	Intensive Management systems for small fruits in New Hampshire	Federal $	23,269
Fisher Paul	H-394	Quantifying pH and plant nutrition relationships in soilless media	Federal $	12,223
	H-396	Decision support for design and control of plant growth systems	Federal $	8,946
Knight Suzann	H-402	Rural low-income families: tracking their well-being and functioning in the context of welfare reform	Federal $	10,100
Neal Cathy	H-413	Nutrient management for production and maintenance of ornamental plants	Federal $	11,715
Margolin Aaron	H-414	Application of sewage biosolids to agricultural soils in the Northeast: Long-term impacts and beneficial uses	Federal $	9,297
	H-441	Evaluation of adenovirus and astrovirus persistence in Class B limed sludge	Federal $	14,796
McDowell William	H-415	Application of sewage biosolids to agricultural soils in the Northeast: Long-term impacts and beneficial uses	Federal $	12,987
Stephan Seiter	H-419	Nutrient management on organic farms	Federal $	15,290
Giraud Kelly	H-442	Rural communities, rural labor markets and public policy	Federal $	10,222
	H-443	Beneftis and costs of natural resources policies affecting public and private lands	Federal $	14,555
Schwab Charles	H-447	Metabolic relationships in supply of nutrients for lactating cows	Federal $	27,557
	H-448	Management systems to improve the economic and environmental sustainability of dairy enterprises	Federal $	25,529
Morris Douglas	H-449	Rural communities, rural labor markets and public policy	Federal $	19,341
Erickson Peter	H-450	Management systems to improve the economic and environmental sustainability of dairy enterprises	Federal $	20,933
Alberto Manalo	H-452	Rural communities, rural labor markets and public policy	Federal $	26,560
Trumble, William		Director, NH-AES	Federal $	52,698

Assessments	**$ 9,749**
TOTAL	$ **363,482**

Integrated Project Descriptions

Loy, Brent — H-074 Genetics, breeding and physiology of yield in cucurbits

This program has resulted in the development and release of several hull-less seed pumpkins. High N levels after the vegetative stage can increase seed yield and protein N levels in seed. Higher seed protein increases its nutritional value as a food source.

Loy, Brent — H-387 Conservation and utilization of plant genetic resources

This program has developed new varieties tomatoes and winter squash that have improved quality for consumers. New gourd varieties being released will help extend gourd culture to more northernly regions. Adoption of the new glabrous summer squash varieties should eliminate harvest injury to fruit as well as skin irritation to field workers.

Lord, William — H-436 Intensive management systems for small fruits in New Hampshire

Strawberry floral initiation and development can be altered by day-length extension following induction. This finding has potential as a cost-effective technique for maximizing fruit size for early season marketing of premium priced strawberries by NH roadside stands and pick-your-own operations.

Lord, William — H-375 Multidisciplinary evaluation of new apple cultivars

The shift of the NH apple industry market orientation from wholesale to retail requires that growers offer consumers unique and exceptional varieties. Several cultivars in this planting have potential for these retail operations at the roadside stand and U-Pick markets. Growers are ordering those that are available for trial.

Fisher, Paul — H-394 Quantifying pH and plant nutrition relationships in soilless media

Recommendations from this research for correcting low media-pH problems, particularly using flowable lime and potassium bicarbonate drenches, are widely used in the industry. Iron-EDDHA is now more commonly-used as a corrective material for iron deficiency at high pH, based on this research. Growers are beginning to group plant species more effectively according to pH needs.

Fisher, Paul — H-396 Decision support for design and control of plant growth systems

Two hundred growers now use decision-support systems developed by UNH to reduce

chemical use by tracking actual versus optimum production levels. Lighting research will increase energy efficiency, reduce financial risks associated with technology investment, and increase the production season of flowering plants for growers and consumers.

Knight, Suzann — H-402 Rural low-income families: tracking their well-being and functioning in the context of welfare reform

Data was collected around three themes: food security, economic well-being, and health. Those who are food insecure need more education on budgeting and meal planning. Employment data indicate that job availability, child care, and transportation are primary obstacles. Study participation has decreased participant isolation, endemic among this population, allowing them to feel more connected to others as well as to the community.

Neal, Cathy — H-413 Nutrient management for production and maintenance of ornamental plants

If current trends continue, Extension recommendations will change to emphasize spring/early summer nitrogen application rather than fall fertilization in order to achieve greater N use efficiency and reduce excess N in the environment. The results apply both to nursery production and landscape maintenance fertilization practices.

Margolin, Aaron — H-414 Application of sewage biosolids to agricultural soils in the Northeast: Long-term impacts and beneficial uses

Land application of biosolids remains a very contentious topic. Alternatives that move society towards sustainability need to be explored. To help diminish the apprehension often encountered in the land application process, further research is being done on the survival and migration of pathogens once they have been applied to the land.

Margolin, Aaron — H-441 Evaluation of adenovirus and astrovirus persistence in Class B limed sludge

Using inactivation conditions similar to applied at treatment plants in NH and across the US, several pathogens and potential indicator organisms were assessed for their survival in alkaline stabilized biosolids. All pathogens tested to date are rapidly inactivated by alkaline treatment. In addition, bacteriophage may be a candidate indicator organism.

McDowell, William — H-415 Application of sewage biosolids to agricultural soils in the Northeast: Long-term impacts and beneficial uses

Changes in NH state regulations were made when this study showed that regulations and permit conditions were not sufficiently protective of groundwater quality at sites having repeated applications of biosolids.

Seiter, Stephan — H-419 Nutrient management for organic farms

Nutrient management study on organic farms will define best management practices for organic amendment use and address the environmental risks of current practices. The work will determine environmentally sound cropping practices when farmers switch from perennial alfalfa to nnual forage soybean in their crop rotation.

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

Analysis of consumer internet buying preferences and producer internet selling patterns is shared with the business owners through the 'New Hampshire's Own' program to better identify their potential in the e-commerce market. Repeated surveys in subsequent years to see if New Hampshire e-commerce shopping and selling patterns change over time.

Giraud, Kelly H-443 Beneftis and costs of natural resources policies affecting public and private lands

This study was conducted before the launch of the 'New Hampshire's Own: A Product of Yankee Pride' marketing campaign. The study will be repeated in the following years to estimate the impact of that campaign on New Hampshire businesses, especially agricultural businesses.

Schwab, Charles H-366 Metabolic relationships in supply of nutrients for lactating cows

This study has focused on ruminally-protected amino acids to enhance protein utilization, to increase milk protein and to decrease nitrogen excretion. More precise feeding for protein increases the conversion of feed nitrogen to meat and milk protein. This reduces the potential for nitrogen pollution and decreases feed costs.

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

The research will allow for more precise protein and amino acid formulation of dairy cattle diets. The result will be increased conversion of feed nitrogen to animal protein. This will not only reduce losses of excreted nitrogen, which is of growing environmental concern, but it will also increase dairy herd profitability.

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

Better defining a given region’s economic base using the reported multipliers will provide a greater understanding of the unique character of each of these regions. Knowledge of these multipliers should help recreation managers, town planners, and politicians to better target tourism investment to develop this industry in a more sustainable and compatible manner with a local community.

Erickson, Peter H-450 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 will determine its efficacy in high protein milk replacer feeding programs and whether lactoferrin enhances intestinal development.

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

The study will measure the importance of a hospital in a rural/semi-rural economy. The study will contribute to an economic assesment of the health-care sector in rural areas. Many rural hospitals face economic difficulties and might shut down; this study will show additional impacts beyond to loss of health care options for rural residents.