

Maine Agricultural and Forest Experiment Station
Annual Report of Accomplishments and Results
Based on the Plan of Work Report

March 2004

Hatch and Multistate Research Funds

Maine Agricultural and Forest Experiment Station
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OVERVIEW OF PLANNED PROGRAM AREAS

Goal 1—An agricultural system that is highly competitive in the global economy

Maine farmers are stewards of 1.42 million acres of land. The agricultural system in Maine directly contributes more than \$1 billion annually to the state's economy and further stimulates the economy by associated banking, transportation, retail, and service activity. Natural resources are central to the export-based economy. Maine's unique geographic properties with 4,500 miles of tidal coastline, glacial soils and a northern climate ideal for growing a number of plants and crops and yet containing a land base that is nearly 90 percent forested, offer unique challenges. Potatoes, blueberries, lobsters, and specialty food products are all exported to other states and throughout the world. Farming systems must meet market demands for high-quality products and allow agricultural products to be produced profitably, while preserving environmental quality and the health and safety of Maine's people.

To achieve a highly competitive agricultural system, Maine must produce high-quality crops and products. To do this, Maine's producers need better disease and pest prevention strategies, new crop varieties, new harvesting management techniques, new value-added products, and access to new markets. These are all areas in which researchers at the Maine Agricultural and Forest Experiment Station (MAFES) are working for the people of Maine. Following is a highlight of this year's accomplishments:

- In a detailed study of blueberry plants, MAFES researchers identified more than 128 genera of fungi from diseased stem and leaf samples, many of which have not been previously described on *Vaccinium*.
- MAFES entomologists observed that queen *Bombus impatiens*, a commercially reared species of bumble bee, were able to overwinter successfully in Maine, which is important for blueberry growers using this species for pollination.
- MAFES turf grass researchers evaluated commercial anti-dessicants to assess their influence on winter survival of four creeping bentgrass cultivars growing on three experimental putting greens. Two of these products have shown a significant benefit to survival.
- MAFES researchers performed varietal evaluation trials for spring spinach, green bean, field tomatoes, sweet peppers, sweet corn, leeks, and pumpkins.
- Working to control Colorado potato beetles on potato plants, MAFES entomologists demonstrated potential for use of synthetic plant attractant for management of the Colorado potato beetle. Management of this important pest using naturally occurring behavioral chemicals offers a biorational alternative to conventional insecticides and may decrease Colorado potato beetle resistance development rates.
- MAFES plant pathologists continued their investigations into the biology and control of seed-borne potato diseases, focusing on powdery scab, Potato Mop-Top Virus, and pink rot.
- MAFES researchers found that current-season potash had much stronger effects on potato tuber quality than did soil potassium: chip color improved dramatically as the potash rate

increased from 0 to 224 kg/ha and more slowly as the rate increased to 448 kg/ha; internal defects incidence declined dramatically as potash rate increased; and increased potash results in higher tuber potassium, calcium, and magnesium concentrations.

- A MAFES project on the invasion of the Japanese shore crab and its impact on juvenile lobsters produced interesting results. Laboratory experiments in recirculating systems showed that even with a more desirable alternative food available to the crab, and shelter provided for the lobster juvenile, the crab still consumed the lobster. MAFES researchers are monitoring the invasion of these crabs, which have recently been found east of the Penobscot estuary.
- MAFES scientists determined that faster tidal currents resulted in 22% to 24% greater shell growth in clams.
- Using a mouse model, MAFES researchers are studying the effect of hypothyroidism on reproductive cyclicity, fertilization and early embryo development in utero. The mouse model, once perfected, will be applied to dairy cattle to determine whether hypothyroidism at critical stages of development is negatively affecting reproductive efficiency.
- MAFES scientists developed a sensitive and specific method for detecting parasites, *Bonamia ostrea*, in European oysters, *Ostrea edulis*. A fluorescent in situ hybridization (FISH) assay was designed to detect *B. ostreae* in standard histological sections of infected oysters using fluorescently labeled DNA oligonucleotide probes.
- In three projects dealing with fish health, MAFES researchers have continued work on identifying and characterizing various factors of innate immunity that are important for resistance to disease in fish, developing an integrated vaccine against vibriosis and aquatic birnaviruses, and have developed an RT-PCR assay for the simultaneous general identification of infectious salmon anemia virus (ISAV) and the discrimination between the European and North American strains of ISAV.

Scientist years:	21.0
Hatch Funds:	\$685,000
Multistate Research Funds:	\$345,000
State Funds:	\$3,639,000
Total Funds:	\$6,220,000

Key Theme—Adding Value to New and Old Agricultural Products

- a) Each year, the lobster, shrimp, and crab fisheries in Maine produce millions of pounds of post-processing discards that are usually dumped in the ocean or sent to landfills. These discards include whole legs and shells with adhering meat that is not cost-effective for the processors to remove. This creates both a waste-management and overall profitability issues. MAFES researchers are developing value-added uses for minced meat and other products that can be extracted from crab and lobster processing byproducts. Researchers developed and tested crab processing byproduct (CPB) in a calcium-rich snack. They also evaluated the quality and shelf life characteristics of fresh pasta containing mechanically separated Jonah crab mince. As another value-added product, the scientists evaluated the effects of incorporating CPB into pelleted feeds on weight gain, shell strength, sensory quality and proximate composition of American lobsters. And they also investigated the

use of chitosan, from crab shell chitin, as a dip for fish fillets as well as looking at its antimicrobial properties.

- b) Impact—Crab processing byproducts including chitosan, mechanically deboned crab mince, and ground pre-picked crab legs were used to develop value-added human food products and aquaculture feed. The development of these new products and functional food ingredients can help alleviate the problems associated with waste disposal, and increase the total value of our natural aquatic food resources.
- c) Source of Federal Funds—Hatch
- d) Scope of Impact—State Specific

Key Theme—Adding Value to New and Old Agricultural Products

- a) The traditional application of manure to cropland associated with animal agricultural operations is undergoing increasing scrutiny for environmental reasons. As the number of animal units per acre increases on many farms, the problem of manure disposal increases. Further, the failure rate among Maine dairy farms has been higher than the national average, for many years. If composted manure can provide a profitable and environmentally safe means of manure disposal, this may solve the problem of manure disposal and at the same time increase the profitability of Maine's potato farms. MAFES scientists have investigated the profitability of on-farm composting using dairy manure amended with sawdust and urea to achieve appropriate moisture and carbon:nitrogen ratios for both bulk and bagged compost products. The analysis included costs of construction for a composting site, and new equipment requirements. Results indicate that at typical market prices, if all sawdust is purchased bulk composting is not apt to be profitable. To the extent that appropriate bedding is used and mixed with the manure, costs may be reduced sufficiently to generate profit. The purchase of bagging equipment for producing a bagged compost product for the retail market also generates profits.
- b) With break-even farm gate price for bagged compost ranging from \$1.43 to \$1.71 per 40# bag, and retail prices for similar products ranging from about \$2 at major retail stores to almost \$5 at more specialized outlets, MAFES researchers conclude that producing a bagged compost product for the retail market may be a potentially profitable enterprise, even for individual herds with fewer than 100 cows. The inclusion of seafood waste in the compost appears to generate a significant premium.
- c) Source of Federal Funds—Hatch
- d) Scope of Impact—State Specific

Key Theme—Animal Health

- a) The Eastern oyster is the primary species of bivalve cultured in the northeastern United States. Since 1988, however, many producers in this region have experienced annual mortalities of juvenile oysters (up 90% of total production) due to a syndrome of unknown cause. Juvenile oyster disease (JOD) is now prevalent in several areas in Maine,

Massachusetts, and New York, and there has been no way to predict the impact of JOD or test for its presence. MAFES researchers isolated a bacterial agent that was associated with affected oysters, but found it was not representative of any known genus. This research has confirmed that JOD is caused by this bacterium, for which these researchers have proposed the name *Roseimarina crassostreae* (*Roseimarina crassostreae*, gen. nov., sp. nov.), which belongs to the Roseobacter clade. MAFES researchers have also shown that exposure to antibacterial agents both delayed and reduced the impact of JOD. From data obtained from across the Northeast in 2003, MAFES scientists have confirmed (i) that the physical manifestations of disease are the same regardless of location, and (ii) that in all instances, the tissue surfaces of affected animals are colonized by *R. crassostreae*. These data also support the existence of a pool of potentially infectious *R. crassostreae* strains. The researchers believe that most new instances of JOD result from *R. crassostreae* that become enriched at oyster lease sites, and that prolonged use of culture sites may lead to increased chances of JOD-related mortalities. These scientists have also identified a probiotic that may help minimize losses in areas if JOD is a constant problem.

- b) The Eastern oyster is important economically, worth more than \$60 million annually for the Atlantic and Gulf states, and ecologically, as they help filter estuarine waters. This research into the causes and management of JOD will keep this industry healthy and viable.
- c) Source of Federal Funds—Hatch, NRI Competitive Grant
- d) Scope of Impact—State Specific

Key Theme—Plant Production Efficiency

- a) MAFES scientists are part of a multistate project that develops and tests new potato varieties under widely varying environmental conditions. Test locations range from Atlantic Canada to Florida. The goal is to select improved potato varieties to meet the production and marketing needs of the potato industry in the eastern United States.
- b) The University of Maine and Cornell University have developed and released a new potato variety known as Monticello. Monticello is a mid-season variety with white flowers. It has small, round, and attractive tubers and produces a good-quality potato chip after being held in long-term storage. Consumer tests conducted by researchers at UMaine found that it makes a tasty potato chip and that in addition to having an appealing appearance, Monticello is good boiled and baked. These qualities make Monticello a valuable additional potato variety for farmers who sell to potato chip processors and will also work well for farmers who sell to the fresh market. Growers interested in this variety should check the Maine certified seed potato directory for availability. The project is also releasing Harley Blackwell for chipping and AF1753-16 was licensed to a private company for french fry processing.
- c) Source of Federal Funds—Hatch, Special Grant

- d) Scope of Impact—Multistate research with FL, ME, NC, NJ, NYC, OH, PA, VA

Key Theme—Plant Production Efficiency

- a) The apple industry requires highly adapted and productive rootstocks to produce high-quality fruit and to maintain competitiveness in a global market. MAFES researchers as part of a multistate project are evaluating size-controlling apple rootstocks for their adaptability to Maine's climate, and their effect on yield and fruit size. MAFES researchers found none of the dwarf rootstocks currently tested were more productive than M.26 EMLA, the current rootstock of choice. Of the semidwarf rootstocks, G30 was the most productive. There was little difference in nine-year cumulative yield between dwarf and semidwarf. Semidwarf rootstocks with a lower establishment cost would be more profitable than dwarf rootstocks. Growers need winter hardy, precocious rootstocks in the same size class as M26. Two rootstocks, V1 and V2, in the M.26 EMLA size class, had similar or greater productivity, and G30 had greater productivity than M26.
- b) Impact—Rootstocks affect early yield of an apple planting. G30 has very high early yield, but lower establishment costs than dwarf rootstocks making it a more profitable choice. Based on cumulative yield after nine years, tree spacing and fruit prices, G30 revenues would be \$6050/acre greater than with M.26 EMLA.
- c) Source of Federal Funds—Hatch
- a) Scope of Impact—Multistate research with IL, IN, IA, MI, MN, MO, OH, SD, WI, AR, CA, CO, GA, KY, MA, MD, ME, NC, NJ, NY-CU, OR, PA, SC, TN, UT, VA, VT, WA, USDA/ARS, USDA/CU, Canada, Mexico

Key Theme—Plant Production Efficiency

- a) Apple production in Maine is a strong and viable industry producing a crop value of more than 11 million dollars in 2001. Increasingly the Maine apple growers are competing with foreign producers, and to stay competitive it is important to rapidly deploy new and viable apple cultivars. MAFES scientists are participating in a large, multi-year, multidisciplinary project that is evaluating the performance of new apple varieties for different growing regions within the U.S., and is developing new protocols for managing these varieties. MAFES researchers evaluated twenty different apple varieties for suitability for large-scale commercial production. Most varieties had weaknesses that would limit commercial planting with problems such as poor eating quality, severe biennial bearing, skin russetting, and excessive softening in storage. Honeycrisp and Enterprise showed the most potential for commercial production. Most varieties in this trial had good quality at harvest. Two summer apples have good potential for a short-term marketing season, Gingergold and Zestar!. Apples that performed poorly or have serious weaknesses include Sunrise, Arlet, Orin, Gala Supreme, Cameo and GoldRush.
- b) Impact—New varieties with the potential to be more profitable than current ones are being planted. Current production of Honeycrisp is 110 acres representing an increase in returns of approximately \$572,000 or \$5,200 per acre.

- c) Source of Federal Funds—Hatch
- d) Scope of Impact—Multistate research with AR, CTH, GA, MA, ME, MI, MO, NC, NH, NJ, NYC, NYG, OH, OR, PA, VA, VT, WA, WI, WV, PA/RODALE, WV(USDA), CANADA

Goal 2—A safe and secure food and fiber system

Food production and processing is important in several key sectors in Maine: dairy, fisheries, potatoes, and blueberries and other fruits and vegetables. Food safety in these areas is an important concern to producers and consumers. Researchers in the Maine Agricultural and Forest Experiment Station have continued working on food-handling and processing technologies aimed at extending shelf life of product and preventing food-borne risks. MAFES scientists have continued investigating consumer food preferences and testing crops for pesticides residues. All this work helps ensure that the people of Maine have a high-quality, safe food supply and that Maine growers and producers remain competitive in the face of changing consumer demands.

In the past year to meet Maine's performance goal to develop technologies and methods to assure access to a safe food supply for Maine people, MAFES researchers accomplished the following:

- MAFES food scientists have continued to develop methods for the detection of residual pesticides in food and water. A multi-residue method, using HPLC/DAD, was developed to detect four pesticides, widely used for turf grass management, in surface and ground water. In addition to these methods, scientists are investigating methods for attaching antibodies to standard paper surfaces to create new biosensors.
- In the area of phytochemical analysis, MAFES scientists have been screening for glycoalkaloids in potato tubers, for a number of U.S. potato-breeding organizations.
- MAFES researchers have developed a new and simpler extraction procedure, using co-polymer SPE, for the patulin in apple cider. They will use this new method to assess the prevalence of this mycotoxin in commercially available apple juices and ciders.
- MAFES researchers completed a study of demand for fresh haddock in the U.S as part of an interdisciplinary research effort to develop a financially viable farmed haddock industry in Maine.
- To assess consumers' attitudes, perceptions, and behavior toward locally grown farm products and farmers' markets, MAFES researchers conducted a survey of households in two counties in Maine.
- MAFES food scientists developed and analyzed frozen dessert products containing both wild blueberries and soy. The three bars' overall acceptability scores averaged about 5 (neither like nor dislike); testers indicated that the texture and flavor need improvements.

Scientist years:	1.7
Hatch Funds:	\$80,000
Multistate Research Funds:	\$19,000
State Funds:	\$193,000
Total Funds:	\$302,000

Key Theme—Food Safety

- a) Our ability to ensure the safety of the nation's food supply depends on the availability of accurate, rapid dependable, and inexpensive detection systems. The most reliable methods for assessing food contamination involve enrichment and selective culture conditions. Although sensitive enough to identify a single colony-forming unit, culture assays are time consuming, typically requiring 4 to 7 days. Over the past decade, researchers worldwide have developed several rapid diagnostic agents for common food contaminants. Although rapid and sensitive, implementation of these procedures for routine food screening is hampered by the requirement for skilled operators, inhibition by food constituents, and expense. MAFES researchers are developing an inexpensive, sensitive, non-PCR assay that is simple enough to be used by food processors or regulators to screen for known food contaminants. The approach employs rolling circle amplification of pathogen targets using sequence specific molecular padlocks, which we have used for detection of other bacterial targets. Researchers are concentrating first on developing this assay for *Listeria monocytogenes* because of potential application to the dairy, blueberry, potato, meat-processing, and seafood industries in Maine. MAFES scientists further modified and described a padlock probe that accurately detected *L. monocytogenes* oligonucleotide, cDNA, and genomic DNA containing a 16S rRNA sequence. This technique was effective in the presence of crude plant leaf extracts in contrast to a PCR assay, which failed to detect the presence of *L. monocytogenes* targets in crude leaf extracts. Sensitivity of the padlock procedure was determined to be 0.02 ng using *L. monocytogenes* genomic DNA. Results also showed the efficacy of molecular padlocks to detect *L. monocytogenes* pathogens in a 5-mg potato leaf RNA background and crude leaf extracts, although sensitivity of the assay is insufficient to dispense with a pre-enrichment step for reliable detection of *L. monocytogenes*. The advantage of the molecular padlock assay over other FDA-approved serological and molecular-based assays, is that it can be designed to be species or strain specific while still retaining the ability to be performed in simulated crude food extracts.
- b) Impact—This procedure should provide an alternative testing mechanism for food borne pathogens that can be used in crude food extracts.
- c) Source of Federal Funds—NRI Competitive Grant
- d) Scope of Impact—State Specific

Goal 3—A healthy, well-nourished population

Under Goal 3, the Maine Agricultural and Forest Experiment Station set for itself the performance goal of improving nutrition for all Maine people, especially the elderly and teen population. Improving the nutrition of young people is important because it is during youth that people acquire and consolidate eating patterns and develop lifelong attitudes toward food. Many diseases that affect us later in life are caused in part by poor eating habits. The nutrition of the elderly is important as Maine's population ages and more seniors are living into their eighties and beyond.

In this human nutrition program area, MAFES researchers are carrying out research projects that will lead to the development of a knowledge base that can be used by clinicians, cooperative extension, public school administrators and teachers, and social service agencies to improve the nutrition of all Maine people. Accomplishments this year include the following:

- In an investigation into the effect of dietary manganese on the functional properties of arterial walls MAFES nutritionists have documented that dietary manganese may be involved in partially offsetting contraction of arterial tissue when challenged with a stress hormone, i.e., phenylephrine.
- MAFES nutritionists continued their involvement in a multistate project designed to increase the consumption of fruits and vegetables by young adults.
- From their investigation into calcium, vitamin D, and seasonal bone turnover in adolescent girls, MAFES nutritionists have found marked seasonal variation in the levels of serum 25 hydroxyvitamin D, with levels dropping an average of 28% and parathyroid hormone levels increasing by 15% between September and March. They found vitamin D deficiency, defined as a serum 25 hydroxyvitamin D level less than 50 nmol per L, in 48% of subjects at some point in the three years.

Scientist Years:	1.2
Hatch Funds:	\$30,000
Multistate Research Funds:	\$28,000
State Funds:	\$123,000
Total Funds:	\$252,000

Key Theme—Human Nutrition/Human Health/Nutricueticals

- a) There is a revolution going on in nutrition coined the “smart food revolution.” It has to do with the growing body of research showing that everyday fruits and vegetables can function medically to prevent, treat, and even cure common diseases. Fruits and vegetables get their bright colors courtesy of phytonutrients, natural plant compounds. Anthocyanin, the phytonutrient responsible for blueberries’ deep hue, is largely thought responsible for the fruit’s protective power. Blueberries contain the highest concentration of anthocyanin of all fruits and vegetables, giving the fruit superior ability to clean up oxygen free radicals, which undermine body processes by attacking cell membranes and the genetic material contained inside cells. Smaller, wild blueberries, grown primarily in Maine and Canada, contain more anthocyanin than cultivated blueberries. MAFES nutritionists have found evidence that consumption of wild blueberries can help relax arteries and reduce the risk of cardiovascular disease and that consumption of a highly concentrated blueberry drink can lead to a rapid increase in antioxidant status in vivo. Additionally, MAFES food scientists have been working to develop new uses for blueberries. At first scientists paired blueberries with hamburgers in an attempt to eliminate the unpleasant taste that comes from reheating meats, a common practice in institutional settings. Now the researchers are putting blueberries into burgers made of beef, chicken, and turkey to improve their texture and nutritional value, a dose of cancer-fighting antioxidants and vitamins with each burger.

- b) Impact— This research has led to a USDA school lunch program initiative. The project not only makes burgers nutritionally better, it is giving a boost to Maine's wild blueberry industry by expanding new market possibilities.
- c) Source of Federal Funds—Hatch, NRI Competitive Grant, Special Grant
- d) Scope of Project—State specific

Goal 4—Greater harmony between agriculture and the environment

To achieve greater harmony between agriculture and the environment, MAFES scientists are working to protect soil and water quality, to preserve wetlands, to develop ecologically friendly waste management systems, to design sustainable agricultural systems, to develop biological pest controls, and to better manage our wildlife and other natural resources. The following are highlights of this year's accomplishments:

- In a study of the economic value of conservation easements to farmland for Maine and Georgia, MAFES economists found that people place a substantial value on preserving farmland as undeveloped open space through conservation easements.
- MAFES scientists collected data needed to create the bathymetric map of the Taunton Bay estuary.
- MAFES scientists examined the effect of large-scale applications of the clonal entomopathogen, *Beauveria bassiana*, for control of agricultural pests, on the genetics of indigenous populations of the same pathogen.
- In a multistate, multidisciplinary study on reintegrating crop and livestock enterprises, MAFES researchers are transferring soil quality and economic information to farmers who are evaluating the potential for crop and livestock integration.
- MAFES hydrologists investigated contamination of ground water by salt from many sources including road salt, landfill leachate, and sea-water intrusion. They are evaluating the application of isotopes for distinguishing between these various sources of salt.
- Using remotely sensed data based on satellite images and aerial photographs, US Census records, US Agricultural Census Data, Forest Inventory Analysis Data, USDA Natural Resources Inventory Data, and municipal tax assessment records, MAFES economists have begun a study of the causes and consequences of land use change in Maine. Because of Maine's unique landscape and the importance of coastal, forest, and agricultural resources to the regional economy, the study of land use change in Maine is particularly meaningful.
- A MAFES study focused on the analysis of watershed exports of carbon, nitrogen, and other nutrients in Maine rivers, contributing to our understanding of non-point pollution in Maine watersheds draining to the Gulf of Maine.
- MAFES scientists are evaluating seepage lake chemistry as an indicator of climate induced shifts in hydrologic connections with the landscape.
- Working with Maine salmonids, MAFES scientists are assessing locally adaptive variation within the fish populations. This information is expected to provide the most direct insights into what adaptive resources exist and how to preserve them.

- To examine effects of predation on survival of Black Tern chicks, MAFES researchers tested the hypothesis that in the absence of predation, chick survival would be near 100% and they found that using exclosures, nearly all chicks survived to fledging in the absence of predation and chick growth was not limited by food. Furthermore, a GIS analysis of wetland habitats in Maine indicated that 51 wetland sites in Maine have high potential suitability as Black Tern habitat.
- *Myrmica rubra*, an invasive fire ant species native to northern Europe, has been documented in 20 communities in Maine. MAFES researchers are looking at the presence of pathogens in these populations of the invasive ant, hoping to find new, environmentally friendly ways to control them.
- MAFES soil scientists continued an examination of the effects of residue quality on rates of carbon mineralization and soil solution chemistry.
- Creating 4,000 land use polygons in ArcGIS from CIR 1:12000 air photos for three study towns encompassing the 102 vernal pools, MAFES researchers have continued their investigation into amphibian breeding responses at landscape scales.
- MAFES research has shown that animal manure application can affect the chemical characteristics of the soil, which in turn results in changes in phosphorus bioavailability.
- As part of multistate project NRSP-3—The National Atmospheric Deposition Program—MAFES has continued to support the operation of the Greenville, Maine, NADP site over the past year. This site represents the interior forested region of northern New England and has one of the longest records of data in the network.
- MAFES researchers continued their long-term, interdisciplinary potato ecosystem project. This project is designed to provide information on the costs, productivity, and environmental impacts of alternative cropping strategies for potato.

Scientist years:	11.4
Hatch Funds:	\$374,000
Multistate Research Funds:	\$103,000
State Funds:	\$1,510,000
Total Funds:	\$2,792,000

Key Theme—Natural Resources Management

- a) Ocean fisheries management in New England and elsewhere has conventionally been applied at a very large scale. The approach has not had good success principally because it has not been able to incorporate ecological detail nor has it been able to develop the management institutions necessary for stewardship. A question of critical importance to Maine's coastal communities is "How do we build a social environment in which marine resources, especially fisheries, can be sustained?" MAFES researchers have adopted a cutting-edge approach through an integration of the social and natural sciences and a thorough understanding of the human environment, i.e., the real people involved, to try to answer this question. Work on this research program has proceeded along theoretical and practical implementation lines. On the theoretical side, it has led to the development of a conceptual approach to fisheries that emphasizes a bottom-up democratic approach to fisheries management. These ideas are based upon complex adaptive systems theory and are, in essence, a prescription for adaptation to a multi-scale, highly variable and unpredictable environment. On the practical side, the work has made a substantial

contribution to the formation of (1) the lobster zones, (2) area management of the off-shore lobster fishery under the Atlantic States Marine Fisheries Commission, (3) the sea urchin management zones within the state and (4) some current developments that plan to expand the approach to the off-shore fisheries.

- a) Impact—The development of these programs within the state of Maine and at the federal and regional levels represents a substantial change in the way marine fisheries are managed. This reform involves a significant shift in the scientific perspective of both the biological and social aspects of management.
- b) Source of Federal Funds—Hatch
- c) Scope of Research—State Specific

Key Theme—Biodiversity/Natural Resources Management

- a) *Ascophyllum nodosum*, a common, large brown seaweed, attaches to rocks and boulders on the middle shore in a range of habitats, from estuaries to relatively exposed rocky shores along the coast of Maine. In recent years this species has come under harvesting pressure because it is used for the extraction of alginic acid, a polysaccharide used in foods and in biotechnology, and is used as fertilizer. Not much was known, however, about the effect this harvesting would have on the seaweed itself and on the marine life that rely on it for food and shelter. MAFES researchers have found that *Ascophyllum nodosum* serves as habitat for more than 100 species of algae and invertebrates in Maine. Forty-five taxa, including sessile algae, sessile invertebrates, mobile invertebrates, epiphytic algae, and epiphytic invertebrates, were recorded on or in the holdfast, understory or plant body. In addition, 70 seaweed taxa were identified in the canopy space. The diversity of species associated with *A. nodosum* was greatest at moderately exposed shores. Researchers have also investigated the effects of removing the canopy and the effects of water motion on the survival of *A. nodosum* zygotes.
- b) Impact—These studies have provided the basis for rockweed regulations by the state of Maine. In particular, the Maine Department of Marine Resources (DMR) has used these findings to establish guidelines for harvesting this resource. Also, the Maine Seaweed Council (harvesters, processors, dealers and scientists) has used these findings to develop and adopt their own measures to continue the sustainable harvest of this alga. The researchers have also provided information and advise to the Canadian Department of Fisheries and Oceans and have presented their findings at several workshops, emphasizing problems concerning the old age of plants, low recruitment by *Ascophyllum*, loss of vigor and associated species with intense harvests. This outreach has led to the industry becoming more cautious in removing basal parts of plants, in cutting heights, and in annual amounts of biomass they remove.
- a) Source of Federal Funds—Hatch
- b) Scope of Research—State Specific

Goal 5—Enhanced economic development and quality of life for Americans

The following are highlights of this year's accomplishments:

- MAFES researchers continued investigating the factors that affect the location and growth of businesses located in rural Maine. Their results have implications about the effects of fiscal policy and rural industry clusters on local economic growth and development.
- MAFES economists gathered and organized data on historic and current land use trends in Maine. A variety of relevant data sources were identified in our search, including remotely sensed data based on satellite images and aerial photographs, US Census building permit records, US Agricultural Census Data, Forest Inventory Analysis Data, US Census of Population and Housing Data, USDA Natural Resources Inventory Data, and municipal tax assessment records. This project will provide an improved understanding of both the causes and consequences of land use change in Maine. Because of Maine's unique landscape and the importance of coastal, forest, and agricultural resources to the regional economy, the study of land use change in Maine is particularly meaningful.

Scientist years:	1.5
Hatch Funds:	\$63,000
Multistate Research Funds:	\$11,000
State Funds:	\$178,000
Total Funds:	\$364,000

Key Theme—Consumer Management

- In debates surrounding health and environmental labeling programs, some people have argued that the lack of consumer response to these programs may indicate that consumers do not really care about, or at least are not willing to pay more for, these types of products. Although this explanation is potentially valid, it is not necessarily true. An alternative explanation is that consumers do care about, and are willing to pay for, healthier or more environmentally benign products, but that the current state of labeling these products is slowing the development of these markets. MAFES researchers have found that that well-designed health and environmental labeling can significantly alter consumer and producer behavior. Their results suggest that U.S. consumers do value the benefits created from healthier or more environmentally benign products. Thus, consumer-driven purchases could potentially support growth in these markets. However, the results also suggest that the current state of many labeling programs, where firms can (voluntarily) label their products with simple seals-of-approval from a variety of organizations, may not be the most effective method of communicating the health and environmental attributes of products to consumers. Labels that display detailed information about health and environmental attributes would be more beneficial for consumers than a simpler labeling program. In terms of firm-level impacts of disclosure, MAFES researchers found that a lack of health or environmental labeling will generally benefit the low-price product. Although price considerations are given equal or more weight, some consumers are willing to pay a premium for products and services that feature improved health or environmental attributes. Hence, products featuring well-

designed health or environmental disclosures, will likely find broad, albeit mild, support. While not finding widespread appeal, many products may be able to fill key niches in the marketplace.

- b) **Impact**—With the increased interest in labeling programs, this information will help policy makers and producer groups to design effective and cost-efficient labels that identify the health and environmental attributes of various products. Individual producers can use this information to fine-tune product labels to attract consumers who are willing to pay a premium for products that feature improved health or environmental attributes.
- c) **Source of Federal Funds**—Hatch
- d) **Scope of Research**—State Specific

Assessments of Accomplishments

As discussed in the Stakeholder Input Process section, the Maine Agricultural and Forest Experiment Station shares the preproposals for all research projects with the Board of Agriculture and the Forest Resources Advisory Committee and the Cooperative Forestry Research Unit advisory board. In addition, as discussed in the Program Review section, all MAFES research projects are peer-reviewed. We believe that these two steps ensure that our research is good science and is meeting the needs of the state.

STAKEHOLDER INPUT PROCESS

a) Actions taken to seek stakeholder input and encourage their participation:

MAFES continued to seek the input of stakeholders during CY 2003. Research faculty and administrators attended meetings of stakeholder groups and assessed the needs expressed at the meetings. Researchers also served on a special task force appointed by the Governor to identify the needs of the dairy industry to assist it during the difficult times caused by a protracted period of low milk prices. MAFES continued to work with the Agricultural Council of Maine to identify needs of all sectors of the agricultural community.

MAFES also continued to work with the Forest Resources Advisory Committee and the Board of Agriculture to seek their input on stakeholder needs. MAFES also has expanded its “field days” where stakeholder groups observe the demonstration and research plots at MAFES research farms. Field days were held for apples, small fruits and vegetables, potatoes and blueberries, along with field days to demonstrate IPM, weed control and other special areas of interests of growers. Field days have been developed for master gardeners, landscape horticulture and greenhouse growers during the last two years. All these events allow researchers and administrators to learn more about the needs of the stakeholder groups in attendance.

b) Process used to identify stakeholders and to collect input:

The process used to identify stakeholders in CY03 was a continuation of the process used in previous years. MAFES maintains a list of all known stakeholders related to agriculture and forestry, and these groups are contacted on a regular basis. Personal visits and telephone conversations are used most frequently to collect input from these groups.

c) How collected input was considered:

With the assistance of the Board of Agriculture, the input received on agricultural issues was used to update the Maine Agricultural Center's Long Range Plan. Based on the input received and the priorities set by the Board of Agriculture, the three areas identified for expansion are profitability of agriculture, agrosecurity and food safety, and sustainable water use and irrigation as research funding permits.

The data obtained from a forestry survey of Maine adults in 2002 was analyzed further in 2003 and has been discussed with forestry groups, including the Forest Resources Advisory Committee. The information is being used to assess future research and outreach needs as viewed by the public. It has been suggested that more research is needed on ways to improve the public perception of forestry and improving the overall business climate in the state. More specifically, new research is needed to address the biological and socioeconomic uncertainties facing the forest resource during the coming years.

PROGRAM REVIEW PROCESS

The external scientific peer review process described in our 2000-2004 Plan of Work continues to be used to evaluate all MAFES projects, regardless of funding source. Preproposals are also shared with MAFES advisory committees to insure that the projects are relevant and address needs of the industry

EVALUATION OF THE SUCCESS OF MULTI AND JOINT ACTIVITIES

Multistate Activities

a) Do they address key issues, including those identified by stakeholders?

Multistate projects continue to be an important component of the MAFES research portfolio, contributing to many of the key themes identified earlier. For example, three multistate projects supported by MAFES, NE-183, *Evaluation of New Apple Cultivars*, NE-1000, *Improved Weed Control Through Residue Management and Crop Rotation*, and NE-1012, *Sustaining Local Food Systems in a Globalizing Environment*, contribute to the important issue of economic profitability identified above by improving production efficiencies, developing new production methods that reduce cost, and/or increasing yields. Another multistate project, W-133, *Benefits and Costs of Resource Policies Affecting Public and Private Lands*, provides measures of the amenity benefits that agriculture provides through open space and desirable scenes. Measurement of the amenity values makes it possible to investigate socially acceptable methods to compensate landowners for these values, thereby improving the economic viability of agriculture.

b) Do they address the needs of under-served and under-represented populations?

Research results are not specific to a given population. All research results obtained through MAFES funded projects reside in the public domain and are available to any individual or group. Some multistate projects address needs of a specific population, such as the elderly or other non-traditional stakeholders. For example, two multistate projects in the area of human nutrition supported by MAFES, NE-172, *Nutritional Risk and Antioxidant Status in the Elderly*, and NC-219, *Using Stage-Based Interventions to Increase Fruit and Vegetable Intake in Young Adults*, address nutrition needs of the elderly and young adults, both of which are non-traditional stakeholders.

c) Do the programs describe expected outcomes and impacts?

New multistate research projects are written in a format that includes a statement of expected outcomes and impacts. Older multistate projects have been revised to include expected outcomes and impacts. Multistate projects contribute to the outcomes and impacts listed in an earlier section of this report.

d) Do they result in improved effectiveness/efficiency?

Multistate projects enhance effectiveness and efficiency by having faculty from different universities work together to generate more information and knowledge than can be obtained by a single person. The information also has broader applicability as the research is performed under different conditions, such as weather, soil type, or social/cultural conditions. Some of the research could not be done without multistate participation. For example, multistate project NE-1014, *Development of New Potato Clones for Improved Pest Resistance, Marketability, and Sustainability in the East*, could not be done without the participation of all eastern states that produce potatoes. Information is needed from all production areas to fully evaluate the performance of new clones.

Integrated Research and Extension Activities

All MAFES-supported integrated research/extension activities are managed through the Maine Agricultural Center (MAC). The Center has continued to emphasize joint research/extension positions and to support integrated research/extension projects. Each year, MAC supports several research/education projects that address high-priority needs that are conducted jointly by research and extension faculty.

a) Do they address key issues, including those identified by stakeholders?

The integrated research/extension grants supported by MAC require a letter of support from the appropriate segment of the agricultural industry to ensure that the research/extension faculty have communicated with the industry and that the industry supports the project. Joint extension/research positions are presented to and approved by the Board of Agriculture before they are advertised.

b) Do they address the needs of under-served and under-represented populations?

The new extension/research position in food safety and product development allows MAFES to serve a group of stakeholders that have not been well served in the past. Established food

processors and potential home-based food processors can now obtain help in development and testing of new products. They also can be trained in food safety and sanitation requirements. Potential home-based processors have not been well served in the area of product development and testing in the past. People in this group also often live in rural areas with very few employment opportunities.

Some of the MAC projects have also served new, non-traditional stakeholders. For example, production trials for cut flowers were conducted to help people interested in developing fresh and/or dried cut flower businesses. A survey of fungal diseases that affect pumpkin production in Maine is another example of project that benefited a new stakeholder group in Maine.

c) Do the programs describe expected outcomes and impacts?

All projects submitted for MAC funding must state the expected outcomes and impacts of the research/extension activity. Upon completion of the work a short final report is required and the actual outcomes and impacts are presented in the report. The reports are then placed on the MAC website.

Examples of outcomes and impacts from the MAC projects are summarized here:

- Mastitis—an infection of the mammary gland caused by either bacteria, fungi, or mycoplasma—is the most costly disease affecting dairy farms in the U.S, costing farms an estimate \$2 billion per year. Mycoplasma mastitis is resistant to antibiotics and once infected, a cow may remain infected for her life serving as a source of infection to other cows in the herd. MAC funding has allowed UMaine scientists to develop mycoplasma culture procedures for the UMaine Animal Disease Diagnostic Laboratory and to routinely offer the culture of mycoplasma in milk from Maine dairy farms. This project also enhanced the capabilities of the diagnostic lab staff so that additional diagnostics can be offered to Maine producers.
- The blueberry spanworm is a destructive spring caterpillar pest that can defoliate the wild blueberry. Infestations of spanworm larvae can completely defoliate large areas of both crop and bearing fields and greatly reduce wild blueberry production. Data from a MAC project led to the development of a statistical model for forecasting the proportion of eggs that have hatched in a field at any given point in time as long as daily soil surface temperatures are monitored. This “early warning” system should reduce the number of visits to a given field by 50 to 75 percent, thus reducing costs while providing better control.
- Specialty cut flowers (cut flowers other than roses, chrysanthemums and carnations) offer great potential for connecting Maine producers with urban consumers, and offer higher profits and rising demand compared to traditional field crops. UMaine research and extension staff established field trials to assess the performance of specialty cut flower production in rural Maine. Harvested flowers were distributed through a wholesale broker and were welcomed by local retail florists. Survey results from the owners of the 80 retail florist shops revealed that 20 of the 21 respondents had previously purchased from local growers, and all 21 were interested in doing so in the future. They reported that their decision to buy Maine-grown flowers was based on high quality, direct delivery from farm to shop, and availability of unusual flowers.
- The majority of new food products fail within one year of introduction because consumers do not find them appealing or worthy of brand loyalty. Careful pre-testing with consumers can

reduce risks for food companies that want to expand their product lines. To promote growth among Maine food and personal product industries, UMaine scientists are offering sensory evaluation workshops that will be held in the new Consumer Testing Center (CTC) at the University of Maine. The workshops are designed to benefit companies with existing sensory testing programs as well as firms that may want to initiate programs in the future. MAC funds were used to purchase workshop supplies and to enhance facilities for the CTC.

d) Do they result in improved effectiveness/efficiency?

Joint appointments are an effective way of insuring that research and extension activities are integrated. Furthermore, it helps insure that the research is relevant to stakeholders because of the close interaction that occurs between the faculty member with a joint appointment and the segment of the industry he/she serves. Supporting projects that have principal investigators from both MAFES and UMCE is also an effective way to integrate research and extension activities.

MULTISTATE EXTENSION ACTIVITIES

Not Applicable

INTEGRATED RESEARCH AND EXTENSION ACTIVITIES

The Maine Agricultural and Forest Experiment Station has continued to expand its integrated research and extension activities through the Maine Agricultural Center. One new joint extension/research position was filled during CY03. Over the last four years, the number of faculty with joint appointments in the experiment station has increased by 100 percent.

In CY03, MAC funded eight projects that had co-principal investigators from MAFES and UMCE. About \$27,000 was provided to support these projects.

The Maine Agricultural and Forest Experiment Station has met its requirement to spend at least 12.8 percent of its Hatch allocation on integrated activities. Based on FY03 Hatch allocations, our target for integrated activities was \$222,266. We are certifying a total of \$316,693 expended on integrated activities for FY03. Form CSREES-REPT is attached.

