V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			5%	
102	Soil, Plant, Water, Nutrient Relationships			20%	
112	Watershed Protection and Management			16%	
123	Management and Sustainability of Forest Resources			16%	
133	Pollution Prevention and Mitigation			6%	
135	Aquatic and Terrestrial Wildlife			13%	
136	Conservation of Biological Diversity			3%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			21%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.9	0.0
Actual Paid	0.0	0.0	2.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	143384	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	237656	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	288421	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conduct scientific research. Publish peer-reviewed journal articles and other publications. Present findings at professional and public meetings and at other venues. Educate undergraduate and graduate students.

2. Brief description of the target audience

Maine natural-resource-based industries, Cooperative Extension staff, other scientists, state and federal policymakers, regulators, and legislators, classroom teachers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2014

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	18	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of other publications

Year	Actual
2014	5

Output #2

Output Measure

- website: www.mainelandusefutures.org

Year	Actual
2014	1

Output #3

Output Measure

- Extramural funds awarded to researchers in this program area

Year	Actual
2014	433597

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Development of new knowledge and technologies and the transfer of these to clientele to address the effects of climate variability and change
2	Enhance adaptive capacity of production and natural systems to reduce exposure and vulnerability to climate change
3	Improve mitigation strategies for the reduction of greenhouse gas emissions and increase carbon sequestration in production and natural systems and communities
4	Improve knowledge on the effects of climate change on Maine's lake water quality

Outcome #1

1. Outcome Measures

Development of new knowledge and technologies and the transfer of these to clientele to address the effects of climate variability and change

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Freshwater ecosystems are heavily affected by a combination of ongoing and accelerating global climate changes and a suite of localized environmental stressors linked to increasing human resource use. These impacts have the potential to strongly degrade freshwater ecosystems and the cultural, economic, and social services (e.g., fisheries) they provide the people of Maine. Although water managers can do little about changes in temperature and hydrological cycles expected with the regional effects of climate change, they can mitigate impacts by prioritizing the maintenance of resilient freshwater ecosystems when making decisions on the sustainability of localized environmental stressors. However the ability to make these decisions is limited by a lack of understanding of how local stressors influence the vulnerability of freshwaters to climate change.

What has been done
MAFES researchers are analyzing the current biological monitoring database to investigate the impact of natural and anthropogenic environmental gradients on freshwater food webs, using the database in a novel way by partitioning the abundance of commonly assayed organisms into three trophic levels (predators, herbivores and algae) to quantify how the trophic structure of food webs (e.g., relative abundance of predators and prey) change with local environmental stress.

Results
To date, the scientists have, made a series of recommendations on how to improve the use of biological information in wetland assessment. Their recommendations include (i) developing closer links between structural and functional measures of ecosystems and (ii) incorporating the confounding effects of spatial and temporal drivers of ecological processes. Results from a field survey of the impact of urbanization on the structure and function of vernal pool food webs

revealed that the more open canopies of urban vernal pools produced communities more dependent on algal resources, whereas the heavily shaded vernal pools in unmodified forest were dominated by detritivores consuming terrestrial leaf litter. The researchers has shared his findings with a broad audience of freshwater and fisheries scientists and resource managers from Maine Department of Environmental Protection, Maine Department of Inland Fisheries & Wildlife, NOAA, USFWS, Penobscot Nation and the Atlantic Salmon Federation during participation in working groups and focus groups.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #2

1. Outcome Measures

Enhance adaptive capacity of production and natural systems to reduce exposure and vulnerability to climate change

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Facing a variety of pressures, from a highly competitive international market to the uncertainty of potential climate changes, tree-fruit growers must look to economically and environmentally sustainable management schemes of production. Growers who want to stay profitable must establish high-density plantings with smaller trees using new cultivars. These high-density plantings cost 10 to 20 times more per land area to establish than lower-density plantings, thus greatly enhancing economic risk. Additionally, high-density systems were originally developed in Europe with rootstocks adapted to a European climate. Finding new high-performing rootstocks less susceptible to the rigors of the North American production areas is important. Furthermore, some scientists predict that rootstocks will have to be more competitive for nutrients and water as inputs decline due to environmental stressors.

What has been done

In this integrated project, MAFES scientists, as part of multistate project NC140, established a trial was established with 10 different rootstock genotypes to measure suitability to high-density orchards in Maine. Another trial was established with four genotypes as a grower-collaboration in far northern Maine. They measured cold-temperature tolerance fall, winter, and spring in 16 genotypes, and under deacclimating conditions in four genotypes. Early onset of cold hardiness, an economically important trait, occurred in several varieties of apple. The ability to maintain hardiness during warm weather in winter is critical to tree survival and occurred in one of the four varieties measured.

Results
Results from NC-140 research continue to accelerate the process of identifying superior performing tree rootstocks and of their propagation and commercialization. Growers in various regions of the North America have benefited by having these rootstocks made available earlier by nursery companies. The NC-140 cooperative plantings have identified the benefits of the disease resistant CG rootstocks for North American sites. In Maine, as a result of this research, growers are planting trees that are more productive and have greater adaptation to the local climate.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Improve mitigation strategies for the reduction of greenhouse gas emissions and increase carbon sequestration in production and natural systems and communities

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Improve knowledge on the effects of climate change on Maine's lake water quality

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2014 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Although recent research has documented earlier ice-off dates and increased concentrations of dissolved organic carbon (DOC) in many lakes of the northeastern U.S., the extent to which associated changes in the physical and biological structure of these systems are occurring remains unclear. These changes, however, have the potential to substantially alter lake productivity and community structure thereby affecting drinking water quality, trophic transfer of toxic substances, and fisheries resources. Understanding the links between DOC, algal communities, and climate-relevant lake thermal structure will aid drinking water utilities in assessing the degree of risk and required treatment strength with DOC fluctuations in their water source.

What has been done
MAFES scientists conducted a detailed survey of Jordan Pond in Acadia National Park, a lake that has been exhibiting declining water clarity and increasing DOC over the past two decades. The researchers collected detailed baseline data for the lake, by conducting vertical profiles of the lake every 2 weeks over a 7-month period. Samples were collected for physical, chemical, and biological features.

Results
This research provided a more comprehensive perspective on the dynamics of physical, chemical, and biological succession from the time the ice went off this Maine lake to the time it went back on in the fall.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations are currently conducted at the project and program levels. At the project level, all projects are reviewed by an internal research council and external peer reviewers when initiated and again at completion by the research council. During the research council final evaluation, the focus is on determining if terminating projects met their stated objectives, secured extramural funding, and produced peer-reviewed publications. For FY14, 2 projects went through the review process in this program area. As for other measures of successful research programs, faculty in this program area published 18 peer-reviewed articles and secured more than $433,597 in extramural funding. Researchers use a variety of methods to evaluate their own research projects including evaluations retrospectively, before-after, and during the life of the project; case studies; and comparisons between treatment/intervention and nontreatment/nonintervention.
At the program level, external NIFA review teams are asked to review the research programs of schools/departments. These teams provide input on the impact and productivity of research programs supported through the station. The station is working to develop a standard program-level evaluation process, which will be used to evaluate each station program area. Our current plans include an approach based on use of expert panels as recommended by the federal Government Accounting Office with individual program evaluations occurring every four to five years on a staggered time table.

Key Items of Evaluation

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