

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Sustaining Natural Resources

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
111	Conservation and Efficient Use of Water			7%	
123	Management and Sustainability of Forest Resources			10%	
132	Weather and Climate			2%	
133	Pollution Prevention and Mitigation			2%	
134	Outdoor Recreation			8%	
135	Aquatic and Terrestrial Wildlife			43%	
136	Conservation of Biological Diversity			13%	
206	Basic Plant Biology			7%	
301	Reproductive Performance of Animals			2%	
306	Environmental Stress in Animals			4%	
723	Hazards to Human Health and Safety			2%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	5.4	0.0
Actual Paid Professional	0.0	0.0	6.9	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	332717	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	610042	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	363425	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

Other scientists; teachers at all levels; directors of aquariums and museums, exhibit halls, etc.; endangered species biologists/managers; policy makers; state regulatory agencies; environmental consultants

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	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: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	6	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- # of other types of publications

Year	Actual
2012	6

Output #2

Output Measure

- # of research projects completed

Year	Actual
2012	5

Output #3

Output Measure

- Faculty in this program area secured \$1,635,254 in extramural funding

Year	Actual
2012	1635254

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of streams identified as promising or critical candidates for native salmonine conservation, based on potential perturbation from invasive species and/or riparian zone management
2	# of natural resource managers or biologists incorporating research results on conservation of native fishes into official policy and management plans
3	Number of management agencies using empirical data and model systems to draft recommendation on fish management and conservation
4	Percentage savings for the U.S. government in the cost of estimating the number of harbor seals after a new protocol for estimating the number of harbor seals has been adopted as a standard for the Northeast.
5	Recovery actions will be implemented to conserve the endemic Clayton's copper butterfly and its habitat
6	Increase in the distribution and abundance of migratory fish in Maine
7	Population monitoring plan will be instituted for the long-term use of the Maine Dept. of Inland Fisheries & Wildlife biologists to ensure the conservation and recovery of Clayton's copper butterfly
8	# state and federal agencies applying knowledge of bird migration patterns in the Gulf of Maine in planning and permitting decisions related to off-shore wind development in state and federal waters
9	# regulatory agencies considering impacts of fishing activities and coastal/offshore energy development activities on seabird breeding and foraging as they relate to population regulation in the Gulf of Maine
10	Development, by state and federal agencies, of long-term resource management plans that use a "seasonal interactions" framework for songbird, shorebird, and seabirds in the region
11	Improve knowledge of, or strategies and tools for, protecting fish and wildlife habitat
12	Adoption of strategies for protecting fish and wildlife habitat

Outcome #1

1. Outcome Measures

of streams identified as promising or critical candidates for native salmonine conservation, based on potential perturbation from invasive species and/or riparian zone management

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

of natural resource managers or biologists incorporating research results on conservation of native fishes into official policy and management plans

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of management agencies using empirical data and model systems to draft recommendation on fish management and conservation

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Humans are currently the world's most potent evolutionary agent, drastically reshaping the face of biodiversity in the wake of various forms of disturbance. Indeed, many of our current approaches to the management and conservation of natural resources can alter such genetic diversity for the better or worse. Although the preservation of locally adapted diversity is commonly cited as a central tenet of conservation biology and natural resource management, several factors still limit our ability to implement evolutionarily-informed monitoring and management practices: (1) population resources (genetic and phenotypic) are often poorly characterized, (2) a lack of quantitative insights into the role of evolutionary diversity in the fate of populations and function of

ecosystems, and (3) a lack of guidance to managers and the public with respect to why or how genetic diversity and ongoing evolution should be incorporated in resource management.

What has been done

University of Maine scientists are conducting empirical research to assess potential reciprocal interactions between evolutionary diversity, ongoing evolutionary processes mediated by humans, and emergent ecological effects on aquatic populations, communities and ecosystems. They are also beginning to develop a synthetic eco-evolutionary framework to problems in ecology and conservation biology, by employing appropriate theory and model systems. Further efforts involve providing resource managers and the public with scientifically based insights into the evolutionary resources that exist in Maine's aquatic ecosystems and the potential consequences of various resource management decisions.

Results

Based on University of Maine research on the diversity of among Arctic charr populations in Maine, management agencies (MDIFW), local interest groups and NGOs (TU, The Nature Conservancy) are now emphasizing the importance of local populations in management of both healthy and imperiled populations in Maine. This research has led to an almost 180 degree change in perspective to one that greatly values local populations and their ecological significance. University scientists have provided evolutionarily informed reviews of fisheries management projects planned by MDIFW. Their comments in those cases have direct influences on the implementation of such projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #4

1. Outcome Measures

Percentage savings for the U.S. government in the cost of estimating the number of harbor seals after a new protocol for estimating the number of harbor seals has been adopted as a standard for the Northeast.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Recovery actions will be implemented to conserve the endemic Clayton's copper butterfly and its habitat

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Increase in the distribution and abundance of migratory fish in Maine

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Native fishes of commercial, recreational, or ecological importance in Maine, such as Atlantic salmon, brook trout, alewife, and sea lamprey, have experienced range-wide decline because human activities have degraded freshwater habitats. Recently humans have sought to mitigate these negative impacts and restore native fisheries, especially for migratory species, by removing dams and restoring access to historic habitat. Both types of human impact can result in rapid changes to in-stream habitat, and it is vital to understand how native species respond and how their functional roles change so we can evaluate and adjust management objectives and actions accordingly. Much of Maine's economy and cultural identity is based upon restoring native fish species and their habitats while also providing angling opportunities for citizens and tourists.

What has been done

University of Maine ecologists have described and quantified changes in fish assemblage structure and function, and monitored demographics of sentinel species such as Atlantic salmon, sea lamprey, and alewife, in response to dam removal and restored habitat connectivity in small streams and large rivers.

Results

Their research showed distinct patterns in stream fish metrics over time and space due to the presence of a dam, and immediately after removal we saw drastic changes, including sea lamprey, juvenile ATS, and alewife recolonizing previously inaccessible habitat. Furthermore, they documented a four-fold increase in abundance of sea lamprey adults and showed that lamprey spawning alters physical habitat in the stream, and that other biota respond quickly. This study will help the scientists predict how other streams will respond to impending dam removal, and assist managers in future planning.

4. Associated Knowledge Areas

KA Code **Knowledge Area**
135 Aquatic and Terrestrial Wildlife

Outcome #7

1. Outcome Measures

Population monitoring plan will be instituted for the long-term use of the Maine Dept. of Inland Fisheries & Wildlife biologists to ensure the conservation and recovery of Clayton's copper butterfly

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Clayton's copper butterfly is listed as endangered in Maine and is known from only 13 sites globally (in Maine and New Brunswick, Canada). The population size has only been estimated at one of these sites in Maine.

What has been done

MAFES scientists conducted field studies from 2007-2011 to increase understanding of the distribution and density of eight Clayton's copper butterfly sub-populations in Maine. With the exception of Maine's largest occurrence, censuses to estimate site-specific population density had not previously been done. One subpopulation of Clayton's copper went extinct during the study. They also analyzed butterfly-host-plant habitat characteristics to address issues related to wetland habitat requirements at seven sites occupied by Clayton's copper butterfly.

Results

The researchers recommended a sampling approach for Clayton's copper butterfly to the Maine Department of Inland Fisheries & Wildlife, the agency responsible for conservation of this state endangered species. Estimates of Clayton's copper population density at eight of the nine known sites (one of which has apparently gone extinct) will aid state personnel in prioritizing sites for management. These results provide baseline information for future study of butterfly and host plant population dynamics at each site.

4. Associated Knowledge Areas

KA Code **Knowledge Area**

135 Aquatic and Terrestrial Wildlife

Outcome #8

1. Outcome Measures

state and federal agencies applying knowledge of bird migration patterns in the Gulf of Maine in planning and permitting decisions related to off-shore wind development in state and federal waters

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

USFSW and CWS

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
301	Reproductive Performance of Animals
306	Environmental Stress in Animals

Outcome #9

1. Outcome Measures

regulatory agencies considering impacts of fishing activities and coastal/offshore energy development activities on seabird breeding and foraging as they relate to population regulation in the Gulf of Maine

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Development, by state and federal agencies, of long-term resource management plans that use a "seasonal interactions" framework for songbird, shorebird, and seabirds in the region

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A great many migratory bird populations that breed in New England have experienced dramatic declines over the past few decades. It is important to understand how migratory birds are affected by events occurring away from the breeding grounds along with the need for suitable breeding habitat so we can separate the direct effects of breeding habitat quality from carry-over effects set in place before birds arrive to breed.

What has been done

University of Maine scientists have focused on understanding the interaction among ecological, behavioral, and physiological factors as underlying mechanisms influencing how life history stage-specific responses can be carried over from one stage to the next. They have been examining plasma hormones, metabolites, immune function, and other measures of body condition in a variety of migrant and resident landbird and seabirds during different stages of the annual cycle. The researchers also use stable isotope signatures incorporated into tissues such as feathers, claws, and blood as biogeographic markers of where and when within the annual cycle individuals may be encountering challenges to their energy demand.

Results

The results of this project have led to an increased understanding of how migratory bird populations are regulated throughout the annual cycle, and how different stages of the annual cycle are not discreet and independent units. A series of laboratory and field studies has shown that stages of the annual cycle, often treated as discreet units and studied independently, have significant overlap, and that environmental factors can influence physiological mechanisms that manifest as seasonal interactions across the non-breeding, migration, and breeding periods.

Maine's Department of Environmental Protection, Department of Conservation, and Department of Inland Fisheries and Wildlife, along with the U.S. Fish & Wildlife Service, are using this information to develop long-term resource management plans based on a seasonal interactions framework for songbird, shorebird, and seabirds in the region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
301	Reproductive Performance of Animals
306	Environmental Stress in Animals

Outcome #11

1. Outcome Measures

Improve knowledge of, or strategies and tools for, protecting fish and wildlife habitat

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

As Maine's forest landscape continues to change in response to economic and societal expectations, it has become critical for researchers and natural resource managers to have access to the most advanced information and technologies to plan for the future.

What has been done

University of Maine forest scientists have applied integrated data sets including time-series satellite imagery, GIS data, spatial modeling and statistics to address changing forest-cover composition and structure, recent insect defoliation events (gypsy moth), forest vulnerability to insect defoliation (spruce budworm), and disturbance rates and intensity in Maine forests and watersheds. An interdisciplinary team has integrated satellite-derived forest disturbance maps with aspatial Forest Inventory and Analysis (FIA) plot data to evaluate potential spruce budworm impact for a large northern forest study area.

Results

Using a version of the Spruce Budworm Decision Support System, researchers have successfully modeled the relative abundance of a suite of tree species groups required for landscape simulation using partial least squares regression, coupled with a genetic algorithm for optimal selection of predictor variables. Preliminary results indicate that the relative abundance of budworm host species can be modeled with a high degree of accuracy which will greatly improve our ability to model budworm dynamics. Project results will be important to land managers and municipal planners in understanding and predicting changes in forest composition and land use and in working toward improved methods of forest resource assessment using appropriate remote sensing technology.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #12

1. Outcome Measures

Adoption of strategies for protecting fish and wildlife habitat

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Commercial forest harvesting across the ~10 million acres of privately owned lands in northern, eastern, and western Maine exerts the greatest affect of all human activities on the habitat quality and population densities of resident vertebrates. Since the late 1990s, approximately 500,000 acres of commercial forestland have been harvested annually and forest management has increasingly come to rely on a variety of partial harvest treatments that result in a wide range of residual forest conditions. Since 1991 and the implementation of the Maine Forest Practices Act, harvested wood volumes have remained relatively stable, whereas the annual harvesting footprint has more than doubled and the annual acreage in partially harvested treatments has increased from approximately 50% to 96% of the area harvested.

What has been done

University of Maine wildlife ecologists have been evaluating the effects of current forest practices on a classic early successional species (i.e., snowshoe hares) and a classic mature and conifer-associated species (spruce grouse) and modeling the influences of those effects across the rapidly changing commercial forest landscapes of northern and western Maine.

Results

Their report titled "A landscape planning initiative for northern Maine using area-sensitive umbrella species" (July 2011) has been used as the foundation for a multi-species forest management plan implemented by The Nature Conservancy across 186,000 acres of northern Maine. This plan is being used as a prototype by several other large commercial forest landowners who are participating in a landscape planning initiative funded by the USDA's Healthy Forest Reserve Program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

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
- Populations changes (immigration, new cultural groupings, etc.)
- Other (new invasive species)

Brief Explanation

Some projects terminated early or PIs changed focus of their research, which affected our ability to report on all previously submitted state-defined outcomes.

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 FY12, 5 projects went through the review process in this program area. As for other

measures of successful research programs, faculty in this program area published 5 peer-reviewed articles and secured more than \$1,400,00 in extramural funding. Also during this time period, research results published by faculty in this program area were cited by peers more than 800 times in other peer-reviewed journals.

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

In a project involving citizen science and the role of social capital, trust and learning in solving groundwater quality and quantity issues UMaine scientists initially relied on informal project evaluations to measure success. For example, students, community volunteers and school teachers and administrators reported increased awareness of historic land use issues in the community in Rhode Island, Connecticut, New Hampshire, and Maine. As more data collection occurred, however, the researchers were able to formally evaluate outcomes and impacts. For example, they documented that 10% of parents who participated with their child in a 4-H GET WET! weekend tested their private well water within 6 months of the program. Both parent and child participants from the 4-H weekend indicated increased knowledge and level of concern related to groundwater issues. At the community level, their results showed increased resilience in groundwater communication networks, along with increases in community social networks in all five participating New England states. They also found that school-based community programs lead to stronger social networks. Study sites show interest in continuing the program after the end of the grant, which is a positive sign of sustainability.