V(A). Planned Program (Summary)

Program # 3

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
102	Soil, Plant, Water, Nutrient Relationships	0%		33%	
123	Management and Sustainability of Forest Resources	0%		19%	
132	Weather and Climate	0%		14%	
136	Conservation of Biological Diversity	0%		19%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		6%	
302	Nutrient Utilization in Animals	0%		8%	
601	Economics of Agricultural Production and Farm Management	0%		1%	
	Total	0%		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	5.9	0.0
Actual Paid Professional	0.0	0.0	3.4	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	592008	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	490467	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	17095	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension:
Extension efforts share the research and how it can be applied with appropriate audiences ensuring the viability of agriculture based business who produce food and interact with the environment. No effort for Extension is reported to this planned program, but rather reflected in Global Foods.

VT-AES:

- **Measure earthworm mediated losses of N from Dairy and Maple Production Systems in Vermont.**
- **Develop models to show that invasive populations possess smaller genomes and harbor greater evolutionary potential than native populations of this species**
- **Develop models to show that invasive genotypes have the ability to maintain their phenotype in response to an moisture gradient while native genotypes cannot**
- **Develop modes to show an evolution change in C:N ratio in the leaves of invastive genotypes can be responsible for making red canary grass more agressive in wetlands**
- **Use global vegetation models to project the responses of forests across New England to regional climate change.**
- **Identify if different breeds of dairy cows are likely to produce less methane per kilogram of fluid milk or milk solids as ruminant livestock are the major single source of potent greenhouse gas (contribution to climate change).**
- **Determine the effect of sustainable harvesting practices on soil carbon and nutrient pools.**
- **Determine the effect of crop rotation systems on carbon and nutrient pools.**
- **Conduct soil fertility testing on samples from ongoing trials with new crops.**
- **Determine the effect of geographic variation among beetle populations in their ability to survive northern winters.**
- **Determine if preadaptation's or rapid evolution contributed to the success of Colorado Potato Beetle (CPB)**
- **Determine the effect from various cold acclimation times on subsequent regrowth of perennials**

2. Brief description of the target audience

Research:
Sugar maple producers

Foresters
Environmental scientists and planners
Horticulturists
Ecologists
Farmers
Livestock producers
Wholesale nurseries
Policy decision makers

3. How was eXtension used?

Extension was not used in this program.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	60	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	6

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Manuscripts

Year **Actual**

2012	2

Output #2

Output Measure

- Workshops

Year	Actual
2012	1

Output #3

Output Measure

- Scientific journals

Year	Actual
2012	1

Output #4

Output Measure

- Regional meetings

Year	Actual
2012	4

Output #5

Output Measure

- Program symposium

Year	Actual
2012	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	identify mitigate the invasive species threat to the environment
2	research regarding the generation of greenhouse gas emissions from farm animals and through soil processes
3	Number of factors identified effecting carbon storage in the soil.
4	Number of habitats that have changed due to congregation of earthworms.
5	Genetic data for the Colorado Potato Beetle identified.

Outcome #1

1. Outcome Measures

identify mitigate the invasive species threat to the environment

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With the extensive spread of invasive species (invasive plants) throughout North America and Europe there is an urgent need to better understand the characteristics of successful invasive plants. Invasive plants can have a significant threat to many native plants and be a significant cost to agriculture, forestry, and recreation. UVM AES is determining why a species that is not invasive in its native range becomes invasive in the introduced range.

What has been done
UVM AES studied a weed, Phalaris arundinacea, taken from its native European range and from invasive genetic variants from North America. Using a combination of population genomics, manipulative crossing experiment(s), and field studies they were able to determine traits that led the plant to transition into a native community. Farmers use this information for better crop management. The results were published in a scientific journal.

Results
UVM AES results show that invasive populations possess smaller genomes and harbor greater evolutionary potential than native populations. In addition, scientists have shown that invasive genotypes have the ability to maintain their phenotype in response to a moisture gradient while native genotypes cannot.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

Outcome #2

1. Outcome Measures

research regarding the generation of greenhouse gas emissions from farm animals and through soil processes

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of factors identified effecting carbon storage in the soil.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Change is occurring in the Northern Forest because of human activities. These activities include regional and global influences of continued acidic deposition, mercury deposition, and climate change. In addition, local forest management practices create an impact, the extent of which may accelerate as increasing pressures are put on local communities to seek alternative energy sources from forests. Science is now showing the positive role forest ecosystems can play in removing and storing excess carbon from the air.

What has been done
Six subplots were established and soils sampled by depth. Soils were analyzed for carbon, nitrogen, and total mercury. Additional vegetation and physical site characteristics were measured and plots were permanently monumented for future use. Results have been presented at regional meetings and to forestry professionals.

Results
Results from pre-harvest sampling showed that more carbon was stored in the soil. Carbon storage in the soil is dependent on multiple factors, including soil depth, elevation, wetness and time since disturbance and land-use change.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Number of habitats that have changed due to congregation of earthworms.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Earthworms play a key role in recycling nutrients in the soil but may also be altering habitat for plants and wildlife. All earthworms in Vermont are invasive species. Where earthworms congregate the soil is exposed to predators and harsh weather. Increased losses of nutrients as a function of earthworms may be financial losses to farmers who have to replace nutrients.

What has been done
After 90 days of incubation the scientists found a number of results. The earthworms contained calcium. Greenhouse gases were greater in soils that have earthworms. The scientists disseminated these findings at a professional workshop, with woodlot owners, and at meetings.

Results
The forests soil makeup could be explained by the action of earthworms.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
601	Economics of Agricultural Production and Farm Management

Outcome #5

1. Outcome Measures

Genetic data for the Colorado Potato Beetle identified.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Humans have strongly influenced insect pest evolution and ecology through host shifts, crop domestication, change in cultivation practices, and human-mediated translocations. The research studies these themes to determine how we can use ecological and evolutionary information to improve sustainable pest management such as the Colorado Potato beetle.

What has been done
The scientists collected beetles from several Mexican states (Jalisco, Oaxaca, Texcoco) along with two states (Kansas and Vermont). After the beetles experience the shortening days during fall, they were buried in PVC (Polyvinyl Chloride) tubes at 15 cm below the surface to see what was the survival rate during the winter. The research was presented at a program symposium and several manuscripts are currently underway.

Results
As a result, the scientists have found that pest beetles appear to be most similar in feeding performance and cold tolerance to beetles from Texcoco, Mexico. About 6% of beetles from Texcoco survived the Vermont winter, but no beetles from other populations survived. The scientists have found preliminary genetic data that suggests that the Texcoco populations are the most genetically similar to the Colorado Potato Beetle.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

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

Brief Explanation

Invasive Plants - research will continue on the genetic and physiological basis for "invasiveness" of problem plant species and introductions.

Greenhouse Gas Emissions - research has been initiated to evaluate microbial population dynamics in ruminant farm animals in an effort to control/minimize the production of methane and other greenhouse gases. Parallel efforts are underway to understand soil processes that affect the carbon cycle, and that may sequester carbon in soil sinks.

On-site demonstrations at fields days, development of a guide on forest management recommendations.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

- On-site demonstrations at field days, development of a guide on forest management recommendations.
- Disseminated findings at the Forest Health meetings reaching forest professions, at a vermicomposting workshop for Master Composter, at a gathering of woodlot owners, and at the Annual Meeting of the SSSA.

Key Items of Evaluation