

V(A). Planned Program (Summary)

Program # 12

1. Name of the Planned Program

Forestry and Forest Products

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
123	Management and Sustainability of Forest Resources	50%		40%	
124	Urban Forestry	25%		20%	
125	Agroforestry	25%		20%	
133	Pollution Prevention and Mitigation	0%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	8.5	0.0	33.7	0.0
Actual Paid	16.4	0.0	35.3	0.0
Actual Volunteer	0.9	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
528053	0	416682	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1621083	0	2525769	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
748917	0	3416009	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Minnesota has over 17 million acres of forests that support a forest products industry that adds more than \$8.9 billion annually to the state's economy. Research on forestry and forest products focuses on protecting and using this vital state resource to its fullest potential. Threats including diseases, pests and climate change are particularly concerning for researchers and conservationists. Diseases alone account for 65 percent of the wood volume lost in forests annually.

MAES supports basic and applied research on managing and maintaining our state's forests and developing new forest products. Some research results in this area are reported under the Climate Change and Sustainable Energy programs.

Research highlights for 2014 include:

- Surveys revealed heterobasidion irregular e (a.k.a. Circles of Death) has entered southeastern Minnesota and is causing mortality in red pines. This disease has previously been reported in Wisconsin and 24 other countries. Additional surveys are being conducted to determine the extent of the infestation, and to assist with the development of management guidelines.
- Research on wood decay fungi has revealed new information on how the woody plant cell is degraded. Results suggest the need for a new classification system for decay fungi.
- Work to map the distribution boundaries of earthworms in the region of the northern hardwood forests continues.
- Three eastern white pine disease gardens have been established in high rust risk areas. These trials will provide estimations on the level of rust resistance heritability between parents selected for putative resistance and their open pollinated, or controlled pollinated progeny.
- As part of a program working to increase white pine blister rust resistance in eastern white pine, a 23-year old progeny was planted in a high area near Lake Superior. While survival was limited to only 2.3 percent of the seedlings planted, survivors are being used in the eastern white pine breeding program.
- Researchers are collecting and storing ash seeds as part of an ash gene conservation program. To date, they have collected seed from over 350 black ash, and 150 green ash.
- About six years ago, Flavin-dependent monooxygenases were identified by U of M researchers as the most likely candidates to depolymerize-lignins. Since then, researchers' characterization of a salicylate hydroxylase from lignin degrading enzymes has led to a patent application. This represents a major discovery in the field of lignin biodegradation.
- A bid experiment was conducted with the St. Louis County Land and Minerals Department to evaluate the impact payment method has on the prices offered by timber buyers. In addition, data was collected for 584 tracts sold by the Department from 2003 to 2014 to analyze how gross revenue per acre for a timber sale is influenced by timber sale characteristics.
- Researchers studying the response of various first-year tree species to the effects of climate change found a species-specific model is best for considering emergence, and development rates, but growth and survival data can be captured in broader groupings. Specifically, the broadleaf temperate group exhibited the best growth, and conifers had the shortest survival times.
- A study modeling how global warming could increase the negative impact caused by European earthworms in northern Minnesota forests found that the effect of warming could in fact slow-down the impact by creating less favorable soil conditions for earthworms. However, the model also shows, if warming is accompanied by even distributions of rainfall, this might sufficiently offset the water losses caused by higher evapotranspiration.
- Results from focus groups with individuals owning 20+ acres in the Lake States region revealed payment amounts offered for carbon credits are not likely, on their own, to encourage participation in carbon markets. Landowners preferred the other potential benefits of carbon management (e.g., improved

stand species mix, wildlife, and trails), and any potential tax benefits.

Extension. Minnesota forests are undergoing both economic and environmental stress, and Extension forest programming in 2014 addressed those problems. Climate change is challenging native forest ecosystems and allowing invasive pest species that previously could not survive winter in Minnesota to get a foothold in northern forests.

The power of Extension's volunteer networks has been harnessed to tackle new forest threats. Results from 2014 efforts of the Forest Pest First Responder program and Wasp Watchers program are reported in Outcomes. As new research emerges on the cold tolerance of Emerald Ash Borer, forest program teams are updating management strategies. Moreover, the proactive vigilance of Extension-trained volunteer networks has meant the Emerald Ash Borer has been contained so far to only six counties in the state.

Invasive species training has been incorporated into multiple programs. For example, in 2014 an Extension forest specialist integrated education on designing insect traps into the White Earth Reservation student summer math and science program in collaboration with Reservation foresters.

Another major focus in forestland management for Extension programming has been helping private forestland owners make management decisions, and helping to encourage local community involvement of private forestland owners. As so much of Minnesota forestland is in private hands, the long term health of Minnesota forest depends on owners supporting the sustainability of their own land, as well as neighboring lands. For example, the Extension forest team has been working with groups such as the North Shore Forest Collaborative to foster community discussion about restoring conifers to forests of dying birch trees that are owned by many thousands of landowners.

In 2014, Extension continued its long running Shade Tress short course, the largest annual urban forestry conference in the U.S. This conference targets municipal tree inspectors and also trains Master Gardeners on tree care.

Another volunteer program that was piloted in 2013, the "Citizen Pruner Program," was so successful that it was expanded in 2014 to eight additional communities. Extension educators worked with communities to find and train volunteers to conduct on-the-ground pruning of city owned trees. This helped communities develop more architecturally sound trees and lessened the burden on local budgets by using volunteers for critical yet less dangerous and less technical work.

Extension forestry activities in 2014 also have supported Minnesota's tourism industry. Forest teams worked with two communities to create three "Tree Treks" which incorporate QR-coded signage for trees in urban parks for informal education of park visitors. The Tree Treks are marketed by the communities and the QR codes are linked to web sites that Extension creates for the communities.

2. Brief description of the target audience

In 2014, Extension education and support in forestry issues reached forest landowners, natural resources professionals, farmers, state and local forest policy makers, community volunteers, woodland owners, city workers who care for trees, Soil and Water Conservation officials, city foresters, and Minnesota loggers.

Target audiences for **research** include forest and forest products researchers, information specialists in natural resource management, public forest land management decision-makers and policymakers, plant pathologists specializing in tree diseases, wood products industry, biotechnology and biofuels industry, arborists, conservators, and biological science researchers.

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	7358	124842	0	0

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

Patent Applications Submitted

Year: 2014
Actual: 2

Patents listed

61/953,1183/14/14 Compositions Including Lignin
14/364,4486/11/14 Lignin Degrading Methods

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	10	55	65

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops, tours, and demonstration projects that increase awareness of landowners, volunteers, loggers, natural resource professionals and businesses involved in forestry, agroforestry, urban forestry and forest products.

Year	Actual
2014	132

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Program participants (landowners) will learn new information that helps them manage forest land. (Target expressed as percentage of participants.)
2	Program participants will improve forest management on a significant number of acres. (Target expressed as number of acres on which management was improved.)
3	Extension education and outreach efforts will help control urban forest and landscape invasive species. (Outcome is the number of landowners who are working with state departments to control and eradicate invasive species because of early detection by Extension and its volunteers.)
4	Extension education and outreach will help contain the spread of Emerald Ash Borer. (Outcome is the number of Minnesota counties where the emerald ash borer has been contained due to Extension's efforts.)
5	Research will provide new protocols to assist forest managers and conservationists with protecting Minnesota forests from invasive pests.

Outcome #1

1. Outcome Measures

Program participants (landowners) will learn new information that helps them manage forest land. (Target expressed as percentage of participants.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

About 45 percent of Minnesota forestland is privately owned. When landowners don't protect the conservation value of the property, it gets sold and often subdivided. When forestland is subdivided into five or 10 acre plots it is no longer economically viable. Minnesota has more than a half million forestland owners, and that population is getting older. The average age of Minnesota forestland owners is now 63. For both economic and environmental reasons, it's important that thoughtful and planned estate decisions be made about that forestland.

What has been done

To address this potential forestland fragmentation issue and help landowners make decisions that are best for them and for the environment, Extension offered a series of workshops on land transfer issues. The workshops were an interdisciplinary effort with Extension specialists in family development because workshop presenters have found it is important to start with a family conversation that articulates values before discussing options such as conservation easement, or selling intact. Because family members can be living in different places, web-based technology was used to connect family members for the discussion.

Results

A recent study of the results of this training has shown nearly 100 percent of the families who have attended the workshops engaged in family conversations about land transfer decisions, and the majority had decided to keep the land intact.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #2

1. Outcome Measures

Program participants will improve forest management on a significant number of acres. (Target expressed as number of acres on which management was improved.)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many Minnesota farmers are also woodland owners. However, this woodland is often unmanaged and underused. With better management, woodlands could be an asset to farms.

What has been done

The Extension forest team established three silvopasture demonstration sites in central Minnesota. They also worked with livestock producers who practiced unmanaged woodland grazing, educating them about silvopasture as a best management tool that can be used for profit and also to improve the environment.

Results

As a result of this work, at least 30 farmers have started using silvopasture, covering at least 3000 acres. These farmers reported considerable livestock weight gain yield of \$10,000-\$15,000 average income per year. They also reported seeing an increased presence of wildlife in their pasture. The program's success has led to the landowners and producers exploring the potential of silvopasture to manage underground vegetation and invasive species in grazed wooded system.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
125	Agroforestry

Outcome #3

1. Outcome Measures

Extension education and outreach efforts will help control urban forest and landscape invasive species. (Outcome is the number of landowners who are working with state departments to control and eradicate invasive species because of early detection by Extension and its volunteers.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	82

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

To control invasive species, early spotting of the invasion is better. Once an invasive species has a foothold, elimination of the pest is vastly more difficult and sometimes impossible. Knowledge, in this case, is power. And this power is even more important because Minnesota forest and water pests are on the rise and on the move.

What has been done

The Forest Pests First Detector program is credited for early detection of the emerald ash borer. As a result, only six counties have been affected. The Detector program trains volunteers to identify, scout, and track invasive pests. In 2014, Extension led volunteers in two large surveys of the Root and Cannon Rivers to assess the presence of four invasive species: Oriental Bittersweet, Japanese hops, cut-leaved teasel and Japanese knotweed. Volunteers surveyed 40 miles of the Root River and 40 miles of the Cannon River.

Results

All species except teasel were found. A follow up found large infestations of Japanese hops on river banks. This information was funneled to the Department of Agriculture which verifies and enters them into a Mapping System to track the range and scope of infestation. Early detection

has allowed resource and land managers to perform aggressive management of invasive species, helping to control and possibly eradicate them. As a result of the efforts of the Forest Pest First Detector, the Minnesota Department of Agriculture has agreements with 82 landowners for crews to work across property lines to control Oriental bittersweet. The Minnesota Department of Natural Resources is using the First Detectors model for early detection and rapid response invasive plant management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
124	Urban Forestry

Outcome #4

1. Outcome Measures

Extension education and outreach will help contain the spread of Emerald Ash Borer. (Outcome is the number of Minnesota counties where the emerald ash borer has been contained due to Extension's efforts.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The problem with identifying a new Emerald Ash Borer infestation is that ash borers stay hidden in the leaves of a tree while they girdle its bark. By the time they are noticeable the damage is done. But one wasp has been identified as the ash borers enemy. Finding the wasp can track the emerald ash borer.

What has been done

An offshoot of the First Detector program, the Wasp Watcher program is a citizen science project that uses the *Cerceris* wasp, which does not sting humans, for bio-surveillance. Volunteer Wasp Watchers are trained to identify the wasp and find its nests, as the wasp can be followed to find the ash borer. The wasp likes full sun and sandy compacted soils for its nests, making them easy to spot at ground level. Elementary school ball fields have been found to be a favorite nesting

spot of the wasp.

Results

In 2014, with the help of new and returning volunteers, more than 40 new sites were checked and 10 confirmed *Cerceris* colonies were found. Thirteen colonies were found at baseball diamonds in the Twin Cities and Rochester. Sites were monitored in the six counties where emerald ash borer has been identified. Minnesota's aggressive detection system has been credited to keeping the ash borer infestation to only six counties. The Wasp Watcher project is getting citizen volunteers involved in collecting mass quantities of data that allow the state agencies to better manage their resources and target their response to control invasive species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
124	Urban Forestry

Outcome #5

1. Outcome Measures

Research will provide new protocols to assist forest managers and conservationists with protecting Minnesota forests from invasive pests.

2. Associated Institution Types

- 1862 Extension
- 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)

Non-native earthworm invasions are causing substantial adverse effects to hardwood forest ecosystems in Northern Minnesota. Earthworms threaten the long-term productivity of forests by eliminating understory plants, reducing tree regeneration, increasing soil compaction and erosion, and causing nutrient runoff.

What has been done

Researchers set out to create a rapid assessment method to measure the level of earthworm invasion at a location based primarily on a visual assessment of the forest floor. They worked at two sites, one in northeast Minnesota and one in northwest Wisconsin where they calculated earthworm biomasses, and uncovered relationships between individual forest cover matter and the presence of different species of earthworms.

Results

A five-stage rapid classification protocol was developed for conservationists, land managers, biological technicians, researchers, and citizen science monitoring programs to use for assessing earthworm invasion. A two-hour training session has been made available, and feedback shows the training was easy to follow, and 90 percent found it critical for effectively assessing earthworm invasion. This protocol can also serve as a blueprint to develop protocols in other regions experiencing earthworm invasions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (no factors)

Brief Explanation

The goal of engaging with communities and landowners to strengthen the stability of Minnesota's forests is being achieved.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Forestry team tracks whether education of citizens and professionals results in local action to protect forests or to use them for economic or natural resource gains. In 2014, education resulted in better use of silvopasture on Minnesota farms and helped Minnesota address invasive species on river banks and in communities.

Key Items of Evaluation

In 2014, education resulted in better use of silvopasture on Minnesota farms and helped Minnesota address invasive species on river banks and in communities.