

**V(A). Planned Program (Summary)**

**Program # 9**

**1. Name of the Planned Program**

Forestry, Wildlife, and Fishery Systems

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%	0%	3%	
123	Management and Sustainability of Forest Resources	75%	100%	28%	
124	Urban Forestry	0%	0%	1%	
125	Agroforestry	10%	0%	0%	
133	Pollution Prevention and Mitigation	0%	0%	4%	
135	Aquatic and Terrestrial Wildlife	10%	0%	21%	
136	Conservation of Biological Diversity	0%	0%	3%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	3%	
206	Basic Plant Biology	0%	0%	2%	
213	Weeds Affecting Plants	0%	0%	1%	
215	Biological Control of Pests Affecting Plants	0%	0%	7%	
301	Reproductive Performance of Animals	0%	0%	3%	
311	Animal Diseases	0%	0%	2%	
312	External Parasites and Pests of Animals	0%	0%	3%	
605	Natural Resource and Environmental Economics	5%	0%	7%	
721	Insects and Other Pests Affecting Humans	0%	0%	2%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%	0%	3%	
903	Communication, Education, and Information Delivery	0%	0%	7%	
	<b>Total</b>	100%	100%	100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2013	Extension		Research	
	1862	1890	1862	1890

Plan	4.0	0.5	47.0	0.0
Actual Paid Professional	9.0	1.2	45.2	0.0
Actual Volunteer	3.0	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
160033	51704	815438	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
733412	51704	3349973	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
43040	0	3546886	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

UT and TSU Extension cooperated with the Tennessee Forestry Association to plan and conduct group meetings to inform forest landowners of issues pertaining to forestry and wildlife. Topics included management and marketing. Volunteers were recruited and trained to present at group meetings, provide information, demonstrate equipment and provide materials for demonstrations. UT and TSU Extension provided education at local, regional and statewide events, such as the Tennessee Forest Festival to inform the general public about forest management issues. Demonstrations were provided for landowners and forestry workers. Extension Agents and Specialists educated attendees at County Forestry Landowners Association. UT and TSU Extension worked closely with private consultants, Tennessee Wildlife Resources Agency employees, Tennessee Division of Forestry and others in forestry related industries to develop educational programs and activities for professionals and landowners.

UT and TSU Extension will continue one-on-one contacts with landowners throughout the year and use mass media and newsletters to inform the general public on issues and educational opportunities related to natural resources. Both UT and TSU Extension will provide leadership for conducting programs that target limited resource landowners with TSU providing specialist leadership for this effort.

For Tennessee's forestry sector, UT AgResearch continues biological control of Hemlock Woolly Adelgid by known predators and new species and release technologies. We evaluate methods of increasing seedling success, and techniques for improving reforestation. We exploit genetic variation in nursery and field characteristics of native hardwood and coniferous forest tree species. We try novel strategies to address exotic forest tree pests and corresponding forest restoration. We establish collections of woody plants, including species and cultivars, and plants having potential commercial value as forest species or for landscape development, from which materials may be obtained for breeding/propagation.

For wood products manufacturing, we characterize key parameters associated with the formation of durable, high-performance composite materials, and establish new statistical methods to advance intelligent manufacturing practices. We explore new methods to produce carbon fibers from low-quality

raw materials and are developing a process for bonding plastic or polymer to lignocellulosic fibers (using ultrasonic vibration) as a replacement for toxic wood preservatives.

We identify approaches and services to landowners that would enable them to realize a wide range of landownership benefits while fostering stewardship and sustainability of private forest lands in Tennessee. Both qualitative (e.g., personal interviews and focus groups) and quantitative (e.g., survey responses) data are collected and analyzed to better understand landowners understanding of management.

Although manipulative studies of tree seedlings and saplings are cost effective and quick, recent research has shown that they may not allow for valid predictions on mature trees. Therefore, direct experiments on large trees or forested catchments have been developed. Experiments are being conducted on local forest research sites developed by the Department of Energy (DOE). Each are large-scale, multi-year, multi-investigator experiments.

UT AgResearch wildlife and fisheries research evaluates and quantifies the effects of deer on agricultural production and identifies associated land-use patterns and biological and ecological factors that could be used for reducing that impact. We monitor target avian species and relate specific population parameters to factors affecting forest health and sustainability, and develop new forest management prescriptions that promote sustainability. We develop prediction methods and evaluate selected aquatic species in existing and new production systems adapted to Tennessee's climate and geography.

**2. Brief description of the target audience**

The target audiences for this program were forest landowners, the professionals and volunteers who serve them, as well as those who enjoy the state's wildlife resources.

**3. How was eXtension used?**

This Forestry, Wildlife, and Fisheries planned program was enhanced through the service of:

- one Tennessee Extension personnel on the "Climates, Forests and Woodlands" CoP,
- one Tennessee Extension personnel on the "Extension Wildfire Information Network" CoP,
- one Tennessee Extension personnel on the "Feral Hogs" CoP, and
- one Tennessee Extension personnel on the "Wildlife Damage Management" CoP.

Tennessee Extension personnel shared implementation strategies, outcome measurement, and research results with their CoP colleagues.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	23222	1811514	9193	0

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

**Patent Applications Submitted**

Year: 2013  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

<b>2013</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	10	76	86

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Release of Hemlock Woolly Adelgid predators reared in Tennessee (Parkman).

<b>Year</b>	<b>Actual</b>
2013	121000

**Output #2**

**Output Measure**

- Field validation/demonstration of remotely-controlled acoustic monitoring system for monitoring grassland birds on no-entry zones in military installations (Buehler).  
Not reporting on this Output for this Annual Report

**Output #3**

**Output Measure**

- Develop phytosanitary methods for disinfecting walnut logs that are currently under quarantine for walnut twig beetle. (Taylor)

<b>Year</b>	<b>Actual</b>
2013	0

**Output #4**

**Output Measure**

- In next four years reintroduce four to eight missing species into TN & NC portions of the Pigeon River, and supplement/augment existing numbers of species (see perhaps another four that have recolonized). (Wilson)  
Not reporting on this Output for this Annual Report

**Output #5**

**Output Measure**

- Developed a web-based application that allows users to view the estimated amenity values of forest landscapes (Cho)

<b>Year</b>	<b>Actual</b>
2013	0

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Forest Landowner Education: Number of landowners who now understand the ecology of forest development and succession (using forest management plans or contacting a professional forester.)
2	Forest Landowner Education: Number of landowners who improved profitability (marketing) of forest ownership.
3	Tennessee Master Logger Program
4	Log-on Before You Log
5	Thousand Cankers Disease on black walnut (Grant, Lambdin, Hadziabdic, Windham)
6	Develop Apps for IPM (Fulcher, Hale, Windham)
7	Wintering habitat for black ducks (Gray)
8	Black fly/gnat suppression (Moulton)
9	Cellulose nanocrystals (Wang)
10	Deer harvest strategies for Oak Ridge (Muller)
11	Elk restoration and genetic diversity (Muller)
12	Suppression of Emerald Ash Borer (Grant, Wiggins)
13	Ground cover for better mine reclamation (Franklin)
14	Insecticide effects on Hemlock (Lambdin, Grant)
15	Northern Bobwhite protection and restoration (Buehler)
16	Predatory beetles against HWA (Lambdin, Grant, Wiggins)
17	Protecting amphibians from ranavirus (Gray)

18	Wildlife-mediated ecosystem services (Kwit)
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**Outcome #1**

**1. Outcome Measures**

Forest Landowner Education: Number of landowners who now understand the ecology of forest development and succession (using forest management plans or contacting a professional forester.)

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	215

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

**Outcome #2**

**1. Outcome Measures**

Forest Landowner Education: Number of landowners who improved profitability (marketing) of forest ownership.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	105

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources

**Outcome #3**

**1. Outcome Measures**

Tennessee Master Logger Program

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Training of loggers in Best Management Practices (BMPs) is necessary to protect water quality during forest harvesting operations.

**What has been done**

In 2013, 20 continuing education logger workshops were held with 410 loggers, foresters, and landowners.

**Results**

Each participant increased their knowledge on BMPs to protect water quality during harvesting operations during the one-day continuing education workshop. Approximately 50% of the trained logging work force in Tennessee attended the workshops (requirement to maintain Master Logger designation is to attend one continuing education workshop every two years). Each logger is estimated to harvest 500 acres per year, averaging 3,000 board feet per acre (partial harvests included), and with an estimated average timber value of \$1,000 per acre. The Tennessee Master Logger educational program has reached more than 1,200 loggers since 1983 or about 90 percent of the state logging workforce.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources

**Outcome #4**

**1. Outcome Measures**

Log-on Before You Log

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Privately family forests own 87 percent of Tennessee's 14 million acres of forestland. This ownership class is very important for the protection and wise use of the state's forest resources, as well as for producing timber necessary to sustain the state's wood industry.

**What has been done**

UT Extension's "Log-on Before You Log" website went live in 2013. The site serves as a clearing-house for current forest stewardship educational material, including best management practices (BMPs).

**Results**

In 2013 there were 636 unique visits (or an average of two per day) to the "Log-On Before You Log" website. The site survey indicated that 97% of the visitors owned forestland, with total ownership of 83,912 acres. Impacts included: 67% indicated they would seek professional help when marketing timber, 91% gained better understanding about forestry BMPs, and 94% would implement forestry BMPs as a result of viewing the website.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources

**Outcome #5**

**1. Outcome Measures**

Thousand Cankers Disease on black walnut (Grant, Lambdin, Hadziabdic, Windham)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Thousand canker disease (TCD) has been found in two additional counties in Tennessee in since the first six counties were identified to have the disease. The disease has also been found in four other states with two of those states being reported to have TCD in 2013.

**What has been done**

Information regarding genetic differentiation and spatial structure of *Geosmithia morbida* in the eastern United States provided a first insight into population genetics of the pathogen and plausible explanation of disease spread into the native area. The paper is the first to describe genetic diversity of *G. morbida* isolates in the native range of black walnut.

#### **Results**

Our study revealed high haploid genetic diversity among seven *G. morbida* populations with evidence of gene flow, isolation by distance and significant differentiation among two identified genetic clusters. Our ultimate goal is to provide a platform for informed disease management to prevent widespread epidemics in the native region of black walnut and conservation of public and private land resources.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
125	Agroforestry
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
215	Biological Control of Pests Affecting Plants

#### **Outcome #6**

##### **1. Outcome Measures**

Develop Apps for IPM (Fulcher, Hale, Windham)

##### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

##### **3a. Outcome Type:**

Change in Condition Outcome Measure

##### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

##### **3c. Qualitative Outcome or Impact Statement**

###### **Issue (Who cares and Why)**

###### **What has been done**

An app, IPMPro, and an e-book, IPM for Select Deciduous Trees in Southeastern Nursery Production, were developed by the Southern Nursery IPM Group.

### Results

Users of the app for mobile phones and tablets estimate that the app has saved them over \$1,350,000 as a group. Users were surveyed and savings were reported by eliminating sprays or effectively timing sprays using alerts issued by IPMPro. Users of the e-book estimate the economic impact at over \$1,280,000 using information in this book written by members of the Southern Nursery IPM Group. Readers of the book stated that information in the book helped them identify pests and diseases, plan IPM strategies and was an overall useful reference.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
124	Urban Forestry
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
903	Communication, Education, and Information Delivery

### Outcome #7

#### 1. Outcome Measures

Wintering habitat for black ducks (Gray)

#### 2. Associated Institution Types

- 1862 Research

#### 3a. Outcome Type:

Change in Knowledge Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2013	0

#### 3c. Qualitative Outcome or Impact Statement

##### Issue (Who cares and Why)

Black ducks migrate and winter in Tennessee.

##### What has been done

Findings: (1) American black ducks (*Anas rubripes*) wintering in Tennessee used flooded forest and shrub edges in greater proportion to their availability compared to other habitats, and (2) food abundance and foraging effort by wintering black ducks were low in forested and scrub-shrub wetlands compared to other habitats.

### Results

These results indicate that wetlands with woody vegetation are important for wintering black ducks in Tennessee for life history activities other than foraging. Natural resource agencies should provide forested or scrub-shrub wetlands in close proximity to habitats with high food abundance (e.g., moist-soil wetlands, flooded cornfields) for black ducks that are migrating and wintering in the interior United States.

### 4. Associated Knowledge Areas

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

### Outcome #8

#### 1. Outcome Measures

Black fly/gnat suppression (Moulton)

#### 2. Associated Institution Types

- 1862 Research

#### 3a. Outcome Type:

Change in Action Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2013	0

#### 3c. Qualitative Outcome or Impact Statement

##### Issue (Who cares and Why)

Female gnats belonging to the *Simulium jenningsi* species group are nuisance and sometimes biting pests of humans and livestock throughout eastern North America. Large outbreaks in east Tennessee in areas adjacent to the French Broad and Pigeon Rivers in Cocke and Sevier counties precipitated a control program that ran successfully from 2007 until 2009, when funding became problematic due to the recession. Females of SJG species are so structurally similar they cannot be identified by eye and thus species identity and most likely natal watercourses (all black flies develop in running water) cannot be ascertained.

##### What has been done

A molecular phylogenetic means of SJG species identification was discovered.

**Results**

This DNA fingerprinting method will allow more precise stream/river targeting to control SJG pest species resulting in less total cost and environmental exposure to the control agent, *Bacillus thuringiensis* var. *israelensis* endotoxins.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
721	Insects and Other Pests Affecting Humans

**Outcome #9**

**1. Outcome Measures**

Cellulose nanocrystals (Wang)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Due to the advantages of cellulose nanocrystals (CNCs) high modulus, low density, high aspect ratio, and negligible thermal expansion, they have attracted much attention from materials scientists. As a functional material, the mechanical properties of CNC films are very important. The CNC films studied in the previous researches were all prepared by sulfuric acid hydrolysis and were not modified, but the moduli of these CNC films had a considerable range, from 2 to 8.3 GPa.

**What has been done**

**Results**

Our recent research has solved this mystery. The results show that the environmental conditions had a great influence on the mechanical properties of pure CNC films and attracted great attention.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
125	Agroforestry

#### Outcome #10

##### 1. Outcome Measures

Deer harvest strategies for Oak Ridge (Muller)

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Deer overabundance has caused many new management challenges. We need critical information essential on deer ecology for managers to successfully develop deer harvest strategies to minimize conflicts.

###### **What has been done**

Physiology controls how an animal functions in its natural environment. Physiology is the core of applied wildlife management because extra resources (nutrition) are used to maximize reproduction and survival. My work looks at the interaction of physiology and population growth and well-being.

###### **Results**

Hunting seasons for white-tailed deer occur during the peak breeding season to make mature males easier to harvest. We found these excursions beyond the home range during the breeding season also occurred in female deer. Harvest seasons timed during the rut are effective for both males and females because of increasing movements and exposure to unfamiliar areas beyond normal home ranges.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

135	Aquatic and Terrestrial Wildlife
301	Reproductive Performance of Animals
605	Natural Resource and Environmental Economics

### **Outcome #11**

#### **1. Outcome Measures**

Elk restoration and genetic diversity (Muller)

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

Elk restoration projects try to maximize genetic diversity

##### **What has been done**

We looked at genetic structure of elk from the source population and again in translocated animals in Tennessee and North Carolina.

##### **Results**

There may be a problem with segregation of elk related to source populations.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
301	Reproductive Performance of Animals

## **Outcome #12**

### **1. Outcome Measures**

Suppression of Emerald Ash Borer (Grant, Wiggins)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

A new invasive insect threat (emerald ash borer) has been documented in 21 counties in Tennessee, representing the southernmost distribution of this insect pest in the U.S. This insect threatens to greatly reduce, if not cause the extinction of, populations of ash in the U.S., leading to tremendous economical and ecological losses.

#### **What has been done**

Entomologists at UTIA are at the forefront of research focusing on emerald ash borer in the southern U.S., with efforts directed at implementation of biological control to protect ash trees in forests, nurseries, and urban areas.

#### **Results**

Results of studies on parasitoids of EAB in Tennessee will help determine if these insects are suitable and effective natural enemies in southern climates. The recovery of the introduced *S. agrili* indicates this non-native biological control agent can successfully parasitize EAB and overwinter in the southern U.S., and this finding will help inform future management decisions by leaders of the USDA APHIS Emerald Ash Borer Program. Results from both on-going and planned studies, as well as continued monitoring of release sites and activities at new study sites in 2014, will further help assess parasitoids of EAB in the south.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
125	Agroforestry
215	Biological Control of Pests Affecting Plants

### **Outcome #13**

#### **1. Outcome Measures**

Ground cover for better mine reclamation (Franklin)

#### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

#### **3a. Outcome Type:**

Change in Condition Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

There is an ongoing effort to restore forests that have been altered or removed by human activity but forest restoration can be hindered by invasive species, poor soil properties, and changing climate.

##### **What has been done**

We studied how these factors influence the establishment and growth of trees native to Tennessee.

##### **Results**

Working on reclaimed mine sites, we showed that the selection of ground cover species is important for the success of reforestation, that herbaceous cover greater than 60% impedes forest establishment, and that a single, low-rate application of fertilizer increases the growth but not survival of trees. Because we were able to demonstrate successful reforestation of reclaimed mine sites and transfer this technology to industry, more than 90% of new coal mining permits in TN have designated forestry as the end land use, restoring the ecosystem services to thousands of acres mined of land in east TN.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
125	Agroforestry
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

## **Outcome #14**

### **1. Outcome Measures**

Insecticide effects on Hemlock (Lambdin, Grant)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Insecticides are an essential component of management plans directed at hemlock woolly adelgid in forest systems. Without these management tools, the numbers and health of our hemlocks in our forests would decline tremendously. Maintaining forest viability and sustainability enhances the aesthetics of our tourist region as well as contributes to forest ecology, conservation of native species, and enhancement of wildlife, including our aquatic organisms (such as trout).

#### **What has been done**

We investigated the persistence and efficacy of a widely used insecticide, imidacloprid, and its metabolites to determine how long they provided adequate control of hemlock woolly adelgid in a typical managed forest.

#### **Results**

Our results demonstrated that pesticidal compounds were still present in twigs and needles 5 to 7 years after treatment and that adelgid populations were suppressed during those years. These results will enable management personnel to refine and enhance their Long-term Management Plan for Hemlock Woolly Adelgid resulting in longer years between treatments while still adequately protecting the trees, yielding financial savings and minimizing potential secondary impacts to non-target organisms or to the environment.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
125	Agroforestry
133	Pollution Prevention and Mitigation

605 Natural Resource and Environmental Economics

**Outcome #15**

**1. Outcome Measures**

Northern Bobwhite protection and restoration (Buehler)

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Grassland bird populations are declining at a greater rate than any other bird group across North America. Because of these declines, major conservation initiatives, like the National Bobwhite Conservation Initiative, have been launched to reverse the population declines. Over a billion dollars have been invested in federally subsidized conservation practices focused on promoting native grasses in agricultural settings.

**What has been done**

We evaluated the population response of grassland birds to these conservation practices at multiple spatial scales across the Central Hardwoods Bird Conservation Region. We monitored over 5000 monitoring points across the region, recording the abundance of nine focal species at these points from 2008-2012. We modeled the relationship of species occupancy and abundance with conservation covariates and a variety of other landscape parameters.

**Results**

In general, the relationship between the presence or amount of conservation near a point and bird occupancy and abundance was fairly weak. We have concluded that either more conservation is needed and/or the management of these practices need to be improved to elicit a stronger response and turn population declines around.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

605 Natural Resource and Environmental Economics

### **Outcome #16**

#### **1. Outcome Measures**

Predatory beetles against HWA (Lambdin, Grant, Wiggins)

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

Loss of tree species will change the composition of forests comparable to the loss of the chestnut tree during the 1930's by dramatically destroying habitats used by invertebrates and mammals.

##### **What has been done**

UT entomologists remain at the forefront of research focusing on the exotic, invasive hemlock woolly adelgid. Efforts are focused on implementing biological control and chemical insecticides while minimizing any adverse environmental, non-target impacts. These research efforts have contributed to improved tree health in many forested areas, and without these efforts, most eastern hemlock trees would be dead.

##### **Results**

Results of studies on the establishment of Ln and St against HWA are important for several reasons. Documenting the seasonality of both beetle species, the emergence period and density of Ln under tree canopies, the immigration and establishment of St into a non-release site, and the ability of both species to coexist validates the continued use of these natural enemies against HWA, expands what is known of these predatory species, and will enhance future release protocols. The collection of both beetle species in multiple sites, and the resulting spatial and statistical analyses of factors associated with establishment and coexistence, will further advance knowledge on when and how to release these predators in the future, ultimately improving predator establishment.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
215	Biological Control of Pests Affecting Plants
605	Natural Resource and Environmental Economics

### **Outcome #17**

#### **1. Outcome Measures**

Protecting amphibians from ranavirus (Gray)

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

Amphibian species are susceptible to ranavirus.

##### **What has been done**

Findings: (1) fish and turtles can be subclinically infected with ranavirus, (2) transmission of ranavirus among fish, turtles and amphibians through water is possible, and (3) species composition of amphibian communities affects the likelihood of an outbreak.

##### **Results**

Fish and turtles could function as reservoirs for ranaviruses, and facilitate outbreaks in amphibian communities. Also, amphibian communities composed of highly susceptible amphibian species may be more prone to outbreaks. Future surveillance studies should focus on detecting ranavirus and monitoring amphibian communities composed of highly susceptible amphibian species and where turtles or fish are present.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife

136 Conservation of Biological Diversity  
311 Animal Diseases

## **Outcome #18**

### **1. Outcome Measures**

Wildlife-mediated ecosystem services (Kwit)

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

#### **What has been done**

To highlight the importance of wildlife-mediated ecosystem services, I rekindled interests in seed dispersal ecology, and initiated research aimed at redirecting the importance of ants as seed dispersers of myrmecochorous plants.

#### **Results**

Field, greenhouse, and laboratory work, in collaboration with a UTK colleague, has resulted in promising preliminary data highlighting the non-random nature of ant nest locations, and will form the focus of a NSF preliminary proposal to be submitted in January 2014.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
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

### **Brief Explanation**

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

In 2013 there were 636 unique visits (or an average of two per day) to the Log-On Before You Log website. The site survey indicated that 97% of the visitors owned forestland, with total ownership of 83,912 acres. Impacts include:

- 67% indicated they would seek professional help when marketing timber,
- 91% gained better understanding about forestry BMPs, and
- 94% would implement forestry BMPs as a result of viewing the website.

### **Key Items of Evaluation**

In 2013 there were 636 unique visits (or an average of two per day) to the Log-On Before You Log website. The site survey indicated that 97% of the visitors owned forestland, with total ownership of 83,912 acres. Impacts include:

- 67% indicated they would seek professional help when marketing timber,
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