

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

**Program # 7**

**1. Name of the Planned Program**

Natural Resources And The Environment

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	25%		10%	
112	Watershed Protection and Management	15%		15%	
123	Management and Sustainability of Forest Resources	10%		15%	
132	Weather and Climate	15%		10%	
133	Pollution Prevention and Mitigation	10%		15%	
134	Outdoor Recreation	0%		10%	
135	Aquatic and Terrestrial Wildlife	5%		15%	
405	Drainage and Irrigation Systems and Facilities	0%		5%	
605	Natural Resource and Environmental Economics	5%		5%	
806	Youth Development	15%		0%	
	<b>Total</b>	100%		100%	

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

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

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	9.0	0.0	10.0	0.0
Actual Paid Professional	0.0	0.0	3.7	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
259057	0	806759	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
259057	0	806759	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
2431162	0	2360536	0

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

### 1. Brief description of the Activity

Research activities included research showing what best explained nitrate yields in watersheds across the Mississippi River basin [this work has been critical in showing that to reduce nitrate losses in the MRB, the tile-drained corn belt is where conservation activities must be focused], results to assess long-term changes in forest soils [by reporting on this project to other scientists these results can be combined with other studies to show the importance of reducing air pollutants such as sulfur], tile drainage modifications designed to reduce nitrate losses and accompanying outreach activities used to show farmers in the Salt Fork Watershed the response of the tile line to our nitrate reduction method, ongoing development of the **Illinois Soil Nitrogen Test** [ISNT was designed to quantify soil nitrogen supplying power as a means of improving the accuracy of nitrogen fertilizer recommendations and implementing site-specific nitrogen management], a study that will provide new knowledge on the effects of novel water treatment processes which are expected to have certain advantages [in particular, we are focused on treatment systems using activated carbon adsorption, ion exchange, membrane bioreactors, algal treatment systems, hydrothermal liquefaction, and various hybrids of these components], and the analysis of behavior for previously unstudied types of forest landowners [the most important of these unstudied types include landowners who neglect their forest holdings much of the time and those who consider the decisions of owners of adjacent forest properties].

Additional research activities included results that will help land managers identify priority areas for mitigation efforts, anticipate challenges to restoring ecosystem function across the region, and help to educate the public about changes ensuing from the loss of foundation species, an investigation into the mortality, predation risk, and movements of woodchucks across an urban-rural gradient within an agricultural landscape, and work that will generate land management strategies growers can implement on their property to enhance pollination, infiltration, and other ecosystem services.

Research activities focusing on climate change included a comparison of the ecology of ratsnakes across the complete range of this species to assess how the snakes' ecology is likely to be affected by climate change, ongoing monitoring work under the **National Atmospheric Deposition Program** with the goal of developing a better understanding of the chemical inputs resulting from atmospheric deposition and of nutrient cycling in both crop and forest systems, a project that will provide statisticians, modelers, managers and policy makers with the knowledge, methods, and guidelines to reduce uncertainties and improve decision-making with regard to forest carbon [the developed methods can be applied to other regional and global programs of carbon modeling and management and the results will serve as general suggestions applicable to the programs], development of an improved method that will provide environmental chemists with a stable, alternative method for analyzing methylmercury in environmental samples, development of a more thorough inventory and a better appreciation of forested algal talus

slopes [which will lead to better protection of the unique flora, fauna, and soils of fragile ecosystems], improved insights into how habitat structure might interact with climate change to influence the spatial distribution and dynamics of disease potential for amphibians, and a project that will provide us with a physiological, mechanistic understanding of how fish populations respond to stressors associated with land use changes and climate change scenarios.

Conference presentations included the Illinois Mosquito and Vector Control Association, American Society of Agronomy, Illinois Association of Wastewater Agencies, Soil Science Society of America, Rural Sociological Society, Land Grant and Sea Grant National Water Conference, Central States Water Environment Association, Prairie Rivers Network, National Water Quality Conference, American Society of Agricultural and Biological Engineers, Water Environment Federation Technical Exhibition and Concert, Algae Biomass Summit, Pathways to Success Conference: Integrating Human Dimensions Into Fish and Wildlife Management, International Symposium for Society and Resource Management, Ecological Society of America, New Phytologist Symposium, International Society of Chemical Ecologists, Entomological Society of America, Asia-Pacific Association of Chemical Ecologists, Latin American Association of Chemical Ecologists, International Congress of Entomology, Research Institute of Forest Ecology, Chinese Academy of Forestry, Symposium on Nitrogen Fixation with Non-Legumes, New Phytologist Symposium :Functions and Ecology of the Plant Microbiome, Annual Argonne Soil Metagenomics Meeting, and the American Geophysical Union.

Extension activities encompassed a variety of delivery methods to provide education regarding soil and water management, forestry, and environmental stewardship. A description of some of these major areas of focus follows. Activities related to natural resources can also be found in the Sustainable Energy planned program.

Drought conditions and how to deal with them was a topic included in many crop production, livestock, and home and commercial horticulture programs and the subject of many media releases. A drought resources website was created and promoted through Extension as was participation in a statewide webinar focused on drought. Extension educators made presentations on climate change considerations for seed companies, research field day participants, and area livestock producers. Information about crops and climate change was a topic for the four regional **Crop Management Conferences** and continued to be taught in **Master Naturalist** volunteer training as one of the twenty curriculum chapters. Integrated research and Extension supported activities included the campus-based **Third Annual Environmental Change Institute Symposium** which included a presentation on the publication **Change and the Heartland** that addresses climate change challenges in a understandable and meaningful manner and a seminar series that included a presentation on climate change as a health crisis.

This past year's **Soil and Water Management** webinar was hosted at 15 local Extension offices across the state in February of 2012. Topics covered included atmospheric deposition and its effect on soils, water, and crops, biofilters effects on field tile runoff, corn residue management with respect to foliar diseases, and irrigation scheduling. We are in the process of developing two online modules addressing bioreactors and drainage water management.

The statewide **Illinois Tillage Conferences** held in three locations addressed soil drainage, cover crops and no-till, water quality, nutrient placement in strip-till, and nutrient placement on Karst and Sodic soils. Sections of the statewide pesticide safety education program also covered practices related to preventing chemical contamination of our natural resources. **Regional Crop Management Conferences** also included a segment on the impacts of conservation tillage, erosion, and slope on soil organic carbon.

Extension campus and field staff continued to conduct emerald ash borer pest control activities to prevent the loss of shade trees that remove and sequester carbon from the atmosphere. Most of the

forestry-related education focused on forest landowner education and outreach that extends beyond management to include urban forestry, forest product marketing and utilization, and carbon sequestration through presentations, seminars, workshops and field days. **Ask A Forester** is a key feature of the Extension forestry website. We continue to partner with Iowa State University Extension forestry to offer the **Tri-State Extension Forest Stewardship Conference**.

The **Illinois Master Naturalist [ILMN]** program completed a fifth year of statewide implementation. Participation this year expanded to two new locations. A total of 15 Extension multi-county units have provided training for individuals who want to experience nature and to develop knowledge of and respect for the environment. In addition, 463 individuals are actively engaged in a wide variety of projects as environmental stewards. An internal website served as a forum to allow volunteers and Extension staff to communicate and exchange news. A web-based reporting site has been completed and is being used to collect information on all **Master Naturalist** and **Master Gardeners'** training, volunteer hours, and projects.

Youth conservation days with hands-on activities were held in many locations throughout the state and the **I Think Green** curriculum was developed to engage youth in investigating how living things interact with each other and with their environment [the curriculum reached 254 third through fifth graders].

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

Members of the target audience included other scientists, as well as those involved in the agricultural industry in Illinois [including the fertilizer industry, NRCS, soil and water conservation district personnel, and technical service providers], environmental groups, farmers and landowners in the upper Salt Fork watershed, professional insect taxonomists, Extension specialists, professional insect diagnosticians, students, amateur naturalists, insect ecologists, public officials, commercial interests, citizens interested in remediation and restoration of old industrial sites, hydrological scientists, low income minority and urban residents, livestock producers and municipal water and wastewater utilities, agency representatives from multiple land management agencies, private forest landowners, soil scientists, forest scientists, geologists, forest managers, private sector enterprises engaged in carbon credits, state and federal agencies formulating policies on carbon sequestration, USDA Forest Service personnel, aquatic ecologists, conservation biologists, state natural heritage programs, federal government agencies charged with protecting biotic integrity in the nation's waterways and parks, recreation managers, dredge sediment contractors, wildlife biologists and managers, and nuisance wildlife operators. Extension also targeted pesticide applicators and youth.

**3. How was eXtension used?**

Six Extension faculty, staff, and volunteers are members of the Natural Resources eXtension Community of Practice

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

**1. Standard output measures**

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	12995	56203	58320	0

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

**Patent Applications Submitted**

Year: 2012  
Actual: 1

**Patents listed**

TF09095-US - Hydrothermal Processing [HTP] Of Algae Grown In HTP Waste Systems

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

**Number of Peer Reviewed Publications**

2012	Extension	Research	Total
Actual	0	40	40

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

**Output Target**

**Output #1**

**Output Measure**

- Number Of Completed Hatch Projects

Year	Actual
2012	8

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

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

O. No.	OUTCOME NAME
1	Increased Knowledge Of Human Actions That Negatively Affect The Environment
2	Nontarget Effects Of Pesticides And Fertilizers On Aquatic Communities
3	Evaluating The Impacts Of Nitrate And Phosphorus On Water Quality
4	Improvement Of Fertilizer Usage Recommendations To Increase Profitability And Reduce Environmental Impacts
5	Evaluating Watershed Scale Models For TMDL Planning
6	Evaluating Habitat Quality Of Translocated Species
7	Dissemination Of Air Quality And Atmospheric Data Through Web Hits On The National Atmospheric Deposition Program Website
8	Assessment Of The Impact Of Climate Change On Ratsnake Ecology
9	Reducing Uncertainties On Estimates And Spatial Distribution Of Forest Carbon
10	Toward Improving Our Understanding Of How Fish Populations Respond To Stressors Associated With Land Use Changes And Climate Change Scenarios
11	Development Or Revision Of Climate-Relevant Databases
12	Number Of Pesticide Applicators Making Decisions To Avoid Harming The Environment

## **Outcome #1**

### **1. Outcome Measures**

Increased Knowledge Of Human Actions That Negatively Affect The Environment

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

- 1862 Extension

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

Change in Knowledge Outcome Measure

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

<b>Year</b>	<b>Actual</b>
2012	195

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

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

Increasing concern over degradation of the environment addresses a critical issue related to sustaining life for future generations.

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

The new I Think Green curriculum was developed by 4-H and horticulture Extension specialists to engage third through fifth grade youth in investigating how living things interact with each other and with their environment. This program includes three tracks: [1] worms; [2] butterflies; and [3] insects. All three tracks are aligned with Illinois State Educational Goals and follow a sequence of four 40-60 minute investigations in which youth practice observation skills, conduct hands-on investigations with living things, explore different life cycles, identify how living things function/adapt/change, and compare how living things interact with each other and with their environment. The objectives of the program include: [1] to develop youth skills in scientific observation; [2] to increase youth knowledge of concepts that explain how living things function, adapt, change and interact within the environment; and [3] to increase youth knowledge of things they can personally do to help protect the environment. The program was delivered by 4-H and Master Gardener trained volunteers to 13 groups and involved 254 youth this past year.

#### **Results**

In responding to a ten-question evaluation given to the youth participants at the end of each of the three tracks, 77% [195] reported that the activities helped them learn how butterflies, worms, or insects contributed to the environment; 60% [154] reported having more ideas about ways they could help care for the environment; 68% [172] reported being more excited about helping to care for the environment; and 66% [167] reported that they would like to get involved in food composting, recycling, or other activities to help take care of the environment in their community after participating in I Think Green.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
135	Aquatic and Terrestrial Wildlife
806	Youth Development

#### Outcome #2

##### 1. Outcome Measures

Nontarget Effects Of Pesticides And Fertilizers On Aquatic Communities

##### 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)**

In the United States and throughout the world fertilizers and pesticides are used to improve crop production through nutrient enhancement and control of pest organisms. In general, fertilizers and pesticides are applied in terrestrial environments but they also reach water sources, including ditches, livestock watering ponds, and troughs used in agricultural practices. Some of these water sources are potential breeding sites for the immature stages [larvae] of mosquitoes. Little is known about how these nontarget effects of pesticides and fertilizers affect aquatic communities. Therefore, there is a need to study these aquatic systems, especially when considering mosquitoes are transmitters of human diseases.

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

We have generated new knowledge on the non-target effects of a commonly used insecticide, malathion, on mosquito life history traits relevant to pathogen transmission. We have shown that larval rearing temperature can modify the impact of environmentally-realistic concentrations of insecticide malathion on adult mosquito fitness [body size, fecundity and immunity].

###### **Results**

Pesticides are widely used around the world to control undesired plants and animals including mosquitoes. The United States accounts for one-third of the total amount of pesticides used to control agricultural and public health pests around the world. This research has generated data

on non-target effects of pesticide use on mosquito life history traits relevant to mosquito-borne pathogen transmission. This data will aid in development of public health policies that mitigate the negative impacts of pesticide use on the risk of mosquito-borne disease.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

#### Outcome #3

##### 1. Outcome Measures

Evaluating The Impacts Of Nitrate And Phosphorus On Water Quality

##### 2. Associated Institution Types

- 1862 Extension
- 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)**

Agricultural fields in Illinois contribute nitrate and phosphorus to streams from both surface runoff and tile flow, which has led to degraded water quality. This project will examine how various concentrations and forms of these nutrients affect stream algal production, dissolved oxygen, and in-turn biotic integrity.

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

Our analysis supports a series of conceptual models. The first representing small streams with clear water, dominated by periphyton. These streams have a large diel range in dissolved O<sub>2</sub>, but often the minimum dissolved O<sub>2</sub> is high as well; habitat modification [these are often channelized agricultural streams] has reduced biotic integrity, rather than low dissolved O<sub>2</sub>. Our second model

represents large rivers that support sestonic algae. This can lead to lower minimum dissolved O2 concentrations together with a large diel range. However, physical processes often impact dissolved O2 concentrations in these larger rivers and habitat is again a major limitation to biotic integrity. Finally, our third model describes a large number of intermediate-sized streams in the state, with limited productivity [no periphyton and small amounts of sestonic algae] and limited diel range in dissolved O2 concentrations. Again, habitat is a major limitation to biotic integrity, and algal production is limited by substrate, light, or water residence time. In each of these models, nutrients are rarely the limiting factor controlling algal biomass because both N and P typically occur at concentrations well above limiting levels.

### **Results**

One of the most significant outputs was a paper that showed what best explained nitrate yields in watersheds across the Mississippi River Basin [MRB]. This work has been critical in showing that to reduce nitrate losses in the MRB, the tile-drained corn belt is where conservation activities must be focused. Results from this work have been used by the state of Iowa in their recent nutrient reduction strategy. The other significant output was the summary of water quality and biotic effects which strongly influenced the state of Illinois in moving forward with development of nutrient criteria.

## **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

## **Outcome #4**

### **1. Outcome Measures**

Improvement Of Fertilizer Usage Recommendations To Increase Profitability And Reduce Environmental Impacts

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

- 1862 Extension
- 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)

There is substantial evidence that corn is largely dependent on soil N uptake, that soils differ considerably in their capacity to supply plant-available N through mineralization, and that these differences directly affect yield response to N fertilization. The overall goal of this project is to evaluate the potential of the Illinois Soil Nitrogen Test [ISNT] as a basis for fertilizer N recommendations.

#### What has been done

The database for multi-factor calibration of the Illinois Soil Nitrogen Test [ISNT] has been expanded to include soil pH, Bray-1 P, and exchangeable K as well as total nitrogen, organic and mineralizable carbon, and potentially mineralizable nitrogen estimated by the ISNT. In each case, duplicate analyses were performed on plot-specific soil samples collected from two depths [0-12 and 12-24 inches] in conjunction with two nitrogen response studies under a corn-soybean rotation and another under continuous corn that generated plot-specific yield data with plant populations from 20,000 to 40,000 plants/acre. The goal is to develop and evaluate different models that utilize the measured variables to improve the predictive value of the ISNT for optimizing nitrogen fertilizer rates. Modeling efforts to date have identified plant population and organic carbon availability as key factors that increase nitrogen fertilizer requirement at a given ISNT level.

#### Results

The extensive use of nitrogen fertilizers for corn production has major implications not only for the profitability of producers and agribusinesses, but also for the sustainability of cropping and management practices and their impact on soil, air, and water resources. Since the 1970's, these fertilizers have been used without adequately accounting for soil nitrogen reserves that in fact serve as the main source for crop uptake. The ISNT was designed to quantify soil nitrogen supplying power as a means of improving the accuracy of nitrogen fertilizer recommendations and implementing site-specific nitrogen management. Our previous work has provided ample evidence that numerous soil and plant factors affect the interpretive value of the ISNT for predicting crop nitrogen response. By utilizing the ISNT in conjunction with a multi-factor calibration, a 30 to 40 percent reduction should be readily attainable in nitrogen inputs with no yield penalty. At current fertilizer prices, such a reduction would cut the annual cost of Illinois corn production by more than 300 million dollars.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation

605 Natural Resource and Environmental Economics

**Outcome #5**

**1. Outcome Measures**

Evaluating Watershed Scale Models For TMDL Planning

**2. Associated Institution Types**

- 1862 Extension
- 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)**

This study will evaluate watershed-scale water quality models for total maximum daily load [TMDL] planning. Specifically, the components to be examined are tile flow, direct runoff, and base flow. The relative proportions of these components will then be related to environmental variables such as previous rainfall, climate, land-use, tile density, and soil properties. Once algorithms have been examined and incorporated with existing models and evaluated, effort will focus on estimating nitrogen and pesticide loads carried by these flow components.

**What has been done**

In the past, extensive field work on the effects of subsurface drainage on water quality was conducted in Illinois at the Little Vermilion River [LVR] watershed, Lake Decatur watershed, and Upper Embarras River [UER] watershed. We accomplished significant modeling results on microbial pathogen transport in 2011. In 2012, modeling works have been continued. The significant work accomplished during 2012 was on soil erosion and sediment transport experiments. The site construction for the erosion and sediment transport research and training was completed during 2012. Work is underway on sediment transport modeling.

**Results**

In 2012, significant efforts have been made on soil and water assessment tool modeling and model results verification with collected data from Illinois watersheds. This work will have significant impacts for subsurface drained watersheds in Illinois and elsewhere. These results have been presented to watershed groups. Microbial pathogen modeling results are being used in development of guidelines for best management practices. Results from the erosion and sediment control research have been presented to Illinois EPA, Illinois Department of

Transportation and other agencies related to environmental sustainability.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

#### Outcome #6

##### 1. Outcome Measures

Evaluating Habitat Quality Of Translocated Species

##### 2. Associated Institution Types

- 1862 Extension
- 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)**

Increased urbanization coupled with increased abundance of urban-adapted wildlife species has escalated the frequency of human-wildlife conflicts in urban environments. Translocation of nuisance individuals is a common approach for dealing with conflicts because the public views translocation as a humane alternative to euthanasia. However, we know little about the fate of most translocated individuals. Our goal is to develop a clearer understanding of behavior and fate of translocated nuisance woodchucks in the Chicago metropolitan area. Our project has three interrelated research objectives: [1] determine post-release movements and home ranges for translocated woodchucks; [2] examine habitat selection by translocated woodchucks; and [3] estimate survival rates for translocated woodchucks.

### **What has been done**

We collaborated with a nuisance wildlife operator who provided us with captured nuisance woodchucks. Woodchucks were then radiomarked with internal transmitters and released at one of three semi-rural release sites that differed in landscape composition. Each woodchuck was located frequently [daily when possible] for two weeks after release, and then 3-4 times per week during the active season and 3 times per month during hibernation. We have radiomarked and translocated 24 woodchucks and monitored their fates post-release. Results and recommendations from the project were shared with biologists with the Illinois Department of Natural Resources who are responsible for management of woodchucks in Illinois. We communicated our research through presentations and online communications to the public.

### **Results**

We have learned that movement patterns of translocated nuisance woodchucks varied among individuals with maximum distances moved from the release location ranging from <0.3 km to >5 km. In general, however, our initial results suggest that translocated woodchucks are more likely to stay near release sites after translocation compared to other species that often move substantial distances immediately after translocation. The woodchucks that moved considerable distances from release sites could be exposed to heightened mortality risk not only from natural predators, but also from human-related factors. Overall, survival rates of translocated woodchucks in Chicago appear to be lower than resident woodchucks studied in Urbana-Champaign, Illinois. Future efforts will focus on determining how much of the observed mortality of woodchucks in Chicago is due to the translocation process per se versus background predation risk at the semi-rural release sites. The patterns of survival of translocated woodchucks among our three release sites indicate predation risk could vary substantially among release sites. Current management practices for translocated species rarely take into account the habitat quality of release sites. In particular, how landscape structure affects predation risk for translocated individuals at release sites is not normally considered.

## **4. Associated Knowledge Areas**

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

## **Outcome #7**

### **1. Outcome Measures**

Dissemination Of Air Quality And Atmospheric Data Through Web Hits On The National Atmospheric Deposition Program Website

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

- 1862 Extension
- 1862 Research

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

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2012	1613982

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

The National Atmospheric Deposition Program provides fundamental measurements that support informed decisions on environmental and agricultural issues related to precipitation and deposition chemistry, as well as atmospheric mercury and ammonia. NADP data are relevant to a wide audience and provided to all. Data from our monitoring effort is used by a wide range of scientists for a number of research topic areas. Our data is used by policymakers to make informed decisions on agriculturally important topics. Our data is also used in many different education areas including chemical, agricultural, and environment science, and at many different levels. All data are available free of charge via the NADP website located at <http://nadp.isws.illinois.edu>.

#### What has been done

The USGS and NADP collaborated on tracking radionuclides wet deposition from the Japanese nuclear incident resulting from the March 2011 earthquake and tsunami. Normal precipitation samples from the National Trends Network, Atmospheric Integrated Research Monitoring Network, and the Mercury Deposition Network were used during the project, and the resulting studies can be found on the NADP website. By using the existing infrastructure of the NADP's networks in a new and important way, measurements were made that greatly added to the information on the impact on U.S. lands and population. The Central Analytical Laboratory has begun to measure bromide ion concentration in all NADP samples as a routine analyte of the NTN and AIRMoN. Regular measurements will soon be released for 2012. Bromide is important to agricultural users, given its fumigant usage. U.S. EPA scientists, with NADP, continued special studies to determine whether organic nitrogen deposition can be measured reliably and accurately. The results indicated that the measurements are reliable, and that organic N can be differentiated from inorganic N in our samples. This will add much needed information to the understanding of N deposition patterns and sources.

#### Results

NADP's principal outcomes and impacts on the broader scientific and educational communities are reflected in the value and usefulness of our networks and data. This is suggested by the download statistics and by the publications using our network and data [166 journal articles in 2012]. NADP's Ammonia Monitoring Network [AMoN] is now well established and has grown significantly over the past year. AMoN currently operates 58 sites, and has approximately 10,500 observations of atmospheric ammonia. This network has been receiving much interest from the agricultural community [[nadpweb.isws.illinois.edu/nh3net/](http://nadpweb.isws.illinois.edu/nh3net/)]. Since 2006, the NADP has been converting its precipitation gauges to an all-digital network. In mid FY 2012, 85% of our sites were reporting digital precipitation data.

### 4. Associated Knowledge Areas

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

- 112 Watershed Protection and Management
- 123 Management and Sustainability of Forest Resources
- 132 Weather and Climate
- 133 Pollution Prevention and Mitigation
- 135 Aquatic and Terrestrial Wildlife

### **Outcome #8**

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

Assessment Of The Impact Of Climate Change On Ratsnake Ecology

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

- 1862 Research

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

Change in Knowledge Outcome Measure

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

<b>Year</b>	<b>Actual</b>
2012	0

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

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

The ecology of ratsnakes was compared across the complete range of this species to assess how the snakes' ecology is likely to be affected by climate change. Study sites were in eastern Ontario, southern Illinois, and central Texas.

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

After harmonizing data across the three populations, data analysis was completed and a publication submitted. Additional data collection was undertaken, both to document changes in populations and to focus specifically on the extent of nocturnal activity in each population and the temperature thresholds that trigger the switch between diurnal and nocturnal activity using automated telemetry. Thermal ecology data indicate that the ability of these snakes to switch between diurnal and nocturnal activity is a critical adaptation for dealing with climate variation, and will therefore also be critical in allowing these snakes to respond to climate warming. This research led to a new project in South Carolina investigating how thermally-driven changes in snake behavior affect the nesting bird community on which the snakes prey.

##### **Results**

Despite the populations spanning a north-south distance of more than 1,500 km, some aspects of the ratsnake biology are surprisingly similar. Although the duration of annual activity increases from north to south, the profile of the main period of activity is highly conserved across

populations. In addition, snakes in all three populations expend similar effort overall to regulate body temperature through selective use of habitat. The principal mechanism the snakes use for dealing with climate differences across their range is to adjust when they thermoregulate and when they are active. In particular, the ability to shift to nocturnal activity in hot weather appears to be a critical adaptation for dealing with climate variation. Identification of these patterns has substantially altered the direction of this research program. To understand how these snakes will respond to climate warming, and thus to predict the ecological consequences of climate warming on these snakes and their ecological communities, it will be necessary to understand what triggers the snakes to alter when they are active and to determine whether the snakes are able to function equally effectively at night as during the day.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife

#### Outcome #9

##### 1. Outcome Measures

Reducing Uncertainties On Estimates And Spatial Distribution Of Forest Carbon

##### 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 significant carbon sinks, forests play a critical role in the regional and global carbon cycle dynamics and the mitigation of the greenhouse effect. However, there are considerable uncertainties on estimates and spatial distribution of forest carbon because of landscape complexities, inaccurate data, incorrect models and knowledge gaps. There is thus a strong need to develop a methodology to improve the quality of data and products of forest carbon needed for climate change research at global and regional scales. This project intends to overcome current significant gaps in the generation and assessment of the data and products of forest carbon dynamics. The objectives are to develop a theoretical and methodological framework including a

method to scale up spatial data and their uncertainties across scales, and a method to generate spatial and temporal uncertainty and error budgets. This project will then use the methodology to analyze the potential of integrating a process model and various sensor images and will provide general guidelines to improve the accuracy of the data and products by quantifying contributions of various input uncertainties to the outputs.

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

This year we primarily focused on applying our theoretical and methodological framework for comprehensive uncertainty analyses to various case studies where airborne and spaceborne LIDAR [Light Detection and Ranging] were used to generate forest landscape maps of current above-ground forest carbon estimates and for future landscape maps that were projected forward in time with the Forest Service Forest Vegetation Simulator. The FVS system we used for projecting forward time has been modified to account for potential climate change using IPCC [Intergovernmental Panel on Climate Change] global circulation models and emission scenarios. Uncertainty sources considered in the case study assessments were due to the LIDAR generated maps, FVS model projections of future forests, and IPCC global circulation models and scenarios.

#### **Results**

This project will provide statisticians, modelers, managers and policy makers of forest carbon with knowledge, methods, and guidelines to reduce uncertainties and improve decision-making. The developed methods can be applied to other regional and global programs of carbon modeling and management and the results will serve as general suggestions applicable to the programs. The knowledge, methods, results, and guidelines will serve to improve prediction of climate changes through the procedure of carbon budgets at global and regional scales.

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

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation

#### **Outcome #10**

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

Toward Improving Our Understanding Of How Fish Populations Respond To Stressors Associated With Land Use Changes And Climate Change Scenarios

##### **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)

General outcomes and impacts of this work include: [1] improved understanding of the physiological responses of fishes to temperature; [2] improved understanding of how land use and climate stressors can dictate the response of fishes to stressors; [3] training of two graduate students using novel laboratory and field techniques; and [4] improved ability to predict how broad stressors such as climate change and land use alterations can impact fishes.

#### What has been done

The focus in 2012 was to improve our understanding of how land use [forested land, agricultural land, and restored land] impacts the health, condition and stress of resident fishes. Studies were conducted on fish stress, health and condition for individuals residing in a range of habitat qualities, across a gradient of land uses, and in a number of seasons. Outputs will help identify how the response of fish to stressors can vary based on land use and restoration, which will have implications for how different management techniques are applied across regions, and on best management practices for restoring aquatic ecosystems.

#### Results

This project will provide us with a physiological, mechanistic understanding of how fish populations respond to stressors associated with land use changes and climate change scenarios. Knowledge of how ecosystems respond to these different stressors will improve our ability to predict how aquatic ecosystems will respond to future conditions resulting from climate change, and will also provide managers and restoration biologists with definitive guidelines for the habitat requirements of fish species. The target audiences for this research include managers [who will be able to integrate this information into conservation activities and land use decisions to improve management of fish populations and improve water quality], restoration ecologists [who can use this information when either designing or assessing a restoration project], land owners [who can use these results to make informed land-use decisions regarding restoration and activities on their land], and biologists [who will gain an improved understanding of the physiological and ecological impacts of land-use stressors on disturbance, fitness and performance in aquatic ecosystems].

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife

## **Outcome #11**

### **1. Outcome Measures**

Development Or Revision Of Climate-Relevant Databases

### **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>
2012	8

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

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

The NADP provides fundamental measurements that support informed decisions on environmental and agricultural issues related to precipitation and deposition chemistry, as well as atmospheric mercury and ammonia. NADP data are relevant to a wide audience and provided to all. Data from our monitoring effort is used by a wide range of scientists for a number of research topic areas. Our data is used by policymakers to make informed decisions on agriculturally important topics. Our data is also used in many different education areas including chemical, agricultural, and environment science, and at many different levels. All data are available free of charge via the NADP website located at <http://nadp.isws.illinois.edu>.

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

Climate-relevant databases developed or updated in 2012 include: [1] sulfate in precipitation database [atmospheric aerosol, important climate forcing, in-cloud aerosol]; [2] nitrate in precipitation database [atmospheric aerosol, in-cloud aerosol]; [3] ammonium in precipitation database [atmospheric aerosol, in-cloud aerosol]; [4] atmospheric ammonia concentrations in the atmosphere [reactive gas, aerosol formation]; [5] pH of rainfall [partially a function of atmospheric carbon dioxide]; [6] other reactive atmospheric gases [nitrogen, sulfur, precipitation removal]; [7] precipitation record [indicator of climate change]; and [8] work to develop a method for measuring elemental carbon in precipitation.

#### **Results**

NADP's principal outcomes and impacts on the broader scientific and educational communities are reflected in the value and usefulness of our networks and data. This is suggested by the download statistics and by the number of publications using our networks and data [166 journal articles in 2012].

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife

#### Outcome #12

##### 1. Outcome Measures

Number Of Pesticide Applicators Making Decisions To Avoid Harming The Environment

##### 2. Associated Institution Types

- 1862 Extension

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2012	500

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

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

Application of pesticides has the potential to adversely impact the environment, crops grown, and the pesticide applicator.

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

Pesticide training sessions focused on pesticide characteristics, correct application procedures, problems that may occur with the use of pesticides, where information can be obtained, and steps to take if a problem occurs with the use of a pesticide. Private applicator training was delivered by Extension staff in 20 settings across the state to 3,914 individuals in 2011-2012 that included agricultural producers, agriculture and horticulture sales associates, and Extension master volunteers. Following the training, Illinois Department of Agriculture staff administered a certification test. A survey of practice changes was distributed at all the pesticide trainings prior to the beginning of each training session.

###### **Results**

A survey of practice changes was conducted for the third consecutive year at the beginning of the private applicator training sessions in 2011-12. The 629 completed surveys represent

approximately 16% of those who completed the training and had participated in previous training sessions. In response to the question "Because of knowledge gained in previous PSEP training session, I have made the following practice changes" respondents could check up to 16 practice changes. Those most frequently checked by the 581 participants who answered this question included: [1] reading and following label directions for proper pesticide application methods and rates [516 participants or 88.8%]; [2] taking precautions to minimize spray drift when applying pesticides [500 participants or 86.1%]; [3] scouting to determine proper identification of pest before determining if control is needed [497 participants or 85.5%]; and [4] understanding how pesticides can cause contamination and taking steps to prevent it [496 participants or 85.4%]. At least 60% of the respondents attributed at least 14 of 16 possible changes to the PSEP training provided by Extension. Only 219 [37.7%] made changes to prominently label and secure their pesticide storage areas. In response to the question "By successfully passing my private applicators exam, I estimate that I save xx dollars annually by being able to protect my production and apply appropriate pesticides when necessary to my farming operation," 207 [32.9%] chose to respond. The total estimate for all 207 who responded was \$2,056,755 [an average of \$9,936 per operation].

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

#### V(H). Planned Program (External Factors)

##### External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

##### Brief Explanation

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

##### Evaluation Results

The new **I Think Green** curriculum was developed by 4-H and horticulture Extension specialists to engage third through fifth grade youth in investigating how living things interact with each other and with their environment. This program includes three tracks: [1] worms; [2] butterflies; and [3] insects. All three tracks are in line with Illinois State Educational Goals and follow a sequence of four 40 to 60 minute investigations in which youth practice observation skills, conduct hands-on investigations with living things, explore different life cycles, identify how living things function/adapt/change, and compare how living things interact with each other and with their environment. The objectives of the

program include: [1] to develop youth skills in scientific observation; [2] increase youth knowledge of concepts that explain how living things function, adapt, change and interact within the environment; and [3] increase youth knowledge of things they can personally do to help protect the environment.

A ten-question evaluation was completed by 254 youth comprised of 88 who participated in the butterfly track, 42 in the worm track, and 124 in the insect track. Response tallies for the six questions that were identical for all three groups follow:

#### Environment Related Questions [n=254]

60% [154] of youth reported having more ideas about ways they could help care for the environment; 68% [172] reported being more excited about helping to care for the environment; and 66% [167] reported that they would like to get involved in food composting, recycling or other activities to help take care of the environment in their community.

#### Participation Related Questions [n=254]

48% [122] of youth reported that the **I Think Green** activities were fun to do; 77% [195] reported that they would like to do more activities like the ones in **I Think Green**; and 65% [167] reported that they would like to help with a community garden project.

#### Butterfly Track Specific Questions [n=88]

80% [70] of youth in this track reported that they were encouraged to ask questions about butterflies and the environment; 77% [68] reported that the activities helped them learn about butterflies and how they grow; 72% [63] reported that the activities help them to learn how butterflies interact with other living things; and 73% [64] reported that the activities help them learn how butterflies contribute to the environment.

#### Worm Track Specific Questions [n=42]

57% [24] of youth in this track reported that they were encouraged to ask questions about worms and the environment; 90% [38] reported that the activities helped them learn about worms and how they grow; 67% [28] reported that the activities help them to learn how worms interact with other living things; and 71% [30] reported that the activities help them learn how worms contribute to the environment.

#### Insect Track Specific Questions [n=124]

56% [69] of youth in this track reported that they were encouraged to ask questions about insects and the environment; 84% [104] reported that the activities helped them learn about insects and how they grow; 77% [95] reported that the activities help them to learn how insects interact with other living things; and 79% [98] reported that the activities help them learn how insects contribute to the environment.

A survey of practice changes was distributed for completion for the third consecutive year at the beginning of **private applicator training sessions** in 2011-2012. The 629

completed surveys represent approximately 16% of those who completed the training and had participated in previous training sessions. In response to the question 'Because of knowledge gained in previous PSEP training session, I have made the following practice changes' respondents could check up to 16 practice changes. Results follow and include responses from 581 participants who chose to answer this question: 88.8% [516] read and follow label directions for proper pesticide application methods and rates; 86.1% [500] take precautions to minimize spray drift when making pesticide applications; 85.5% [497] scout to determine proper identification of pests before determining if control is needed; 85.4% [496] understand how pesticides can cause contamination and take steps to prevent it; 80.4% [467] mix and load pesticides in a well-lit open-air area to minimize exposure to pesticides; 79.2% [460] store pesticides in a secure location separate from any feed stuffs; 78.5% [456] know how to respond to pesticide exposures if they should occur; 74.9% [435] use recommended personal protective equipment when working with pesticides; 73.3% [426] refer to treatment thresholds to decide if a pest needs to be controlled; 69.4% [403] calibrate their sprayer regularly to ensure accurate application rates; 68.8% [400] inform family, friends, and employees of the safety precautions to follow around pesticides; 66.4% [386] have adopted IPM practices in managing pests in their farming operation; 65.2% [379] adjust cultural practices whenever practical to control/manage pest populations; 63.2% [367] select the safest pesticides possible to control/manage pest populations; 58.9% [342] thoroughly examine their fields to determine the distribution of a pest population; and 37.7% [219] have their pesticide storage areas prominently labeled and secured.

Two hundred seven [207] of the respondents indicated that they had saved money by successfully passing the private applicators exam and applying appropriate pesticides when necessary to their farming operation. Estimated dollars saved totaled \$2,056,755 which averages to slightly over \$9,936 per operation. The 446 respondents who provided information on acres treated with pesticides reported application to 443,623 acres. It should be noted that since PSEP testing is required every three years, this is the last of the three annual groups of applicators that will be asked to complete the evaluation.

### Key Items of Evaluation

Approximately three-fourths of the youth participants in **I Think Green** learned about how butterflies, worms, and insects grow, interact with other living things, and contribute to the environment. Although fewer youth reported changes in how they felt, ideas gained, and interest in how they could care for the environment, more than 60% of those responding did report changes. The number of participants was limited this past year. Continuation of the evaluation effort will be a priority as will increasing the number of trained volunteers with a resulting growth in youth participants who develop an understanding and commitment to protecting the environment in the coming year.

Although private pesticide applicators would prefer not to take the required Illinois Department of Agriculture certification exam every three years, those who attended recertification training and completed a survey indicated that the information taught during the training had been applied as a part of their farming operation. Although some of the practices applied relate to regulations concerning pesticide use, others clearly reflect actions taken to protect themselves, their friends, family, neighbors, livestock, and the environment. Attention needs to be given to address how to increase the prominent labeling of pesticide storage areas in future trainings.