

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Soil and Water Quality

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
112	Watershed Protection and Management			30%	
133	Pollution Prevention and Mitigation			70%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.5	0.0
Actual Paid Professional	0.0	0.0	6.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	119781	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	513500	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	193929	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The main research objectives are to develop chemical, biological and mechanical methods of

controlling invasive plants, to use molecular methods to identify invasive plants, and to develop procedures to monitor herbicides in water. Additional objectives focus on the detection and potential remediation of heavy metals and persistent organic pollutants in soil. Good progress was been made on these objectives. The outputs were new scientific findings; scientific publications, newsletters, and fact sheets; talks and interviews; and the number of state residents served directly by analyzing soil samples, identifying invasive aquatic or terrestrial weeds, or controlling these pest plants. These activities, services, or events are designed to provide new information that can be used by the general public and to seek their input on the research program and findings. Participation by members of lake associations in group discussions and workshops are particularly important because these stakeholders must agree on how to remove aquatic weeds from lakes. Options are limited for herbicide treatment and mechanical methods, which can vary in effectiveness depending on the extent of invasive weed infestations and possibly by the co-presence of threatened or protected non-target species. Diagnostic services are available to determine the extent of pollution problems and to determine the success of field experiments. Water quality standards for acceptable herbicide concentrations are those established by the CT Department of Energy and Environmental Protection and the US Environmental Protection Agency. Information was made available to all stakeholders on the CAES website and other social media, in newsletters and fact sheets, and in displays at the open house events or at agricultural fairs. It is also expected that there will be interest from reporters to write articles on the research, thereby enhancing awareness of invasive plant infestations. Results of these output activities did or will lead to specific outcomes, such as removing pesticides from soil and water, clearing lakes and ponds of invasive aquatic plants, and preventing loss of water quality.

2. Brief description of the target audience

A broad base of stakeholders, including under-represented and under-served persons, was targeted. The following stakeholder groups did or will directly benefit from the research: farmers, lake associations, boaters, homeowners, water company officials, environmentalists, extension specialists, corporate and municipal officials, and pesticide producers. Special efforts continue to be made to contact and include members of minority organizations, women, and children to provide information and to participate in open house events.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	250	1828	85	314

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

2013	Extension	Research	Total
Actual	0	14	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Total research papers

Year	Actual
2013	29

Output #2

Output Measure

- # of talks and interviews given to stakeholders

Year	Actual
2013	46

Output #3

Output Measure

- # of diagnostic tests performed

Year	Actual
2013	10312

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of homeowners gaining knowledge on pesticide pollution and invasive aquatic plants
2	# of homeowners gaining knowledge about watershed protection and soil and water quality
3	# of lakes and ponds surveyed and/or cleared of invasive aquatic plants

Outcome #1

1. Outcome Measures

of homeowners gaining knowledge on pesticide pollution and invasive aquatic plants

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	335

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Extensive growths of invasive aquatic weeds, such as Eurasian watermilfoil (*Myriophyllum spicatum*) and curly leaf pondweed (*Potamogeton crispus*) can significantly reduce water quality and alter native aquatic habitats. Stakeholders requested assistance with determining the species of aquatic vegetation and integrated weed control.

What has been done

Staff mapped native and invasive aquatic vegetation in 16 new and 14 previously surveyed water bodies. The effects of six years of winter drawdown on invasive plants were quantified in the States largest lake. The effects of grass carp (fish that eat aquatic plants) in Grannis Lake was evaluated. Fall herbicide applications in Bashan Lake to control variable watermilfoil were continued.

Results

After eight years of surveillance, 60 percent of Connecticut lakes and ponds have been shown to contain invasive plants. These plants cover approximately 10 percent of the combined area of all Connecticut lakes and the problem is increasing. The coverage of Eurasian watermilfoil shows a negative relationship to drawdown depth and duration in Candlewood Lake. After no decrease in curly leaf pondweed in Grannis Lake in 2008 and 2009, grass carp were found to reduce the plants abundance in each year thereafter. We have largely restored Bashan Lake to preinfestation conditions after years of selective fall herbicide applications. Long-term benefits will be a clean water supply and a body of water which can safely be used for recreation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

Outcome #2

1. Outcome Measures

of homeowners gaining knowledge about watershed protection and soil and water quality

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1986

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Biochar has shown much promise as a soil amendment in enhancing water-holding capacity, nutrient retention, toxin absorption, and promotion of root health. Moreover, the combination of applying earthworms and biochar together may lead to active consumption by the earthworms as a means to deliver biochar into lower soil columns where the living roots reside. The role earthworms play in the cycling of biochar in the soil column is poorly understood.

What has been done

Numerous laboratory and greenhouse studies were conducted to understand the active consumption of biochar by earthworms. In addition, long term asparagus field plots were established in Hamden, Griswold, and Windsor and monitored to study the combination of earthworm with biochar for their effect on Fusarium crown rot, an important disease of asparagus.

Results

Results revealed that biochar alone did not increase yield compared to controls, but did increase mycorrhizal colonization three fold and reduced disease ratings. The earthworm treatment alone produced 37% more yield than controls, increased mycorrhizal colonization by 50%, and also suppressed disease. However, the combination of earthworms and biochar produced 26% more yield compared to controls, increased mycorrhizal colonization from 7.7% to 26.6% (3.5 fold increase) and had the lowest disease ratings. The most preferred biochar that was actively consumed by earthworms was an aged biochar harvested from charcoal mounds, whereas the least consumed biochar was a fast pyrolysis biochar called CQuest. These results show promise for the ability of biochar and earthworms to promote root health, with possible long-term benefits of reduced use of fertilizers and pesticides.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #3

1. Outcome Measures

of lakes and ponds surveyed and/or cleared of invasive aquatic plants

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	23

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Salt marshes are considered the most productive ecosystems on the planet, which provide multiple benefits. They protect coastal communities from storm surges and wave erosion, absorb tons of excess nitrogen and phosphorus from rivers, detoxify pollutants, and provide habitat and shelter for many hundreds of species. Along intertidal creeks in salt marshes of the Atlantic and Gulf States, there have been large, barren areas where the dominant plant, *Spartina alterniflora*, has disappeared. The cause of this condition, called Sudden Vegetation Dieback (SVD), remains unclear. Loss of Connecticut salt marshes would be devastating to delicate ecological cycles, which would be disturbed and potentially lead to cascade disturbances in many other ecosystems.

What has been done

Scientists at The Connecticut Agricultural Experiment Station identified a new endophytic-pathogenic fungus, *Fusarium palustre*, that was found in higher incidence in SVD sites. Although the fungus is not able to incite plant death by itself, it can interact with other stressor(s) such as drought and flooding, to cause mortality. The herbivorous purple marsh crab, *Sesarma reticulatum*, was also found in SVD sites. Given that the cause of SVD remains unknown, scientists hypothesized that *Spartina* plants stressed by drought and disease might be more attractive to feeding by the purple marsh crabs, which in turn, prevents recovery in these sites. Scientists also conducted greenhouse and in situ studies designed to understand the role these species and other stressors (e.g., drought flooding) play in SVD.

Results

Research findings provided a better understanding of the tripartite interaction between plant, fungus, crab, and environment. Infection by the fungus alters the plant to make it more attractive to herbivory by the crab that may in turn lead to a tipping point that results in wide spread dieback and limited regeneration. This information is being used to develop scenarios that may lead to management practices aimed at reducing SVD in Connecticut marshes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Other (Staff changes)

Brief Explanation

Although there were no external factors that immediately affected outcomes during this reporting period, the current economy, changes in state or federal appropriations, and resulting staff changes remain the primary external factors that could affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

"Before and after" and "during" evaluations were conducted to document increased knowledge of aquatic plants, whereas "during" evaluations were most helpful in assessing advanced knowledge of stakeholders on soil and water quality issues. Stakeholders from several lake associations/towns participated in the aquatic weed abatement programs and in town meetings. They followed progress as treatments cleared the weeds from targeted areas.

Key Items of Evaluation

Written information on evaluation forms following workshops, held in different towns, was an important information collection method for program assessments. During this reporting period, there were 1040 citations for scientific articles written by several scientists for the planned program. These citations indicate that knowledge was gained by scientists and used in their studies.