RESEARCH PROJECT TITLE: ED-STEEP: Education Solutions to Environmental and Economic Problems

INVESTIGATORS: Mark A. Quinn and Catherine A. Perillo, Department of Crop & Soil Sciences, Washington State University

INTERIM OR FINAL REPORT: Interim

PROJECT OBJECTIVES:

Objective 1. To create a standards-based series of lessons and learning activities, based on the accomplishments and issues addressed by the STEEP Program, which can be incorporated into secondary school science classrooms (e.g., biology, life sciences, environmental sciences, chemistry, physics, agricultural science).

Objective 2. To create education material and learning activities, based on the accomplishments and issues addressed by the STEEP Program, which can be incorporated into post-secondary courses (e.g., biology, agriculture, and environmental sciences) at 2- and 4-year colleges in the Northwest.

KEY WORDS: Education Website, Curriculum Development, Science Education, Environmental Education

STATEMENT OF PROBLEM: The benefits of the STEEP Program are significant and known to many within the agricultural community. Cooperation between growers, industry, researchers, and extension personnel continue to have a significant impact toward solving many agriculture-related environmental and economic problems. Unfortunately, the research and benefits of the program are not widely known to educators, students, civic groups, and other members of society. To have a maximum impact, the STEEP program should reach out to educators by providing them with relevant and timely information on the goals and accomplishments of the program. It is the education of students that will lead the drive for more innovative and newer solutions to the environmental and economic problems in the Inland Northwest. The specific problem that we wish to address is the lack of connection between the information being generated through the STEEP Program and educators in secondary and post-secondary school classrooms.

ZONE OF INTEREST: All

ABSTRACT OF RESEARCH FINDINGS: To increase the overall impact of the STEEP program on society, we have developed the website, ED-STEEP: Education Solutions to Environmental and Economic Problems (http://pnwsteep.wsu.edu/edsteep), as a component of the STEEP website. We have accomplished the following: 1) identified specific environmental issues being addressed through the STEEP program, 2) catalogued specific results from STEEP research projects, 3) developed a comprehensive set of lesson plans, learning activities, and other education material for secondary and post-secondary science teachers, 4) developed fact sheets, research summaries, and lists of relevant web sites for students, government officials, and others

interested in agriculture-related environmental and economic issues, and 5) have begun evaluating the education material in the classroom. Currently, the website has education material on: biodiversity of ground-dwelling arthropods, biodiversity of soil invertebrates, field burning, global warming and carbon sequestration, organic matter and biodiversity, pesticides chemistry, seed germination, soil bacteria, soil chemistry and physics, soil erosion, and soil organic matter.

RESULTS AND INTERPRETATION: Many of the significant environmental and economic issues being addressed through the STEEP program have been identified and include:

- soil erosion from wind and water
- reductions in air quality from field/stubble burning and wind erosion events
- loss in soil organic matter, soil fertility, and soil water holding capacity from repeated tillage
- fallow-field rotations that lead to wind erosion and loss of productivity
- reductions in soil biodiversity because of repeated tillage
- changes in pest population dynamics in no-till fields
- need for alternate crops in continuous cropping systems
- increase in herbicide usage when adopting no-till methods
- reduced profitability of some continuous cropping systems
- release of carbon from soil after tillage, contributing to global warming

Specific research outcomes from STEEP projects that can be incorporated into secondary and post-secondary science curriculum have also be catalogued. This information was compiled from STEEP reports, publications, consultations with researchers, and through the website, Sustainable Commodity-based Agriculture in the Pacific Northwest, developed by Mark Quinn, Bill Pan, and Bob Gillespie.

The education material developed for the website adheres to specific state and national science education standards. State standards have been identified for Idaho, Oregon, and Washington. For example, the Soil Organic Matter and Biodiversity Unit that we developed meets the following Idaho State Standards:

- 648.01-.03 (Unifying Concepts of Science)
- 649 (Concepts of Scientific Inquiry)
- 650.02-.03 (Concepts of Physical Science)
- 652.02 (Interdependence of Organisms and Biological Change)
- 653.01 (Matter, Energy, and Organization in Living Systems)
- 654.02 (Earth and Space Systems)
- 655.01 (Technology)
- 656.01-.04 (Personal and Social Perspectives)
- 658.01-.02 (Interdisciplinary Concepts)

In addition, this unit also adheres to the AAAS Benchmark standards for Diversity of Life, Interdependence of Life, Flow of Matter and Energy, Scientific Inquiry, and The Scientific Enterprise.

Specific lessons plans, learning activities, and other education material, based on the outcomes of STEEP research projects, were developed for science educators and included in the ED-STEEP website (See attachments; Figure 1 and Table 1). Figure 1 represents the website's homepage. Table 1, shows the list of education topics developed for the website. The pages can also be accessed at: http://pnwsteep.wsu.edu/edsteep. The education material contains lesson plans, fact sheets, student work sheets, links to relevant web sites, and other information on STEEP-related issues and accomplishments. For example, the Organic Matter and Biodiversity Unit contains the following material:

- Summary of STEEP research projects relevant to soil organic matter and biodiversity
- Links to AAAS and state education standards address by the education material
- Choosing a Sample Site and Preparing Soil Samples
- Soil Organic Matter Fact Sheet
- Soil Invertebrate Fact Sheet
- Soil Organism Picture Guide (MS Word file)
- Soil Organism Picture Guide (PowerPoint file)
- Constructing a Berlease Funnel for Collecting Soil Invertebrates
- Simple Soil Analyses
- Scientific Experiments and Lab Report Format
- Constructing Bar and Line Graphs
- Student Handout
- A list of relevant web resources

Much of the education material has been evaluated in the classroom, and refined as needed. Quinn was able to test and evaluate the material while teaching a biology class at Paradise Creek Regional High School (Moscow School District), a life science class at Moscow Junior High School, and during a two-week workshop for high school students participating in WSU's Cougar Quest program. The workshops were entitled, "Exploring the Unseen World Under our Feet."

The Impact of the ED-STEEP website should be far-reaching and immediate as teachers, students, and others access the website for information. Its overall impact will be the focus of the second year of the project.

INTERACTIONS (COOPERATION) WITH OTHER SCIENTISTS CONDUCTING RELATED ACTIVITY: We have consulted with STEEP researchers to identify specific research outcomes that can be incorporated into secondary and post-secondary science curriculum.

PUBLICATIONS AND PRESENTATIONS: ED-STEEP: Education Solutions to Environmental and Economic Problems (http://pnwsteep.wsu.edu/edsteep)

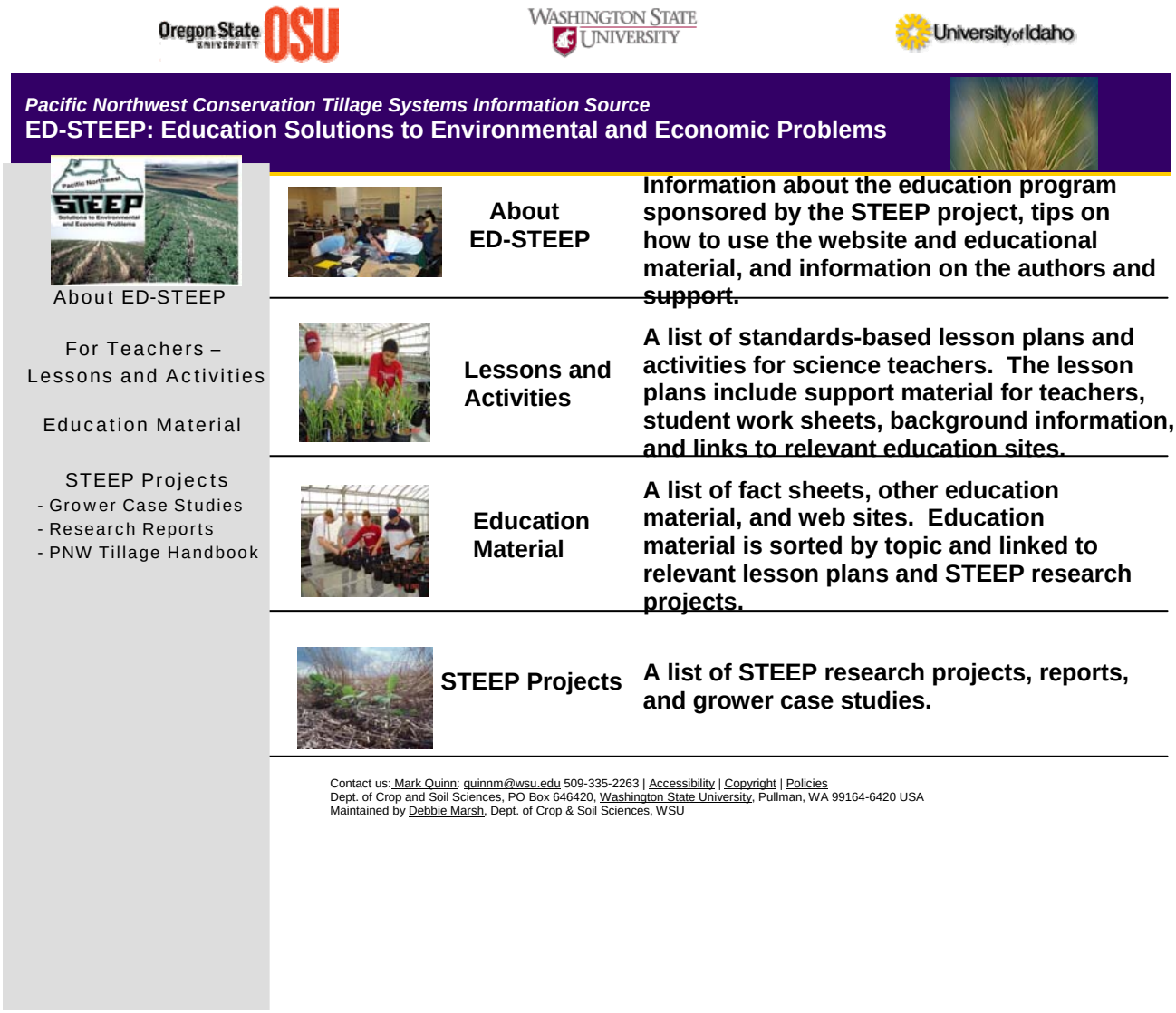

Fig. 1. ED-STEEP homepage.

Table 1. Education Units for teachers showing a list of STEEP-related topics.

Biodiversity of Ground-dwelling Arthropods	In this lesson, students collect ground-dwelling arthropods to compare the biodiversity of different habitats. The lesson allows them to explore the importance of biodiversity, arthropod communities, terrestrial ecology, and classification.
Biodiversity of Soil Invertebrates	Soils are extremely complex and fascinating ecosystems. In this lesson, students extract and identify invertebrates from different soils. It's an excellent lesson in biodiversity, invertebrates, ecology, behavior, and science methodology.
Field Burning	Field burning is a controversial issue in the Inland Northwest. This lesson allows students to debate the pros and cons of field burning
Global Warming and Carbon Sequestration	This lesson allows students to develop and experiment with possible solutions to the global warming problem, with an emphasis on carbon sequestration in soils. It provides background material on the causes and consequences of global warming and examines the role of agriculture it mitigating its effect.
Organic Matter and Biodiversity	This is a comprehensive, experiential-based lesson that lets students explore the relationship between habitat type, soil organic matter, and biodiversity of soil invertebrates. It includes information on constructing Berlese funnels, conducting experiments, and writing lab reports.
Pesticide Chemistry	In this lesson, students conduct internet-based research on the structure, mode of action, uses, and environmental problems associated with common pesticides used in the Inland Northwest.
Seed Germination	In this lesson, students develop and conduct simple experiments to determine the effects of biotic and abiotic factors on seed germination. Its an excellent lesson on scientific methodology and the preparation of lab reports.
Soil Bacteria	Soil bacteria are primarily responsible for the decomposition of organic matter and are essential to ecosystem functions. In this lesson, students use a dilution plate technique to count the number of bacteria found in 1 g of soil.
Soil Chemistry and Physics	This is a series of experiments that allows students to explore the chemistry and physics of soils, including pH, soil charge, movement of chemicals in soil, water holding capacity, texture, composition, moisture, and percolation. Soils are an excellent medium for teaching applied chemistry and physics.
Soil Erosion	Soil erosion is a significant global and regional problem, contributing to the loss of fertile soil and numerous other health and environmental problems. In this lesson, students will explore the causes and consequences of soil erosion and its impact on regional agriculture
Soil Organic Matter	Organic matter is the key to nutrient recycling and plant growth in terrestrial ecosystems. In this lesson, students measure the organic matter content of different soils, and discuss the importance of soil organic matter. The lesson can also be combined with the lesson on Global Warming and Carbon Sequestration.

RESEARCH PROJECT TITLE: Seasonal and Spatial Dynamics of Rodent Damage in No-till Cropping Systems in Idaho and Washington

INVESTIGATORS: Rodney Sayler, Department of Natural Resource Sciences, Washington State University; Gary Witmer, USDA National Wildlife Research Center; David Huggins, USDA-ARS, Washington State University; Richard Rossi, Department of Crop and Soil Sciences, Washington State Univesity; Jason Capelli, Department of Natural Resource Sciences, Washington State University

PROJECT OBJECTIVES: 1) Identify the species and population dynamics of rodents causing crop damage, 2) Describe and model the ecological factors effecting rodent density, and 3) Determine the seasonal use of habitats including agricultural lands and non-agricultural lands.

KEY WORDS: rodents, damage, population dynamics, habitat use

STATEMENT OF PROBLEM: Higher levels of crop residue and lower soil disturbance in conservation tillage farming systems potentially create better habitat for rodent populations, which may cause increased crop damage under high populations and certain ecological settings. Such damage may discourage more rapid adoption of no-till agriculture. Population dynamics of rodents have not been well studied in agricultural settings, particularly in new experimental cropping systems designed to move the industry towards more sustainable agricultural production. Consequently, information on specific environmental factors (e.g, elevation, aspect, slope, soil moisture, crop cover) which may influence rodent ecology and distribution in agricultural settings are not well known. Better information on factors influencing the seasonal and spatial dynamics of rodent damage in modern cropping systems is needed to encourage the spread of conservation tillage farming systems and assist in strategies for management of rodent populations.

ZONE OF INTEREST: Palouse region of WA and ID

ABSTRACT OF RESEARCH FINDINGS: We studied the population and spatial dynamics of rodents in a no-till agricultural setting at the Palouse Conservation Field Station and in surrounding areas from 2003-2004. We used classification and regression trees (CART) and logistic regression to evaluate selected ecological and environmental variables related to rodent abundance and distribution within the Palouse agricultural landscape. Deer mice (*Peromyscus maniculatus*) accounted for 98.5% of rodent captures in the study area. Capture probabilities varied spatially over the farm by season, however, several areas had consistently high or low rodent populations. CART models predicted from 46-75% of the seasonal variation in capture success at 600 permanent trapping sites distributed throughout farm habitats. Environmental variables at trap sites which were significantly associated with rodent trapping success, included crop cover type, grass cover, elevation, slope, soil moisture index, potential yearly solar radiation, and weather, however, importance of specific variables varied by season. Elevation and the presence of non-agricultural grass cover were the two most consistently influential variables predicting higher rodent captures across seasons. Populations of montane voles (*Microtus montanus*) appeared to crash to extremely low levels during our study and although trapping success of deer mice demonstrated that rodents occurred across the farm throughout the year,