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Restoring the Chesapeake--A Watershed Education and Restoration Project for Virginia Youth

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Abstract
A watershed education and restoration project was started in the Virginia portion of the Chesapeake Bay watershed in 2002. Over 37,000 hardwood seedlings were distributed to school groups and 4-H leaders in 19 counties. A geographic information system (GIS) identified subwatersheds in greatest need of riparian restoration. A Web site provided educational material and facilitated communication. Results indicate 3 years are needed to develop partnerships necessary for large-scale projects such as this one. Hands-on activities like planting trees result in large knowledge gains. Use of land-use maps and a Web site also result in knowledge gain about watersheds.

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Introduction

Chesapeake Bay is an estuary with economically important wild fish and shellfish populations that are threatened by an ever-expanding human population and its concomitant negative impacts on water quality (Boesch & Greer, 2003). Threats to the Bay and its species include excessive nutrients, sediments, toxic chemicals, habitat loss, and over fishing (EPA, 2004).

Several strategies have been put in place as a result of the 2000 Chesapeake Bay Agreement <http://www.chesapeakebay.net/agreement.htm> signed by the Bay states governors in Pennsylvania, Maryland, Delaware, and Virginia. These strategies include nutrient reduction, riparian restoration, and a K-12 Meaningful Bay Experience (MBE). The MBE commits states to providing an extended educational experience on or near water to all K-12 students. Riparian restoration in this case emphasizes the fencing out of cattle and the planting of trees, creating a buffer between streams and nearby land uses.

In 2002, Virginia Cooperative Extension received a 3-year grant from the U.S. Forest Service to provide free native hardwood seedlings to youth for tree planting projects in the Potomac/Shenandoah watershed and to create a Web site with information about watersheds and land use. The Potomac/Shenandoah is the most deforested watershed in Virginia, largely due to agriculture. This makes it a prime target for restoration efforts that involve tree planting. Research has shown that forest cover is the most protective of water quality, having the potential to reduce nutrients and sediments from entering a stream (Klapproth & Johnson, 2000).

Our project had two major goals, 1) to develop partnerships that implement watershed-based forestry projects and 2) to increase forest cover in a watershed that is largely deforested. The measurable objective for the first goal was the number of youth conducting the project and their increase in knowledge about land use, watersheds, and seedling care. The measurable objective for the second goal was the number of seedlings planted and surviving 60 days after planting.

Methods

To achieve the first objective, we contacted by e-mail every 4-H Extension agent in the 19 counties within the Virginia portion of the Potomac/Shenandoah watershed. We invited agents to participate in the project and/or to nominate volunteers to serve in their place. As a result, we developed a distribution list of 62 persons who received information about the project, consisting of paid Extension employees (32), 4-H volunteers (17), and agency partners (15). We knew that many Extension agents work directly in schools and that school populations cross sub-watershed boundaries, so we did not put any geographic restrictions on who received seedlings or where seedlings were planted.

Concurrent with these efforts we created the Restoring the Chesapeake Web site, <http://www.cnr.vt.edu/PLT/potomacshenandoah/index.html> with several features. The first was a series of county land-use maps and graphs that could be viewed on the Internet or printed on poster-sized maps for use in a traditional classroom setting. A second feature was a student learning center where students could learn why planting was needed and how to plant seedlings and see examples of good and bad riparian area management. Additional information included an on-line pre- and post-test, links to educational resources, and results of the seedling survival survey. The pre- and post-test consisted of 10 questions about watersheds, land use, sources of pollution, and planting seedlings.

To achieve the second objective, we provided free hardwood seedlings to students to plant on residential land or in riparian areas, and we provided geographic information on where the greatest potential for restoration could be found. To assess restoration potential, we conducted a Geographic Information System (GIS) analysis of the 60-meter area adjacent to water bodies in the watershed. We used a query function to return those areas that were 1) greater than 2% residential (where students are likely to live) and 2) less than 50% forested (where planting is needed most). A detailed description of methods was also included on the Web site.

Orders for free seedlings were taken in the winter months, and seedlings were mailed to Extension offices in March/April and within 3 days of a requested date. Periodic updates were e-mailed to our list of Extension agents and volunteer leaders. Seedling survival surveys were conducted in June, before the end of school. The seedling survival survey consisted of a simple show of hands from students whose seedlings were still alive.

Results

Over 3 years we received seedling requests from 17 of 19 counties that were eligible for the project (Virginia counties that fell within the watershed boundary.) Requests came from a variety of sources--Extension agents, Soil and Water Conservation District educators, 4-H club leaders, K-12 teachers, and others. Nearly every student who participated in this project received at least one seedling to take home (Table 1).

Table 1.
Project Participation

Level or Extent of Participation	**Number**
Counties eligible for project	19
Counties that participated the first year	9
Counties that participated by end of third year	17
Students that participated	20,932

Seedlings distributed	37,225
Seedlings surviving after 60 days	75%

Despite the availability of an on-line pre-test, no one reported results through this medium. As planting time drew near the first year of the project, we made arrangements to visit selected classrooms to give a much simpler three-question test that could be administered in a matter of minutes. Students at two schools were given a written multiple-choice test (Table 2). Students at one school were given a write-in test, where questions were asked but no choices were given (Table 3).

Table 2.
Knowledge Gain--Multiple Choice

Multiple Choice Question	**Correct Answers Before n=44**	**Correct Answers After n= 60**	**Knowledge Gain**
What watershed do you live in?	37	57	15%
What is the most common land use?	8	21	19%
Where should you store a seedling?	3	51	78%

Table 3.
Knowledge Gain--Write In

Write-In Question	**Correct Answers Before n=33**	**Correct Answers After n=33**	**Knowledge Gain**
What watershed do you live in?	4	16	39%
Define a watershed	5	17	36%

The second year of the project, we received pre- and post-test results (scores only) that did not allow us to differentiate among the 10 questions. The average pre-test score was 25% (N=98); the average post-test score was 88% (N=101), for an overall knowledge gain of 63%.

The results of GIS analysis revealed the extent of deforestation in the area where students were most likely to live. We were able to identify 23 subwatersheds with riparian areas less than 50% forested and greater than 2% residential. In the most severely deforested subwatersheds, agriculture was the largest land use, followed by residential use (Table 4). Barren and transitional land uses were combined and listed as "Other."

Table 4.
Selected Subwatersheds--Land use Within 60 m. of a Stream

Subwatershed	**Forest**	**Agriculture**	**Residential**	**Commercial**	**Wetland**	**Other**
Blacks Run	2.21%	90.82%	3.91%	2.55%	0.00%	.51%
Cooks Creek	5.73%	85.49%	7.57%	1.12%	0.10%	.00%

Linville Creek	22.34%	73.00%	3.53%	0.09%	0.03%	1.01%
Middle River/ Lewis Creek	36.19%	58.39%	2.53%	2.24%	0.48%	.17%
Mill Creek	18.70%	72.18%	8.63%	0.13%	0.34%	.03%
Mossy Creek	17.82%	79.23%	2.08%	0.00%	0.87%	.00%
Muddy Creek	35.50%	59.79%	4.28%	0.33%	0.10%	.00%
N. Fork Shen/ Holmans Ck	33.89%	58.79%	4.80%	0.63%	0.68%	1.22%
Pleasant Run	5.76%	88.78%	5.17%	0.12%	0.12%	.06%
Potomac R./Dogue /Little Hunting Ck	34.84%	3.89%	31.06%	6.47%	22.06%	1.66%

Discussion

We expected 100% of counties to take advantage of the free seedlings, so the level of participation was somewhat lower than expected, especially the first year. Personnel loss within Virginia Cooperative Extension due to budget cuts likely contributed. By the end of the third year, nearly everyone was participating, suggesting that partnerships take up to 3 years to develop in counties where tree-planting projects are not already present. In five counties, tree planting was organized by Soil and Water Conservation District Educators and other agency partners, accounting for 62% of the seedlings planted.

We expected 50% seedling survival, so survival was greater than expected. Most seedlings were planted without tree shelters, which is standard practice for riparian plantings in Virginia. Also, our survival percentage accounts for trees that were distributed to students but were not planted. Checking for survival after only 60 days is not ideal (1 year would be more typical), but this is the best we could achieve because our contact with students was lost at the end of each school year.

Knowledge gain was greatest for seedling care. This was not surprising because tree planting is a "hands-on" activity and students have a personal stake in success. Knowledge gain for concepts relating to land use and watersheds were much lower. We cannot be sure if this is because they are difficult concepts to teach and understand, or if teacher/leaders were simply not devoting time to it. The fact that only five of 15 students used one key word ("land area," "drains into," or "body of water") in their definition of a watershed seems to indicate that it is a difficult concept to understand. Understanding concepts related to watersheds is part of the science leaning standards for 4th grade in Virginia, and this is the age of the children taking the tests.

Conclusions

Restoration projects can be conducted over large landscapes using information technology that includes Web-based instruction and e-mail communication. Face-to-face meetings are still needed to complete certain tasks, such as evaluation. With declining personnel and other resources, agency partnerships are essential to success. GIS is a useful tool for targeting efforts and maximizing results.

Traditional Extension methods of teaching, using "hands-on" activities, result in large knowledge gains. Understanding concepts of watersheds and land use would benefit by the development of hands-on activities in which students have a personal stake.

Planting 37,000 seedlings is a small effort compared with the size and extent of deforestation in the watershed. The value of this project is realized in the number of students who learn how to plant a seedling and why restoration is important.

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